I.—GENERAL; PLANT; MACHINERY.

Refrigerating machine employing compression supplementary to high condenser pressures; Test of a carbon dioxide ——. R. Plank. Z. ges. Kälteind., 1921, 28, 157—162. Chem. Zentr., 1922, 93, II., 1102.

The efficiency of compression refrigerating machines in which the working fluid operates in the neighbourhood of the critical state can be increased by submitting the compressed and cooled vapour, or condensed fluid, to subsequent compression followed by further cooling. Thus in a test carried out, not under particularly favourable conditions, an increased power consumption of about 7% for the auxiliary compression increased the cooling efficiency by 18%. The increased efficiency is somewhat greater than anticipated from theoretical considerations on account of the efficiency of the principal compressor being increased owing to diminished thermal losses.—J. S. G. T.

Adsorption of vapours; Calculation of —— at different temperatures. L. Berényi. Z. angew. Chem., 1922, 35, 237—238.

Formulæ and tables are given by means of which it is possible to calculate from the x_1 (quantity adsorbed) and p_1 (pressure) values for a measured adsorption isotherm (at temperature T_1), the corresponding x and p values for other temperatures over a range extending, for substances boiling between 170° and 400° abs., from 0·6 to 1·4 times the boiling point in ° abs. The method is based on Polanyi's theory of adsorption (Verh. Deuts. Phys. Ges., 1914, 16, 1012; 1916, 18, 55; Z. Elektrochem., 1920, 26, 370; Festschr. Kaiser-Wilhelm-Ges., 171) and applies only to the reversible, physical adsorption of chemically homogeneous vapours, alone, or of such vapours from admixtures with comparatively inert gases. The application of the method to published experimental data is described.—H. M.

Adsorption of solutions; General theory of the ——. Wo. Ostwald and R. de Izaguirre. Kolloid-Zeits., 1922, 30, 279—306.

Every adsorption is at first a process of separation, whereby a concentrated solution, the adsorbed solution, forms at the surface of the adsorbent, whilst the equilibrium solution remains behind. The adsorption of the solvent along with the dissolved substance is an important part of every adsorption. (*Cf.* J.C.S., July.)—J. F. S.

Patents.

Liquids of different density [*e.g.*, *oil and water*]; *Separators employed for separation of* ——. W. H. Bateman. E.P. 179,209, 8.11.20.

A "tail-box" for the separation of oil and condensed water produced during the steam distillation of oils is so constructed that it may be attached to any form of separating chamber, and is divided by vertical partitions into four compartments. The first or water discharge compartment is connected with the bottom of the separating chamber and has an overflow pipe of adjustable level so that the column of water therein is balanced by the column of oil and water in the separating chamber. The next compartment is connected with the separator just below the top level of the oil therein and with a third compartment at the same height as the oil level, thus providing a liquid seal in the connexion between the second compartment and the separator to prevent gas loss. The third compartment is furnished with an oil discharge pipe. The fourth compartment is a sight box and has connexions in its upper part with the second (oil) compartment and in its lower part with the first (water) compartment.—F. G. P. R.

Separating solids by crystallisation from solvents; Process for ——. F. W. Berk and Co., and H. V. A. Briscoe. E.P. 179,287, 1.2.21.

To resolve a mixture of two substances into its constituents a solution of the mixture is brought to conditions of concentration and temperature at which one substance only tends to crystallise out on cooling, the solution is cooled, and the crystals of the first substance are separated before the second substance begins to crystallise. The solution is then brought to conditions of concentration and temperature at which the second substance only tends to crystallise out on cooling, the solution is cooled, and the crystals of the second substance are separated before the first substance begins to crystallise. The solution is then again brought to conditions of concentration and temperature at which either substance only tends to crystallise on cooling. The application to the separation of a mixture of potassium nitrate and sodium nitrate is described in detail.—H. H.

Oils; Means of effecting heat interchange between two fluids, particularly applicable for use in distilling ——. T. E. Robertson. From Power Specialty Co. E.P. 179,493, 26.11.20.

In apparatus for heating fluids, such as pipe stills or steam superheaters, the pipes nearer the furnace receive more heat than those more remote, with consequent danger of over-heating the contained fluid. In order to equalise the amount of heat transmitted to the fluid along the whole system of pipes, the latter are enclosed in corrugated casings on which the depths of the corrugations vary more or less inversely, whilst the thickness of the body of the casing varies directly, as the temperature difference between the heating and heated fluids.
—F. G. P. R.

Recuperators for use in connexion with furnaces. Façoneisen Walzwerk L. Mannstaedt und Co. A.-G., and H. Bansen. E.P. 179,639, 7.2.21.

The recuperators may be considered as made up of a series of units. Each unit consists of a number of horizontal waste gas flues, of square cross-section, built one above the other, and connected at their ends so as to form a continuous passage for the gas. A number of such units are placed parallel to one another, with spaces between them, and also between the outer walls and outer units. The gas flues are supported at the lower corners on brickwork, which extends almost the whole length of the flue, and also bridges the gap between the units and forms a support for the corresponding flue of the next unit. In this way there are formed round each gas flue four flues of rectangular section, two horizontal, one above and one below the gas flue, and two lateral flues each extending the length of the gas flue. Waste gas enters the gas flues at the top and passes downwards through the plant. Air enters at the bottom and flows to the back of the plant through the horizontal flue below the lowest gas flue. Here there is an opening between this flue and the lateral flue through which the air returns to the front of the plant, where it enters through another opening the horizontal flue between the two gas flues. Travelling to the back by the horizontal flues and to the front of the plant through the lateral flues, the air gradually rises and is discharged at the top of the plant. When dealing with large quantities of air several gas flues are arranged to work in parallel. Among the advantages claimed for this invention are even distribution of air in horizontal and lateral flues, the possibility of directing air through the recuperators by any path, high speed of air, simplification of construction and repairs, and minimising of stresses set up in masonry.—S. G. U.

Kilns. G. Hughes. From Deutsche Evaporator A.-G. E.P. 179,674, 14.2.21.

The cooling chamber of the kiln is connected with the heating chamber by a yielding member, so that the expansion of the heating chamber is not transmitted to the cooling chamber. Two flat or bulged plates with centres removed to suit the cross-section of the kiln chambers have the inner edge of the one bolted to the flange of the heating chamber, and the inner edge of the other to the flange of the cold chamber. Gas-tight joints are formed at the outer edges of the plates, and in addition one of these yielding members is connected with one end of a plate, the other end of which has slots through which pass studs screwed into the second member, thus covering the gap between the yielding members.—S. G. U.

Kiln; Rotary ——. A. B. Carstens, Assr. to The American Metal Co. U.S.P. 1,415,990, 16.5.22. Appl., 8.12.19.

A rotary kiln is provided in its periphery with openings which are kept closed while the kiln rotates, except during the short period when material is fed into the kiln through them.
—J. S. G. T.

Distillation columns. C. Still and H. Petsch. E.P. 179,745, 15.3.21.

In a continuous column apparatus for the distillation of volatile constituents from a mixture of liquids of high and low boiling points, a preheater is placed between the still and the rectifying column. The sides of the preheater are in line with the sides of the still, and the cover of the still forms the base of the preheater, whilst the cover of the preheater forms the base of the rectifying column. Two channels pass through the base plate of the preheater. One, the downcomer, projects through the base plate into a tray placed in the top of the still, so as to form a seal between the preheater and the still. The other channel, which carries the vapour from the still to the top of the preheater, whence it passes through suitable openings into the rectifying column, is placed diametrically opposite and terminates at a higher level than the downcomer. Steam coils are fitted in the space between the channels, and the liquid to be distilled is fed into the preheater through a short straight perforated pipe placed below the coils. The condensed liquid on the trays of the rectifying column is also led into the preheater. Advantages claimed are elimination of a separate preheater, thus reducing heat losses; a simple path for both liquid and vapour; cheapening of cost and working of plant.
—S. G. U.

Filtering apparatus [*; Rotating valve for* ——]. E. W. W. Keene. E.P. 179,494, 11.3.21.

In a rotating valve for rotary or other continuous filters, the interior ported portion which communicates with the various sectors of the filter proper does not co-operate directly with the stationary outer part of the valve, but through adjustable sliding pieces working in an annular groove between the two main portions of the valve. The sliding pieces are adjustable from outside the cover of the valve, and control the ports by which connexion is made with a high vacuum for filtration, a low vacuum for washing, a supply of air under pressure for discharging, and an air exhaust.
—B. M. V.

Drying apparatus. C. Whitfield. E.P. 179,764, 23.3.21.

The drying chamber consists of a long chamber rectangular in section, having a charging arrangement at one end and a discharging device at the other. The floor of this chamber forms the roof of two smaller chambers; one, the combustion chamber, at the outlet end of the apparatus, extends about one third the length of the drying chamber, and is of rectangular section, whilst the other, about two thirds the length of the drying chamber, is of triangular section and has two outlets at the inlet end of the apparatus, one for condensed liquid and the other for spent gases. The drying chamber is fitted with a flue or flues connected with the inner end of the combustion chamber. The outlet of the flue or flues is turned downwards, so as to discharge the hot gases on to the material at the inlet end of the plant. The gases flow towards the discharging end and there enter two ducts embedded in the brickwork and having their outlets in the inner end of the triangular chamber, through which the gases flow to the charging end of the plant. The plant is particularly suitable for drying wet materials such as peat, which are unharmed by contact with the hot gases; the fuel consumption is small, and it is impossible for any moisture to collect at any point of the drying chamber.—S. G. U.

Dryer. K. Ladisch. U.S.P. 1,416,960, 23.5.22. Appl., 15.8.21.

A rotary perforated heating drum is provided with an inner concentric distributing tube spaced from the drum and composed of a number of spaced sections. Means are provided to adjust the sections in order to vary the width of the spaces and to fix them in place.—H. R. D.

Separating fine material; Apparatus for ——. G. A. Mower and A. Ogilvie. E.P. 179,867, 16.8.21.

Mounted on a vertical spindle are a fan and a series of discs and perforated conical plates. The spindle is coaxial with two concentric cylinders, the outer of which terminates at its lower end in an inverted cone. The inner cylinder terminates at its lower end in an annular grid valve used to regulate the air and operated from the outside of the machine. An inverted conical receiver is attached to the inner edge of this valve, the bottom of the receiver being coupled to a pipe which passes through the outer cone. The material to be separated is fed on to the discs and perforated cones, from which it is discharged by centrifugal force against outer cylindrical and conical plates. The heavier particles ultimately fall into the inner cone and are discharged. The fan situated at the top of the machine draws a current of air through the spaces between the rotating discs and cones and the outer cylinders etc., and discharges into the annulus formed by concentric cylinders, the dust-laden air descending into the space between the inner and outer cones. The dust settles out and is collected at the bottom of the outer cone, the air being drawn again through the grid valve.—S. G. U.

Vapours; Method of dissipating heat in process for extracting —— from gaseous mixtures. G. A. Burrell, O. L. Voress, and V. C. Canter, Assrs. to Gasoline Recovery Corp. U.S.P. 1,382,889, 28.6.21. Appl., 24.1.21.

In the recovery of volatile substances (gasoline, benzol, alcohol, etc.) by absorption in active charcoal, silica gel, etc., considerable heat is developed during absorption, and also the expulsion of the absorbed substance from the absorbent by superheated steam leaves the absorbent considerably warmer than is consistent with efficient absorption.

It is customary to use three absorbers in such a way that one is always being cooled by gas which has been treated in a previous passage. In order to render the process more efficient, it is proposed to increase the heat-absorbing capacity of the gaseous mixture under treatment by mixing with it a gas or gaseous mixture containing only a small proportion of recoverable vapour, or free from such vapour.

High-velocity classifier; Electric —— [for grading particles removed from gases]. C. W. J. Hedberg, Assr. to Research Corp. U.S.P. 1,416,089, 16.5.22. Appl., 26.11.19.

The gas is passed at a high velocity through an electric field, so that the finer particles only are precipitated therein, the larger particles passing on and being separately collected.—J. S. G. T.

Separation of suspended material from gases; Process and apparatus for ——. E. R. Wolcott, Assr. to International Precipitation Co. U.S.P. 1,416,769, 23.5.22. Appl., 30.6.19.

Gas to be treated is moistened and cooled, so that moisture condenses on the particles of suspended material, which are subsequently agglomerated and precipitated by subjecting the gas to the action of an alternating electric field.—J. S. G. T.

Separation of solid or liquid matter held in suspension in gases, employing high-tension electricity; Process of ——. Metallbank u Metallurgische Ges. A.-G. G.P. 348,377, 8.12.19.

Discharge electrodes in the form of smooth rods are disposed at such a distance from the collecting electrodes that the potential of the uniform brush discharge from the former when no deposition has occurred upon them, is higher than the sparking potential between the electrodes on either side. In operation the discharge electrodes are maintained so covered with deposit that the discharge potential necessary to produce a uniform brush discharge is less than the spark potential. By thus utilising the deposited dust to lower the discharge potential it becomes possible to use smooth rods of considerable cross-section as discharge electrodes.—J. S. G. T.

Gases; Disintegrator for use in the wet process for separating dust from ——. E. Wurmbach. G.P. 346,873, 23.12.19.

The amount of surface for the deposition of dust in an apparatus for separating dust from gases by the wet process is increased by the provision of a number of partitions parallel with the outer wall of the spiral separating chamber, whereby the chamber is divided into a number of channels for the passage of the gas.—L. A. C.

Evaporation of stored liquids; Prevention of ——. Prevention of evaporation. (a) F. A. Howard, C. I. Robinson, and J. M. Jennings, (b) F. A. Howard and J. M. Jennings, Assrs. to Standard Oil Co. U.S.P. 1,415,351-2, 9.5.22. Appl., 12.4.20.

Volatile liquids stored in the usual type of tank or container are guarded against loss by evaporation by means of a layer of foam, over the surface of the liquids. Two systems of pipes and apparatus for supplying the foam are described.—F. G. P. R.

Centrifugal oil purifier. M. Leitch, Assr. to The De Laval Separator Co. U.S.P. 1,415,881, 16.5.22. Appl., 22.4.20.

A centrifugal machine having a compound bowl composed of two concentric members, of which the inner one alone has a perforated periphery, is furnished with means for rotating the latter either independently or in conjunction with the outer member.—F. G. P. R.

Separator and dryer. C. J. Wood. U.S.P. 1,416,922, 23.5.22. Appl., 4.6.19.

Granular material is introduced into a separating chamber below which is arranged a valve casing for admitting air to the separator through an inlet port. An outlet port is disposed in the lower part of the casing, and the ports are controlled by a valve so that the separator will discharge through the valve casing and outlet port, when the inlet port in the casing is closed.—J. S. G. T.

Centrifugal separator. C. H. Holmgren. U.S.P. 1,417,064, 23.5.22. Appl., 25.2.21.

The bowl of a centrifugal separator is provided with a number of baffles fitting snugly against the outer wall of the bowl but leaving spaces at or near the axis for the passage of liquid, these spaces decreasing in size from the inlet to the outlet end of the bowl.—B. M. V.

Extractive matters; Process of separating —— from solutions of mixtures of solvents and of recovering the latter. H. Bollmann. U.S.P. 1,417,477, 23.5.22. Appl., 13.1.22.

Mixtures of water and volatile organic liquids which are of constant boiling point and contain extractive matters are separated by distilling the solution so as to obtain a distillate containing the greater part of the water and a part of the solvent mixture, this distillate being separated into two portions of different specific gravity. The remainder of the original mixture is then further distilled, and the distillate mixed with the lighter of the two fractions from the first distillation.—B. M. V.

Lubricant. E.P. 179,344. *See* V.

Filters. E.P. 179,355. *See* XIXb.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Lignin, natural humus material and coal; Autoxidation of —— and the effect of alkali thereon. H. Schrader. Brennstoff-Chem., 1922, 3, 161—167.

Lignin in the presence of $5N$ caustic soda is gradually oxidised at the atmospheric temperature. In presence of oxygen pure lignin lost 9·4% of its weight in 46 hrs., in absence of oxygen 2·6%. The oxidation products recovered from the alkaline solution consisted for the most part of humic acids, together with smaller quantities of succinic and oxalic acids, isophthalic acid (?), pyromellitic or benzenepentacarboxylic acid, and unidentified non-volatile acids soluble in alcohol. Considerable quantities of volatile products (acetic and formic acids, water, and carbon dioxide) were also formed during the oxidation. The oxidation in 8 months proceeded to the extent of about 50% of the original pure lignin. Comparative tests made of the volume of oxygen absorbed in 1000 hrs. by 1 g. of lignin, pine sawdust, lignite, cellulose (filter-paper), and coal, each in contact with $5N$ caustic soda, gave results varying from 82 c.c. of oxygen for lignin down to 6·7 c.c. with coal, the absorptions being in the order mentioned. The bearing of these observations on the theory of the author and F. Fischer that the humic portion of coal is a decomposition product of lignin is discussed, and it is suggested that the action of the caustic soda in the experiments is equivalent to that of lime, ammonia, or bacteria in nature. (*Cf.* J.C.S., July.)—C. I.

Carbonisation of coal; Studies in the ——: the mechanism of coal carbonisation. J. J. Morgan and R. P. Soule. Chem. and Met. Eng., 1922, 26, 1025—1030.

The origin of the aromatic hydrocarbons of ordinary coal tar has been variously attributed to the decomposition of low-temperature distillation products into simple compounds which subsequently undergo pyrogenic syntheses, to the hydrogenation and dealkylation of phenols, and to the dehydrogenation and dealkylation of unsaturated hydrocarbons. A detailed examination of a commercial low-temperature tar in comparison with high-temperature tars (*cf.* page 495 A) shows that pyrogenic syntheses are of secondary importance. The average molecular weights of the liquid products of carbonisation steadily decrease as the temperature of carbonisation rises. The reactions of the phenols are particularly important when distilling coals with an oxygen content equal to that of those used in commercial carbonisation. During the first stage of the decomposition of the primary phenols the side chains of the higher homologues are eliminated, methyl and ethyl groups probably being replaced by hydrogen. Monocyclic aromatic hydrocarbons are mainly derived from phenols and then may be hydrogenated themselves or may participate in pyrogenic syntheses. The quinoline which preponderates among the bases of high-temperature tar is derived from dihydroquinoline. The hydrocarbons in the tars examined result from the dehydrogenation of the naphthenes primarily formed in carbonisation. The formation of di- and tetra-hydro-derivatives constitutes a stable stage in the process as shown by the examination of the tar formed at 600° C. Naphthalene may be formed by hydrogenation of the naphthol derivatives found in low-temperature tar, but, together with other polynuclear aromatic hydrocarbons, mainly results from the decomposition of the polycyclic unsaturated compounds. In view of the preponderance of six-membered ring compounds in low-temperature tar and of the stability of the ring itself, it is suggested that the constitution of the coal substance may be pictured as an aggregate of ring formations. Some of these contain oxygen and possess the characteristics of cellulose degradation products but are regarded as polymerised phenols. Other rings may be held together by paraffinoid groupings, the detachment of which explains the presence of open-chain hydrocarbons in low-temperature tar. Nitrogen and sulphur compounds may appear in analogous configurations.—H. Hg.

Carbonisation; Low versus high temperature —— for the production of smokeless fuel. E. R. Sutcliffe and E. C. Evans. S. Wales Inst. Eng. Gas J., 1922, 158, 631—632.

The combustibility of a coke is not entirely dependent upon the temperature at which it has been prepared but is largely determined by its structure (*cf.* J., 1922, 196 T). Free-burning coke can be prepared at high temperatures from coals which contain little resinous matter and which do not fuse or swell during carbonisation, or from coals which have been briquetted without a binder prior to carbonisation. Such cokes resemble charcoal rather than gas coke in structure. The choice between high and low temperature systems will therefore be governed by economic factors rather than by technical difficulties. The increased yield of coke obtained at lower temperatures is more than counterbalanced by the decreased value of the volatile products. It is possible to obtain high yields of tar and yet carbonise at high temperatures if the temperature is raised slowly.—H. Hg.

Lignites; Comparative researches on the carbonisation of —— on a technical and laboratory scale. K. Bunte and F. Schwarzkopf. Gas u. Wasserfach, 1922, 65, 322—325, 340—343, 355—357.

An earthly lignite from Luckenau was carbonised on a technical scale in retorts and also tested on a laboratory scale, viz., by carbonisation of about 1 kg. in a muffle, by Strache's method of carbonisation in a tube (J., 1911, 1245), using only 0·1—0·2 g., and by Gröppel's tube method of carbonisation using 1 g. of lignite. The figures obtained by the various methods were:—coke: technical scale, 20·0%; muffle method, 23·8%; Strache's method, 28·6%; Gröppel's method, 27·7%; condensed products: technical scale, 35·3%; muffle method, 54·3%; Strache's method, 47·15%; Gröppel's method, 60·3%; gas and loss: technical scale, 44·7%; muffle method, 21·9%; Strache's method, 24·25%; and Gröppel's method, 12·0%. The results obtained by Strache's method, in which air-dried coal is used, and by Gröppel's method, in which the coal is previously dried at 105° C. in a current of nitrogen, are corrected to make them comparable with those obtained by the muffle test and on the technical scale, where the raw lignite is used. There is some uncertainty, however, since some of the moisture undoubtedly leads to the formation of water-gas during carbonisation. In the muffle process, various temperatures were used but in no case did the results correspond with those obtained on a technical scale. By carbonisation in a small tube it was attempted to maintain an even temperature, but by the nature of the process this is not possible, and in consequence the results in different tests are very discordant. The most concordant results are those obtained by the method of Gröppel. All three methods, however, gave results differing widely from those obtained by carbonisation on a technical scale, and no satisfactory conclusion can therefore be drawn from the results obtained by such methods as regards the usefulness of lignites when carbonised at the usual temperatures attained in gas-works.—A. G.

Water-gas generator fuel; Coal and coke mixtures as ——. W. W. Odell. U.S. Bureau of Mines. Tech. Paper 284, 1921. 31 pages.

A decided benefit may be realised by the use of mixtures of coal and coke when operating with a long lay-over period. When the plant is working less than eight hours per day the gas-making capacity is as great as when using coke alone. The fuel consumption per 1000 cub. ft. when employing the blow-run method is less with mixed fuel than when coal alone is used, and gas of a more uniform quality can be obtained. The tar produced from a carburetted water-gas plant using coal or mixtures of coal and coke is less troublesome than that from coke alone as it does not emulsify. The conditions for best results must be worked out for each coal or mixture used, as they vary considerably with the fuel. Special attention is drawn to the necessity of keeping careful watch on the gauges and meters, so that blow-holes or "flues" in the fuel may be quickly detected. The liability to form such is great when mixtures containing over 70% of coal are used and is accentuated by high blast pressure. Trouble may thus be encountered with fuel being blown over into the chequer brickwork. Owing to the tendency of high blast pressures to form blow-holes the amount of air per minute which can be supplied is limited. The use of a fuel spreader is recommended to minimise this tendency. More benefit is derived from an air-purge when coal is used than in the case of coke alone owing to the increase in the methane and illuminants during the progress of the run. Attention is drawn to the danger of damaging the hot valve and generator lid by working with a low fuel bed. It is important to choose the type of oil-spray best adapted for the conditions prevalent. The nozzles should be tested with oil under the conditions of pressure obtaining in actual use.
—A. R. M.

Sulphur and solid paraffins; Probability of reaction between —— in oil-bearing strata. M. A. Rakusin. Petroleum, 1922, 18, 581—582.

Paraffin wax of m.p. 56° C. was heated in a glass retort with sulphur to 190°—205° C. for 18 hrs. The escaping vapours were passed through two U-tubes containing pumice moistened with ammonia and a tube containing calcium chloride. In the first two tubes ammonium sulphide and polysulphides were formed, and the latter were decomposed with hydrochloric acid and the separated sulphur collected. It was found that the amount of sulphur which entered into reaction with the paraffin was about 3% of the weight of the latter. It is concluded that in oil fields which produce both oil free from paraffin wax and oil containing paraffin wax, the oil free from wax should have a smaller sulphur content than the oil containing wax, and this was found to be the case in the Roumanian fields, the respective percentages being 0·042% and 0·112%, and in the Grozny field, where the percentages were 0·212% and 0·782%. For the formation of oil free from paraffin wax from crude oil a temperature of 200° C. would be necessary, which would only be reached at corresponding depths. In the higher and cooler strata the paraffin wax is not attacked by sulphur.—H. M.

Petroleum spirit; Detection of benzene in ——. P. Schwarz. Chem.-Zeit., 1922, **46**, 401.

Five c.c. of the sample is added to 2 c.c. of a mixture of equal vols. of aniline and 95% alcohol; if the petroleum spirit is free from benzene, the aniline separates as a layer, but the presence of as little as 5% of benzene keeps the aniline in solution and the mixture remains clear. The sample may be fractionally distilled, if desired, and the test applied to the fraction having b.p. 80°—110° C.—W. P. S.

Low-temperature carbonisation of coal. Morgan and Soule. *See* III.

Pyrophoric blast-furnace flue-dust. Gilles. *See* X.

Absorption meter for gas analysis. Moser. *See* XXIII.

Patents.

Coal and the like; Washing of ——. A. France. E.P. 179,630, 7.2.21.

Minerals consisting of fine particles, either alone or mixed with larger particles, are separated into constituents of different specific gravities by means of a stream of water in a sloping launder, the heavier material which collects in the lower layers being further sorted by treatment with a liquid of high specific gravity in static columns. The latter liquid may consist of water containing in suspension very fine mineral particles forming the mud which collects in the launder, or may consist of a solution of a solid in water.—A. R. M.

Artificial fuel; Method of producing ——. C. J. Greenstreet. E.P. 179,567, 1.11.20.

Solid fuel, such as coal, peat, lignite, etc., is mixed in a finely powdered state with coal tar, fuel oil, or mineral oil, thickened by means of oleates, stearates, palmitates, or paraffin wax or the like. The mixture can be transported through pipes.
—A. R. M.

Combustible material; Process of making ——. H. S. Mork and G. J. Esselen, jun., Assrs. to A. D. Little, Inc. U.S.P. 1,416,493, 16.5.22. Appl., 10.9.19.

An infusible solidified liquid fuel is prepared by dissolving pyroxylin in a volatile combustible solvent containing a carbonyl group, coagulating this solution in a volatile combustible non-solvent and mixing it with another solution of pyroxylin which is close to the point of coagulation so that the mixture is solidified.—H. Hg.

Burning pulverised fuel in furnaces; Method and apparatus for ——. V. Z. Caracristi. E.P. 179,662, 11.2.21.

Pulverised fuel is allowed to fall into a furnace from burners passing through the furnace roof. Sufficient air for ignition of the fuel is admitted through the burners. Additional unheated air is admitted through a number of ports at different levels in the front wall of the furnace, with the object of preventing intense combustion near the burners and coalescence of the fuel or ash.—H. Hg.

Coke ovens. L. L. Summers. E.P. 179,235, 5.1.21.

An oven with a reciprocating horizontal floor such as is described in E.P. 6504 of 1910 (J., 1911, 274; 1910, 934) is built so that its height is greater than its width. In order to ensure that the frictional resistance between the floor and the material being carbonised is greater than that between the material and the side walls, a vertical longitudinal fin, which may carry lateral flanges, is attached to the floor. Heating flues are provided in the side walls. The material to be coked may be partially distilled and converted into a plastic state in a vertical chamber placed above the charging end of the oven.—H. Hg.

Coking retort oven. J. Becker, Assr. to The Koppers Co. U.S.P. 1,416,322, 16.5.22. Appl., 23.4.20.

A return waste gas main is connected with the regenerators so that if desired waste gas may be directed into some of the in-flow regenerators.
—H. Hg.

Furnace retort. C. H. Smith and E. B. Edwards, Assrs. to International Coal Products Corp. U.S.P. 1,417,113, 23.5.22. Appl., 10.6.19.

A number of combustion chambers are arranged along both sides of a horizontal retort, each chamber extending below the retort. A longitudinal waste gas flue is placed above the retort and the combustion chambers. The connexions are such that gas may be burnt in alternate combustion chambers by means of air preheated in one portion of a regenerator situated underneath the furnace; the waste gases may pass through the remaining chambers and the waste gas flue to the other portion of the regenerator; and the direction of flow may be successively reversed.—H. Hg.

Complete gasification of carbonaceous fuel; Apparatus for ——. J. F. Simpson. E.P. 179,643, 8.2.21.

The apparatus, which may be used either for the production of water-gas from fuel containing no volatile matter, or for the complete gasification of bituminous fuel, consists of a water-gas generator in combination with two regenerators, so arranged that an air blast may be directed through the system in either direction. The regenerators receive their heat in two ways, first from the sensible heat of the gases leaving the generator, and, secondly, from the heat of combustion of a part of the gases which are caused to burn by the admission of the required amount of secondary air. Superimposed upon the generator is a carbonising chamber or retort, which may contain bituminous or non-bituminous fuel. During the period of gas-making, steam is admitted by way of the heated regenerator, through the bed of fuel in the producer, the water-gas thus formed passing up the retort and, in the case of a bituminous fuel, expelling the contained volatile matter. Liquid fuel may, if desired, be admitted into the retort during the "run." The retort is of such construction and of sufficient length that the gas leaving the top is comparatively cool.—A. R. M.

Gas generators for generating low grade gas. J. and O. G. Pierson. E.P. 179,716, 24.2.21.

In a gas producer with an open hearth a mixture of steam and air is supplied both below the grid and to the fuel cone above the grid. The steam is mixed with the air just before entering the fuel bed.—H. Hg.

Gas producer. H. Koppers. G.P. 341,351, 5.12.16.

Gases from a producer shaft enter an adjacent shaft containing fuel through an opening at the bottom of the partition wall between the shafts and pass upwards through the shaft. Non-combustible gases present in the producer gas, together with a mixture of steam and carbon dioxide fed into the stream of gases through openings at the bottom of the partition wall, are converted into combustible gases during passage through the second shaft. The lower ends of both shafts slope towards the partition wall, and means are provided below the opening connecting the two shafts for drawing off the molten slag.—L. A. C.

Gas producer in which the fuel is dried by means of superheated steam. A.-G. für Brennstoffvergasung. G.P. 345,490, 28.1.19. Addn. to 343,048 (J., 1922, 167 A).

In the apparatus described in the chief patent, the connexions between the superheater and drying chamber are connected by pipes provided with valves to the pipe supplying a mixture of steam and air to the producer, so that the proportions of super-heated and saturated steam in the mixture of steam and air can be adjusted as desired.—L. A. C.

Gas producer with separate discharges for the distillation gases and the tar-free producer gas; Recovery of by-products [ammonia] from ——. J. Pintsch, A.-G. G.P. 350,568, 6.10.18.

The distillation gases, cooled to a temperature above that at which moisture is deposited, and the producer gas are scrubbed separately to recover ammonia, and the liquors are united and treated with acid to convert the ammonia into ammonium sulphate.—L. A. C.

Illuminating-gas; Manufacture [purification] of ——. Soc. du Gaz de Paris. E.P. 164,310, 28.4.21. Conv., 4.6.20.

Crude gas is washed with a mixture of a solution of a ferrous salt and milk of lime, whereby hydrocyanic acid is removed as soluble iron-cyanogen compounds and part of the hydrogen sulphide is converted into insoluble iron sulphide. The mixture is then filtered, and the solid material after being exposed to air, is mixed with sawdust, and used for the removal of the hydrogen sulphide remaining in the gas issuing from the washer.—H. Hg.

Gasoline, naphtha, and the like; Process and apparatus for recovering and recondensing ——. G. A. Burrell, C. L. Voress, and V. C. Canter, Assrs. to Gasoline Recovery Corp. U.S.P. 1,382,890, 28.6.21 Appl., 24.1.21.

Gasoline, naphtha, or the like which has been absorbed by active charcoal, silica gel, or the like, is recovered by treating the latter with superheated steam under pressure, the steam and evolved vapours being also condensed under pressure.

Oils; Process of dehydrating heavy ——. F. W. Harris, Assr. to Petroleum Rectifying Co. U.S.P. 1,410,673, 28.3.22. Appl., 31.5.21.

The oil is mixed with a solvent to reduce its viscosity and specific gravity, then treated to remove water, and subsequently freed from the solvent.

[Petroleum oils;] Pressure distillation [of ——*].* E. M. Clark, Assr. to Standard Oil Co. U.S.P. 1,410,797, 28.3.22. Appl., 21.4.19.

A considerable body of the oil is heated under pressure to produce lighter products, and portions of the oil are withdrawn continuously and relieved of pressure in order to distil off the lighter fractions, which are condensed and returned to the main body of oil to undergo further decomposition.

Hydrocarbon oils; Process for treating ——. D. Day. U.S.P. 1,411,237, 28.3.22. Appl., 11.12.19.

Hydrocarbon oils are freed from nitrogenous impurities by treatment with "sludge acid," which is obtained by treating hydrocarbon oils with acid, removing the acid sludge formed, and treating it with steam to separate it into sludge acid and acid tar.

Cracking oils under pressure. C. Ellis, Assr. to Standard Oil Co. U.S.P. 1,415,232, 9.5.22. Appl., 26.11.20.

Oil is passed through a series of narrow tubes heated to 400°—600° C. and from there is led into a tube or chamber of large diameter where exactly the same temperature is maintained. The gaseous products are then led to dephlegmators and fractionally condensed. Superatmospheric pressure is maintained throughout the system, and water, in the form of steam, up to 20—50% by volume of the oil may be fed into the cracking tubes with the oil. Secondary decomposition is said to take place in the large chamber which could not occur in the smaller tubes.—F. G. P. R.

Petroleum-refining apparatus; Continuous ——. C. A. Jouett. U.S.P. 1,415,876, 16.5.22. Appl., 23.9.18.

Preheated oil is sprayed into the top of a vertical cylinder, divided horizontally into a number of chambers, and is heated by means of a concentric flue attached to a furnace stack provided with adjustable ports opposite each chamber. Annular traps are provided at the bottom of each chamber to allow unvaporised oil to flow into the top of the next lower and hotter chamber. Vapour pipes lead from each chamber to superposed dephlegmators provided with run-back pipes to the next lower chamber, and thence through a similar dephlegmator system packed with a solid filtering medium to condensers. Fully refined products are thus produced continuously.—F. G. P. R.

Lubricating oils; Method of producing ——. G. D. Harper. U.S.P. 1,414,695, 2.5.22. Appl., 11.5.18.

Lubricating oils ready for use without purification by acid and alkali may be produced by concentration of a crude naphthene base petroleum oil, such as Franklin heavy oil, to approximately 70% of its original volume and filtration of the residuum.
—F. G. P. R.

Motor fuel. E. W. Stevens, Assr. to Chemical Fuel Co. of America. U.S.P. 1,414,759, 2.5.22. Appl., 9.3.20.

A liquid fuel for internal combustion engines, of the same general character as petrol, is composed of a mixture of a light distillate from petroleum oil, alcohol, a hydrocarbon blending agent, and a small amount of a readily volatile ester of formic acid.
—F. G. P. R.

See also pages (A) 489, *Separating liquids of different density* (E.P. 179,209); *Distilling oils* (E.P. 179,493). 491, *Preventing evaporation* (U.S.P. 1,415,351—2); *Oil purifier* (U.S.P. 1,415,881). 496, *Distillation of oils* (G.P. 338,846). 501, *Ammonia etc. from peat* (E.P. 159,194). 502, *Sulphur from gases* (G.P. 350,271—2); *Hydrogen sulphide from gases* (G.P. 350,325). 510, *Lubricating oil substitute* (G.P. 349,926).

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Wood-distillation process; Application of electrical precipitation to the ——. L. F. Hawley and H. M. Pier. Chem. and Met. Eng., 1922, **26**, 1031—1033.

A Cottrell precipitator was installed between an experimental wood-distillation retort and a condenser with the object of separating the pitch which normally contaminates the pyroligneous acid. The precipitator was heated to give an outlet gas temperature of about 100° C., under which conditions the precipitated pitch and tar flowed away as a liquid. At higher temperatures a solid pitch was deposited and caused short-circuiting. The outlet vapours were condensed and gave an acid containing 3·3% of soluble tar, whereas the acid normally contained 12—15% of tar. By direct neutralisation of the acid a calcium acetate of 77·8% purity was obtained. Some of the tar was probably formed by polymerisation after the vapours left the precipitator (*cf.* Klason, J., 1915, 707). —H. Hg.

Patents.

Oil containing sulphur; Production of —— and water-glass [from bituminous kieselguhr]. R. Illig. G.P. 346,237, 3.1.19.

Bituminous kieselguhr, either alone or mixed with alkalis or alkali salts, is subjected to dry distillation and heated to fusion point. A mixture of bituminous kieselguhr and sodium sulphate on heating in vertical retorts yields a distillate comprising tar, an aqueous liquid, and crude ichthyol oil; the fused residue in the retort can be treated for the production of water-glass. If bituminous kieselguhr is heated alone, crude ichthyol oil is present in the distillate, and the residue consists of an intimate mixture of carbon and silica suitable for use as an absorbent for nitroglycerin, as a decolorising agent, or as a dyestuff carrier in the production of, *e.g.*, black pigments.—L. A. C.

Incandescent lamp. W. A. Darrah. U.S.P. 1,385,608, 26.7.21. Appl., 23.11.14.

The electrical conductor, *e.g.*, tungsten, in the form of a filament or the like, is suported and embedded in boron nitride, or other infusible, inert insulating material which remains unchanged at temperatures near the boiling point of carbon. The outer surface of the boron nitride or the like may be coated with a substance exhibiting selective radiation, *e.g.*, tungsten or the materials used in the Nernst glower, and the lamp may be filled with an inert gas.

Heat; Production of —— and its application for heating liquids and other purposes. D. La Cœur and C. V. Schou. U.S.P. 1,417,075, 23.5.22. Appl., 30.9.15.

See E.P. 1745 of 1915; J., 1916, 105.

III.—TAR AND TAR PRODUCTS.

Lignite tar industry; Distillation under a high vacuum in the ——. E. Graefe. Brennstoff-Chem., 1922, **3**, 167—171.

The usual practice in the distillation of lignite tar has been to commence with a pressure of 10 cm. of mercury below atmospheric and finish at −40 cm. While this reduction of pressure carries with it the advantages of reduced loss from cracking, saving of time and fuel economy, there is no reason why a higher vacuum should not be used with even greater advantage. This is done in the Brünn-Königsfeld continuous distillation plant designed during the war to treat producer-tar. The small stills used in the lignite tar industry are replaced by a series of 8 horizontal boiler stills of 40 cb. m. capacity, each connected with a preheater. The tar flows through the whole series of 16 units and the greater part of its water content settles out and is drawn off as liquid in the preheaters. Behind each preheater is a condenser so that the distillate may be collected in 16 fractions if desired. The whole is maintained at a vacuum of 68 cm. and the temperatures of the stills range from 200° C. to 320° C. The distillation is completed up to coke in 5-ton cast iron discontinuous stills, and the oil produced by the latter fractionated in another series of continuous stills. In consequence of the low temperature of the distillation the lubricating oil obtained is of high quality.—C. I.

Carbonisation of coal; Studies in the —— : characteristics of low-temperature coal tar. J. J. Morgan and R. P. Soule. Chem. and Met. Eng., 1922, **26**, 923—928, 977—981.

The tar produced during the carbonisation of a bituminous coal containing 35·3% of volatile matter in the primary retorts of the "Carbocoal" process (*cf.* Thurston, J., 1921, 51 T) was examined in detail. The temperature in the retort shell was 730° C. and the volatile products leaving the coal came in contact with surfaces at 600° C. The crude tar was dehydrated by distilling up to 200° C., the light oils being separated from the condensed liquid and returned to the tar. Fractional distillation of the dry tar gave results similar to those obtained during parallel distillations of coke-oven and gas works tars, although the sp. gr. was only 1·0676 and the free carbon content only 0·71%. The pitch obtained was less brittle than that obtained from high-temperature tars. Analysis of the distillates obtained showed that the dry tar yielded 13·7% of phenols, 0·624% of nitrogenous bases, 13·4% of unsaturated hydrocarbons, 2·8% of naphthenes, and 1·6% of paraffins. The high proportion of phenols is characteristic of all low-temperature tars, and from a consideration of the acid content of the fractions of high boiling-point it is concluded that the pitch also contained a large quantity of tar acids. The acids were separated from the distillates by extraction with caustic soda solution and, after purification by benzene extraction and steam distillation, were liberated by the addition of sulphuric acid. Carboxylic acids, if present, were negligible; methoxyl and ethoxyl groups were absent. The mixture of phenols had sp. gr. 1·036, while mixed phenols from coke-oven and gas works tars had sp. gr. 1·044. Phenols from both low- and high-temperature tars were fractionally distilled; there was a smaller yield of low-boiling distillates from the low-temperature phenols, but from the sp. gr. of the distillates it is concluded that the components were similar. Naphthol derivatives were found in the fractions of higher boiling-point of the low-temperature tar phenols. Repeated fractionations followed by nitration and determinations of sp. gr. and freezing point showed that the low-temperature tar phenols contained 4·2% of phenol, 33·4% of cresols, 19·0% of xylenol fraction, 34·8% of higher homologues, and 8·6% of pitch. After separation of acids from the tar distillates determinations were made of the bases present. The results indicated that the pitch probably contained more bases than did the distillates. The mixed bases contained no primary, but about 20% of secondary and 80% of

tertiary bases. The sp. gr. of the mixture was 0·993, while that of the bases from high-temperature tar was 1·060. Bases from both low- and high-temperature tars were fractionally distilled; determinations of the sp. gr. and molecular weights of the distillates indicated, in the case of the low-temperature bases, a greater degree of hydrogenation of the nucleus, the presence of aliphatic side-chains of higher molecular weight, or both. After the removal of the bases the remaining oils were found to contain no alcohols. Hydrogen sulphide was present but carbon bisulphide was absent. Upon exposure there was evidence of polymerisation or oxidation of the hydrocarbons. The sp. gr. of the mixed hydrocarbons was 0·891 while that of the hydrocarbons from high-temperature tar was 1·028. The paraffins and naphthenes were separated from the unsaturated and aromatic hydrocarbons by means of sulphuric acid, and the relative proportions present in the different fractions were estimated by sp. gr. determinations. There was a close similarity to the saturated hydrocarbons obtained in a similar manner from petroleum. Unsaturated and aromatic hydrocarbons were recovered by extraction of the total neutral oil with sulphur dioxide. The oils recovered from the sulphur dioxide were washed with alkali and distilled. From determinations of the sp. gr. and refractive index of each fraction obtained it was shown that there are practically no aromatic hydrocarbons in low-temperature tar and that the unsaturated hydrocarbons are cyclic in character.
—H. Hg.

Phenols; Speed of sulphonation of ——. *I. Effect of temperature and the methyl group.* A. F. Campbell. Chem. Soc. Trans., 1922, **121**, 847—857.

The speed of sulphonation of phenols is strongly influenced by temperature but is independent of the time of reaction and of the concentration. In the experiments the time varied from 1 to 6 hrs. and the quantity of sulphuric acid (96%) from 35 to 65% of the weight of the phenols. The influence of introduction of the methyl group into the phenol molecule on the velocity of sulphonation varies with the relative position of the hydroxyl group and to a certain extent with the temperature. In the ortho or para position to the hydroxyl the methyl group retards the speed of sulphonation at all temperatures from 20° to 80° C. The retarding influence of the ortho group is one-third that of the para at 20° C., but diminishes rapidly up to a constant value at 60° C. At 40° C. the velocity of sulphonation of *o*-cresol is 0·859 of the velocity of sulphonation of phenol. A *m*-methyl group has a maximum effect on the speed of sulphonation at low temperatures, the acceleration gradually diminishing until at temperatures above 65° C. the *m*-methyl group has a retarding influence. A point of equilibrium between the respective effects of the ortho and meta groups and of the meta and para groups is reached at 70° C. and 100° C. respectively, at which temperatures sulphonation of the two isomerides proceeds at the same rate. Above 70° C. the speed of sulphonation of *o*-cresol is the higher. The *p*-methyl group exerts the greatest relative effect, approximately 3·75 times that of the ortho, at low temperature. Phenol is sulphonated at a higher rate than either *o*- or *p*-cresol at all temperatures from 20° to 80° C., and at a lower rate than *m*-cresol at temperatures up to about 65° C. At 20° C. the order of rate of sulphonation (decreasing) is *m*-cresol, phenol, *o*-cresol, *p*-cresol. The influence of a second methyl group ortho to hydroxyl in *p*-cresol is further to retard the velocity of sulphonation. A second *m*-methyl group has a great influence than an *o*-methyl group but in the reverse direction, hence *p*-xylenol is sulphonated at a higher rate than phenol at 40° C.—P. V. M.

Peat and shale tars; Composition of ——. J. Marcusson and M. Picard. Petroleum, 1922, **18**, 637—638.

Peat tar on digesting with ether gave 3% of black insoluble residue consisting of oxyacids and their esters and salts of iron and calcium. The ether solution was freed from bases by treatment with hydrochloric acid, saponified with alcoholic potash solution, and separated by Spitz and Hönig's method (J., 1891, 1039). The unsaponifiable portion contained 8% (on the tar) of solids, which were separated by acetone at −20° C. and had an iodine value of 26·3 and an acetyl value of 31. The saponified solution, when treated with hydrochloric acid, deposited 24·5% of acid substances, and when these were digested with ether 3% of oxyacids remained undissolved. The evaporated ether extract when treated with hot benzine left 8% of insoluble oxyacids of lower m.p. than those insoluble in ether; the 11·5% of matter soluble in benzine consisted of fatty acids of high molecular weight together with phenols. Shale tars tested by a similar method gave, as did peat tars, 16—22% of fatty and oxyacids including those present in the form of calcium salts, and 5% of basic substances.
—H. M.

Patents.

Tars or oils; Process for the continuous distillation of ——. E. Blümner. G.P. 338,846, 23.4.20.

Tar or the like is projected in a finely divided form on to the bottom of a vessel containing a molten metal having a boiling point below the temperature to which the tar is to be heated.
—L. A. C.

Dehydration. Dehydration of pyridine. W. J. Huff, Assr. to The Koppers Co. U.S.P. (A) 1,416,205 and (B) 1,416,206, 16.5.22. Appl., 27.1.21.

(A) Pyridine containing water is dehydrated by distilling off a fraction, which serves as a vehicle to carry off water, removing water from the distillate, returning the pyridine distillate to the still, and repeating these operations until the desired degree of dehydration is attained. (B) A liquid of low boiling point is added to pyridine containing water in less amount than that required to form a binary mixture of constant boiling point, and serves as a vehicle to carry off the water. The mixture is distilled and more of the liquid added till the desired degree of dehydration is attained.
—H. M.

Anthraquinone; Manufacture of ——. Chem. Fabr. Worms A.-G. E.P. 169,145, 1.7.21. Conv., 13.9.20. (*Cf.* E.P. 156,215, 156,538, and 156,540; J., 1922, 407 A.)

In the oxidation of anthracene to anthraquinone by means of air or oxygen in presence of oxides of nitrogen, if the operation is conducted in presence also of a readily soluble reagent which fixes nitric acid, *e.g.*, sodium acetate, no dehydrating agent, such as acetic anhydride, is necessary, nor need an anhydrous solvent be employed. The oxides of nitrogen may be introduced in the form of sodium nitrite, in which case if acetic acid is used as the solvent the requisite sodium acetate will be formed during the reaction, or they may be introduced as fuming nitric acid. The yields of anthraquinone amount to about 95% of the theoretical, and the product has a purity of 97—98%.—G. F. M.

Hydrogenated anthraquinone derivatives; Preparation of ——. Tetralin Ges.m.b.H. G.P. 346,673, 21.7.18.

Tetrahydronaphthalene, or a substitution product, is treated at moderate temperatures with aromatic *o*-dicarboxylic acid anhydrides, *e.g.*, phthalic anhydride, in the presence of aluminium chloride and a diluent such as benzene, and the γ-ketonecarboxylic acids obtained are converted into hydrogenated anthraquinone derivatives by treatment with condensing agents, such as fuming sulphuric acid. Tetrahydronaphthalene and phthalic anhydride in the presence of benzene and aluminium chloride at 60°—70° C. yield β-tetrahydronaphthoyl-*o*-benzoic acid, m.p. 153°—155° C., which on dissolving in cooled fuming sulphuric acid containing 25% of sulphur trioxide, with subsequent heating for 10 mins. to 100° C., yields a mixture of α- and β-tetrahydronaphthanthraquinone of m.p. 135° C. and 211° C. respectively. The isomers are separated by fractional crystallisation, first from benzene and then from acetic acid, in both of which solvents the α-derivative is the more soluble. *ar*-2-Methyltetrahydronaphthalene, b.p. 219°—220° C., prepared by the hydrogenation of β-methylnaphthalene in the presence of a catalyst, on treatment as above yields 3-methyltetrahydro-2.1-naphthanthraquinone, m.p. 119° C. The compounds serve for the manufacture of dyestuffs and drugs.—L. A. C.

IV.—COLOURING MATTERS AND DYES.

-Hydroxybenzanthrone; Derivatives of ——. G. G. Bradshaw and A. G. Perkin. Chem. Soc. Trans., 1922, 121, 911—922.

-Hydroxybenzanthrone or the corresponding hydroxy derivative, when heated under pressure or 8 hrs. at 170°—180° C. in the form of a 32% aste with aqueous sodium hydroxide and dextrose, lycerol, mannitol, lævulose or erythritol (the ast-named being especially effective), yields a fluorescent mixture consisting mainly of a brown amorphous substance together with small quantities of hydroxybenzanthronecarboxylic acid which readily passes into the lactone on heating. The dimethyl derivative of the lactone on oxidation with chromic acid yields methyl-2-methoxyanthraquinone-1-glyoxylate, which passes by hydrolysis and elimination of carbon dioxide into 2-methoxyanthraquinone-1-carboxylic acid. Small amounts of 2.2-dihydroxydianthraquinone and of two compounds, $C_{28}H_{14}O_4$ and $C_{28}H_{18}O_4$, the nature of which is as yet uncertain, are simultaneously produced.—P. V. M.

Red dyestuff; New —— from quinoline. M. Giua. Gazz. Chim. Ital., 1922, 52, I., 349—351.

Condensation of quinoline with either epichlorhydrin or α-dichlorhydrin in presence of alkali hydroxide yields a dark red oily mass from which alcohol extracts a brownish-red compound, $C_{21}H_{18}N_2$, having basic properties. (*Cf.* J.C.S., July.) —T. H. P.

2-p-Dimethylaminostyrylpyridine methiodide. Mills and Pope. *See* XXI.

Patents.

Trisazo dyes; Manufacture of diazotisable ——. J. Dedichen, Assr. to A.-G. für Anilin-Fabr. U.S.P. 1,416,621, 16.5.22. Appl., 15.8.21.

Trisazo dyestuffs having the probable formula:

$$(3)SO_3H.C_6H_4.N_2(1).C_{10}H_6.(4)N_2(1).C_{10}H_5.$$
$$(6)SO_3H.(4)N_2(2).C_{10}H_4.(1)OH.(3)SO_3H.(7)NH_2$$

are prepared from metanilic acid, 1-naphthylamine, 1-naphthylamine-6-(or 7)-sulphonic acid, and 2-amino-8-naphthol-6-sulphonic acid. The products dye cotton reddish-blue shades, which after diazotisation and coupling with β-naphthol or *m*-toluylenediamine are changed to bluish-grey shades. —L. A. C.

Brown colouring matter; Production of —— for adding to margarine. A. L. Mohr, G.m.b.H. G.P. 350,802, 30.5.17.

A brown colouring matter containing butyrin and over 10% of lecithin is prepared by extracting dry casein with hot ehhyl and/or methyl alcohol, and separating the solvent from the extract. —L. A. C.

Gold compounds of Methylene Blue etc. G.P. 347,376. *See* XX.

V.—FIBRES ; TEXTILES ; CELLULOSE ; PAPER.

Cotton fabrics; Detection and estimation of acidity and alkalinity in ——. H. F. Coward and G. M. Wigley. J. Textile Inst. (Trans.), 1922, 13, 121—126.

Neutral cloth was prepared by exhaustively washing two samples of pure bleached cotton fabric, one acid and the other alkaline, until neither fabric was further removed from neutrality than 0·005% of alkali or acid respectively, and it was then shown that fabric which, after de-sizing and washing in water, reacts neutral to methyl red is neutral within 0·005% HCl or its equivalent. Acid is more quickly removed from a fabric by washing it with a solution of common salt than by means of pure water. The method of the British Engineering Standards Association used for testing aeroplane fabric is not suitable for estimating the absolute amount of acid or alkali contained by a fabric, since after washing, cotton fabric can retain 0·05% of its weight of sulphuric acid, and may also react strongly acid to several indicators. In estimating the acidity or alkalinity of a fabric by direct titration at the boiling temperature in the presence of the fabric, using phenolpthalein as indicator, results correct within 0·02% can be obtained. When the acidity is determined by the standard method of acidimetry in which potassium iodide and iodate are used, less accurate though satisfactory results are obtained. Coloured indicators of suitable strength can be used for the approximate estimation of the acidity and alkalinity of fabric by "spotting" on the fabric. Approximate figures for the changes of various coloured indicators are tabulated.—A. J. H.

Animal fibres; New protective agent [against alkalis] for ——. A. Edge. J. Soc. Dyers and Col., 1922, 38, 136—138.

"Protectol A.G.F.A." is a brown, syrupy liquid of neutral reaction, perfectly soluble in water and available in two forms—No. 1, which is precipitated by alkali carbonates, and is intended for use in the presence of alkali hydroxides, and No. 2, which is not precipitated by carbonates or sulphides. These liquids, when used in the proportions of ⅓ to 1½ oz. per gall., protect animal tissues, such as fibres, wool, silk, hair, fur, skin, and leather, from the destructive action of alkaline baths. After the addition of Protectol, wool, union goods, silk, and fur can be subjected to the action of alkaline dyebaths without injury to the animal fibre. Protectol can also be employed in the degumming of silk with caustic soda and in the "liming" of skins with sodium sulphide.—J. F. B.

Cellulose; Behaviour of oxidised ——. E. Knecht and F. P. Thompson. J. Soc. Dyers and Col., 1922, 38, 132—136.

Cotton yarn was treated in the presence of 7·5% sulphuric acid in the cold, with increasing quantities of permanganate up to 1 atomic equivalent of active oxygen. The "copper values" of the oxidised celluloses were determined, and it was found that with the consumption of small proportions of oxygen, up to ¼ atom, the increase of the "copper value" was almost proportional to the oxygen consumed; beyond that the increase in "copper value" was far less rapid. The consumption of ½ atom of oxygen gave a product with copper value of 12·7, and this only rose to 14·0 with the further consumption of ½ atom. Thus it appears that the initial action of the oxidising agent results mainly in the formation of aldehydic or ketonic groups, while the later action is complicated, possibly by the production of carboxylic groups. In order to determine whether the oxidation had taken place at the expense of the hydroxyl groups of the cellulose, esters were prepared under identical conditions from the original and oxidised celluloses. The results of acetylation were inconclusive, both celluloses being esterified to approximately the same extent when sufficient time was allowed. The oxidised cellulose, however, was acetylated rather more slowly than the original, and was considerably hydrolysed to products soluble in water. On nitration the oxidised cellulose showed a very distinct suppression of the hydroxyl activity, yielding nitrates containing only 11·5% of nitrogen with acid mixtures which gave nitrates with 13·4% of nitrogen from the original cotton.—J. F. B.

Thiosulphates and polythionates in acid calcium bisulphite solution. Sieber. *See* VII.

Ultra-violet light in analysis. Kitching. *See* XXIII.

PATENTS.

Cotton substitutes; Manufacture of ——. B. Possanner von Ehrenthal. E.P. 156,710, 7.1.21. Conv., 24.11.19.

COTTON substitutes suitable for the manufacture of paper, nitrocellulose, etc., and having a uniform strength and staple so that they can be spun by the usual methods, are obtained from various plants and waste such as linseed and hemp seed, straw, jute, reeds, nettles, potato haulm, willow bark, agave, and the like by the following method:—The fibrous material is steeped for 3—6 days in water at 30°—50° C. and allowed to ferment until incrusting substances are partially decomposed. It is then thoroughly washed in water, hydrolysed by treatment for several hours with dilute solutions containing free mineral or organic acids or their acid salts at temperatures not exceeding 40° C., washed free from acid, and afterwards treated with dilute solutions of alkalis, such as caustic soda, sodium carbonate, ammonium compounds, lime, etc., at temperatures not exceeding 50° C. for one or several days, whereby the fibrous material is "opened up" into flexible single fibres which are then thoroughly washed and dried at a low temperature. The fibrous material is more satisfactorily purified if it is subjected, between the operations of hydrolysis and opening-up, to the action of organic solvents, such as ether, benzol, alcohols, carbon bisulphide, acetone, etc.—A. J. H.

Lubricant [for yarns and weaving machines]. L. Minton. E.P. 179,344, 17.2.21.

A LUBRICANT for yarns and fibrous material, as well as for machines employed for weaving such materials, is composed of a mixture of powdered mica and one or more metals, in the form of powder, having lubricating properties similar to those of aluminium (*cf.* E.P. 140,170; J., 1920, 360 A), such as tin, zinc, copper, silver, and platinum. Suitable proportions are equal parts of mica and metal. The mixture may be used dry or combined with an oleaginous base such as tallow, soap or the like to form a paste.—F. G. P. R.

Fibrous material; Process of retting ——. Aktiebolaget Cellulosa. G.P. 342,121, 26.6.18. Conv., 10.5.17.

FIBROUS material is steeped, at a temperature above 90° C., in a liquor of sp. gr. 1·074—1·100, prepared by adding fresh alkali hydroxide to waste liquor from a previous treatment of similar material. The fibres retain their durability and do not darken in colour.—L. A. C.

Fibrous material; Production of —— from plants. Nessel-Anbau-G.m.b.H. G.P. 343,173, 11.6.16. Addn. to 312,381 (J., 1920, 13 A).

AFTER treating plant material by the process described in the chief patent, the liquor is removed from the vessel, and the material is covered with an oil emulsion and boiled for 4 to 24 hrs., whereby the whole of the fibrous content is disintegrated into the elementary fibres.—L. A. C.

Textile fibres; Production of —— from the stems of nettles and other plants. J. Elster. G.P. 343,256, 1.4.19. Addn. to 305,049 (J., 1921, 689 A).

PLANT stems, after treatment with sodium carbonate solution and previous to subsequent treatment as described in the chief patent, are steeped in hot sodium hydroxide solution and then rinsed in water. —L. A. C.

Textile fibres; Production of —— from typha, rushes, and the like. Faserwerke, G.m.b.H. G.P. 343,340, 21.11.19.

TYPHA, rushes, and similar plants are successively boiled with dilute aqueous sodium hydroxide to loosen the fibres, and treated with a hot, strong solution of an alkali hydroxide.—L. A. C.

Textile fibres and half-stuff suitable for paper manufacture; Simultaneous production of —— from reeds and the like. L. B. von Ordody, and B. Schottik und Co. G.P. 345,401, 14.7.18. Addn. to 285,539 (J., 1915, 1138).

REEDS and similar plants are cut up into lengths of about 1 m., and the leaves are removed and bound together with the stems into bundles, and steeped for 21 to 30 days. After drying and again steeping they are bruised, treated for 1—1½ hrs. with an alkali hydroxide solution of 1·0—0·6° B. (sp. gr. 1·007—1·005) under a pressure of 3—4 atm., treated with dilute acid, boiled with water, washed with cold water, and subsequently treated as described in the chief patent.—L. A. C.

Sulphite-cellulose waste liquors and similar solutions; Apparatus for evaporating ——. F. Paschke. G.P. 345,192, 17.1.20.

A CHAMBER provided with a chimney contains a screw conveyor or several superposed screw conveyors in closed casings for transferring the liquor from one part to another. The top casing is provided with an outlet for gases and vapour, and the lowest discharges into a receiver provided with an inlet for the hot gases.—L. A. C.

Drying webs of paper, fabric, or the like; Apparatus for ——. B. F. Sturtevant Co., Assees. of J. O. Ross. E.P. 156,480, 5.1.21. Conv., 8.12.13.

Drying cylinders [for fabrics] and the like. A. Newton. E.P. 179,621, 5.2.21.

Making road surfaces. E.P. 179,480. *See* IX.

Lacquers from nitrocellulose. G.P. 350,973. *See* XIII.

Lacquers from cellulose esters. G.P. 351,228. *See* XIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

rotective agent for animal fibres. Edge. *See* V.

Patent.

ilk, to be dyed black; Process of weighting or charging ——. A. W. Schmid. U.S.P. 1,417,206, 23.5.22. Appl., 18.2.22.

ILK is weighted by the usual tin-phosphate process, nd then treated in a boiling foam bath containing hæmatein, to which chrysalides boiled up in water have been added.—A. J. H.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Potash brines; Evaporation of —— at Deep Springs Valley, California. L. A. Palmer. Chem. and Met. Eng., 1922, 26, 1034—1037.

A NATURAL brine with sp. gr. 1·2896 and containing 7·27% KCl, 11·53% NaCl, 8·88% Na_2SO_4, 5·36% Na_2CO_3, and 0·70% $Na_2B_4O_7$ is pumped into vats and cooled to 10° C. in order to effect the crystallisation of the greater part of the sodium sulphate and some of the sodium carbonate. The remaining brine is mixed with mother liquor from a final crystallisation and treated in a single-effect evaporator heated by steam. The production of foam during distillation is prevented by the introduction of "slop distillate" in order to increase the surface tension of the liquor, and by strips of sheet lead suspended from the steel-work of the evaporator, whereby oxychlorides are formed by electrochemical action and oxidise the organic matter which causes foaming. Sodium chloride, sulphate, and carbonate crystallise in the evaporator and are removed. The enriched liquor containing 22% KCl is passed through a screen into crystallising tanks. As the solution cools potassium chloride and borax crystallise together and are removed from the mother liquor before carbonates and sulphates are deposited. The crystals are heated by steam so that the borax dissolves in the entrained liquor and its own water of crystallisation. The potassium chloride crystals are then separated in a centrifuge and washed with a jet of wet steam.—H. Hg.

Heterogeneous equilibria. The ternary system sodium sulphate — sodium carbonate — water. A. E. Dawkins. Chem. Soc. Trans., 1922, 121, 776—781.

THE isothermal equilibria of the ternary system sodium sulphate, sodium carbonate, water at 19·1° C. are represented on the triangular coordinate system by two liquidus curves intersecting at an invariant point determined by the presence of two series of solid solutions in equilibrium with the solutions represented by the liquidus curves. The composition of the limiting solid solutions in mutual equilibrium at the invariant point is sodium carbonate 2·0% and sodium sulphate 1·9% by weight. The isothermal diagram at 50° C. consists of a three-branched liquidus curve intersecting in two invariant points, and three solidus curves representing three corresponding solid solutions. The compositions of the invariant solutions are:—Sodium sulphate 23·10%, sodium carbonate 10·21%, and sodium sulphate 5·87%, sodium carbonate 28·52% by weight.—P. V. M.

Thiosulphates and polythionates; Occurrence of —— in sulphite-liquor [acid calcium bisulphite solution]. R. Sieber. Zellstoff u. Papier, 1922, 2, 51—56, 106—114.

WHEN sulphite solution is prepared by the use of gases obtained by the complete combustion of sulphur or pyrites, it invariably contains small quantities of thiosulphate. If the gases are carefully filtered before passing into the solution, then the whole of the sulphur can be accounted for as sulphite and sulphate, no thiosulphate being produced. Hence the presence of thiosulphate is attributed to the presence of traces of free sulphur which has sublimed and is carried over by the gases. The results are similar whether the gases are absorbed by lime or by calcium carbonate. When sulphur dioxide containing free sulphur is passed into milk of lime, thiosulphate is produced, which in presence of excess of sulphur dioxide gives rise to polythionates. Of the calcium polythionates, only the trithionate is stable. Gases obtained by the roasting of pyrites may contain small amounts of arsenious oxide and selenium dioxide, and experiments show that arsenious oxide in presence of sublimed sulphur does not prevent the formation of thiosulphate and polythionates. When sublimed sulphur is entirely absent, arsenious oxide only gives rise to small traces of thiosulphate and polythionates. In the case of selenium dioxide, both thiosulphate and polythionates are produced, even in the absence of sublimed sulphur, whilst in the presence of sublimed sulphur the amount of polythionate increases, the thiosulphate only changing slightly. A method is suggested for the estimation of thiosulphate and polythionates in which the thionates are reduced by aluminium and hydrochloric acid in an atmosphere of carbon dioxide, the sulphur being evolved as hydrogen sulphide, and estimated by passing through standard iodine solution. The results obtained are compared with those obtained by a modification of Sander's method (*cf.* J., 1918, 731 A; 1919, 412 A).—J. B. F.

Polythionates; Analysis of ——. A. Kurtenacker and A. Fritsch. Z. anorg. Chem., 1922, 121, 335—343.

TETRATHIONATES in neutral solution react quantitatively with a cyanide to form thiosulphates (J., 1921, 622 A), and trithionates react quantitatively with cyanides in hot alkaline solutions to form sulphites (*cf.* Raschig, J., 1920, 18 A). The latter reaction is incomplete in neutral solutions, and tetrathionates in alkaline solutions give sulphites as well as thiosulphates, hence treatment with cyanide is unsuitable for the estimation of a mixture of the two polythionates. The estimation of a mixture of polythionates by means of a sulphite as recommended by Raschig was found to be unsatisfactory. The method of Riesenfeld and Feld (J., 1922, 55 A) was also tested. In the absence of other polythionates the trithionate reacts quantitatively with copper sulphate, but the estimation is not applicable to mixtures. A tetrathionate boiled for ½ hour with copper sulphate gave a precipitate of copper sulphide and sulphur in proportions corresponding to the decomposition of the tetrathionate as follows, $S_4O_6'' = S_3O_6'' + S$. The authors found, contrary to the results of Riesenfeld and Feld, that tetrathionates are quite stable. A solution showed no decomposition after standing for 14 days, the instability reported being due to impurities.—W. T.

Mother-of-pearl; Attempts at a synthetic manufacture of —— by production of chemical tracery. Clément and Rivière. Comptes rend., 1922, 174, 1353—1356.

IF calcium carbonate is precipitated in the presence of colloidal protein material, such as gelatin, in thin layers, a deposit is obtained having a nacreous structure. The deposit becomes opaque on prolonged drying at 50° C. just as pearl or mother-of-pearl "dies" when strongly dried. These experiments support the accepted views as to the physical and chemical composition of mother-of-pearl and fine pearl.—W. G.

Phosphorescent zinc sulphide. A. A. Guntz. Comptes rend., 1922, **174**, 1356—1358.

The wurtzite and sphalerite forms of zinc sulphide prepared by heating the precipitated sulphide are both phosphorescent. The phosphorescence of the wurtzite form is the more persistent, but in both cases the decrease of luminous intensity is extremely rapid. Under the influence of heat and shock the two varieties are very thermoluminescent and triboluminescent.—W. G.

Minerals; Attack of —— by bacteria. Oxidation of blende. A. Helbronner and W. Rudolfs. Comptes rend., 1922, **174**, 1378—1380.

Certain bacteria (*cf.* Lipman and others, J., 1922, 187 A; E.P. 161,553; J., 1922, 112 A) have been found which are capable of converting blende into zinc sulphate, and the zinc rendered soluble in this manner does not prevent the further action of the bacteria. The oxidation is favoured by the presence of sulphur, and under such conditions the bacteria are able to convert natural zinc silicate or carbonate into sulphate. In minerals containing both zinc and lead as sulphides the zinc is converted into sulphate to the exclusion of the lead, and hence this furnishes a means of separating these two metals. —W. G.

Vanadic acid solutions; Reduction of —— with mercury. L. W. McCay and W. T. Anderson, jun. J. Amer. Chem. Soc., 1922, **44**, 1018—1021. (*Cf.* J., 1922, 140 A.)

When vanadic acid in the presence of sulphuric or hydrochloric acid is vigorously shaken with mercury it is reduced according to the equation $2HVO_3+2Hg+3H_2SO_4=2VOSO_4+Hg_2SO_4+4H_2O$. If the solution before shaking is mixed with a little more sodium chloride than is equivalent to the mercurous sulphate formed the whole of the mercury is precipitated as mercurous chloride and a blue solution left which may be quantitatively titrated with permanganate according to the equation, $10VOSO_4+2KMnO_4+12H_2O=10HVO_3+K_2SO_4+2MnSO_4+7H_2SO_4$. The following method, based on the above reactions, is described for the estimation of vanadic acid. The solution of vanadic acid containing sulphuric acid and the requisite amount of sodium chloride (0·3 g. for each 50 c.c. of *N*/10 permanganate used) is diluted to 100 c.c., and vigorously shaken in a stoppered bottle with 20 c.c. of mercury for 5 mins. The liquid above the grey mercury mixture is decanted into a small beaker and poured through a suction filter. The residue in the bottle is washed four times by decantation, 20 c.c. of water being used for each washing, and the washings are severally decanted into the beaker and then through the filter. The total filtrate is diluted to 250 c.c., heated to 80°—90° C., and titrated with permanganate to the faintest pink. The whole process may be completed in 30 mins.; it gives results which are identical with those obtained by the sulphur dioxide method, and since uranic and arsenic acids are not reduced by mercury it may be employed in the presence of these acids.—J. F. S.

Colloidal ferric hydroxide, aluminium hydroxide, and silicic acid; Centrifugal method for preparing ——. R. Bradfield. J. Amer. Chem. Soc., 1922, **44**, 965—974.

Colloidal ferric hydroxide, aluminium hydroxide, and silicic acid may be prepared from the freshly formed precipitates by removing the excess of precipitating agent by a very thorough washing, which is achieved by means of a centrifuge rotating at 32,500 revs. per min. This method has many advantages over the older methods. The removal of the electrolytes formed on precipitation is more complete; the addition of a peptising agent and its subsequent incomplete removal by either prolonged boiling or dialysis is unnecessary; sols of a more uniform degree of dispersion can be prepared, since particles of similar size and of similar degrees of hydration are deposited in the same zone of the centrifuge bowl; sols of any desired concentration from a semi-gel to the merest trace can be prepared by the addition of water to the more concentrated form, and all concentrations are very stable. Aluminium hydroxide precipitated by ammonia in the presence of an excess of sulphate ions is not irreversible.—J. F. S.

Reduction of oxides by hydrogen. E. Berger. Comptes rend., 1922, **174**, 1341—1343. (*Cf.* J., 1914, 752; Sabatier and Espil, J., 1914, 351.)

From a repetition of previous work, using samples of nickel oxides prepared in different ways, it is shown that the discontinuity in the velocity curves occurs at different stages in the reduction, varying with the sample of oxide used. This discontinuity cannot, therefore, as was previously thought, be explained on the basis of the formation of an intermediate oxide, and doubt is accordingly expressed as to the existence of suboxides of nickel. —W. G.

Scandium; Extraction and purification of —— from thorveitite from Madagascar. P. and G. Urbain. Comptes rend., 1922, **174**, 1310—1313.

The mineral is fused with sodium hydroxide and the residue left after extracting the melt with water is dissolved in the smallest possible quantity of sulphuric acid. From this solution the rare earths are precipitated as fluorides by the addition of an excess of hydrofluoric acid. The fluorides are decomposed by sulphuric acid, and scandium bisulphate crystallises out on concentrating the solution. The sulphates are converted into nitrates by way of the hydroxides and the solution of nitrates is concentrated on a water bath until it is free from excess acid. To the concentrated solution an excess of powdered potassium sulphate is added until the solution is saturated with this salt. After three days the double scandium potassium sulphate is filtered off and washed with a saturated solution of potassium sulphate. Any scandium remaining in the mother liquors is reprecipitated as hydroxide and passed through the same process. The double sulphate may be dissolved in aqueous ammonium carbonate and from the solution, on warming, scandium hydroxycarbonate is precipitated. The residue of the scandium in the mother liquors may be recovered by conversion into its acetylacetonate, which is soluble in chloroform and sublimes when heated in a vacuum at 200° C.—W. G.

Platinum; Mode of action of —— in oxygen-hydrogen catalysis and the application of titanium sulphate for the control of the course of the change. K. A. Hofmann. Ber., 1922, **55**, 1265—1274.

Sensible quantities of hydrogen peroxide are produced in the surrounding acid during the catalysis of dissolved molecular oxygen and activated hydrogen at platinum surfaces only when the reducing power of the hydrogen-platinum electrode is abnormally reduced, when the liquid surrounding the pole contains large amounts of dissolved oxygen, and when the pole is as free as possible from oxides of platinum. It is highly probable that the hydrogen-oxygen catalysis proceeds normally in two stages $O_2+2H=H_2O_2$ and $H_2O_2+2H=2H_2O$. The velocity of the second action at an tive platinum surface is, however, so great that drogen peroxide does not escape into the rrounding liquid. A specific reducing action vards a third substance of hydrogen peroxide, iich is liberated at the best only in minute traces, not to be expected under any circumstances. irther, the reduction potential of hydrogen roxide is much less than the potential of drogen activated at a platinum surface. In eparative or other work in which reductions are be effected with activated hydrogen, the use of id titanium sulphate is recommended for in- ating the conditions favourable to maximum luction or for controlling the course of the ange, since the activity of the system is readily own by the formation of the characteristic violet-own solutions of the sulphate of trivalent anium. In addition, it is to be expected that e reduced titanium will both accelerate and gulate the reducing action, since reduced anium solutions have been frequently successfully ilised as reducing agents.—H. W.

Patents.

lphuric acid; Process for distilling ——. Chem. Fabr. Weissenstein Ges. E.P. 163,685, 23.3.21. Conv., 21.5.20.

RE sulphuric acid is obtained by distillation of hnical sulphuric acid by using as heating bodies ctrical resistances disposed above the surface of e acid in a cylindrical stoneware pot. The top yer of the acid is thus heated by radiation so that aporation proceeds only on the surface, and it is t necessary to heat to boiling temperature the ole of the acid contained in the pot. In addition platinum, the resistances may be made of terials which are not acid-proof, *e.g.*, nickelin or n, without any formation of sulphur dioxide by composition of the sulphuric acid vapour.
—H. R. D.

ydrochloric acid; Method of making ——. C. P. Townsend, Assr. to Hooker Electrochemical Co. U.S.P. 1,414,762, 2.5.22. Appl., 1.3.20.

BODY of hydrogen is confined in a closed system to hich chlorine is suplied at a substantially constant te. Combination of the two gases is effected and e resulting hydrochloric acid withdrawn from the stem. The desired pressure within the apparatus maintained by regulating the supply of hydrogen.
—F. G. P. R.

mmonia; Recovery of —— from peat and the like. P. Brat. E.P. 159,194, 17.2.21. Conv., 18.2.20. (*Cf.* E.P. 157,745–6 and 159,193; J., 1922, 371 A, 462 A.)

HE material is subjected to a pressure of at least atm. at a temperature of 170°—200° C., in the resence of water and one or other of the following asic substances:—barium, strontium, or mag- esium oxide, alumina, or alkali aluminate. A hydrocarbon" having a high boiling point, such as tch, is added to the residue and after vaporising e water the hydrocarbon contained in the peat is covered by distillation at 200°—700° C.—H. R. D.

mmonia; Process for separation of —— from the gaseous mixture obtained in the synthetic production of ammonia from nitrogen and hydrogen. Metallbank und Metallurgische Ges. A.-G. G.P. 343,320, 15.8.14.

HE ammonia is obtained in the form of a mist or g, *e.g.*, by conversion into an ammonium salt, and then separated by electrical precipitation.
—H. R. D.

Ammonium sulphate and other salts; Apparatus for drying ——. J. B. Hansford. E.P. 179,723, 1.3.21.

THE material to be dried is alternately spread by centrifugal force over a heated tray rotating on a vertical shaft, and turned over and piled into heaps by the action of plough-shaped scrapers. By means of rollers, the load on which can be varied, the crystals are subjected to a crushing action. The dried material is ejected from the tray by increasing its speed, thus causing the material to fall over the edge of the tray into an annular receptacle below.
—H. R. D.

Ammonium chloride; Process of recovering —— from solution. N. T. Bacon, Assr. to The Solvay Process Co. U.S.P. 1,416,772, 23.5.22. Appl., 27.12.19.

SOLUTIONS of ammonium chloride are evaporated so as to precipitate ammonium chloride, free ammonia being maintained in the solution.—J. S. G. T.

Calcium nitrate; Process for manufacture of ——. Aluminium-Industrie A.-G. E.P. 163,330, 5.5.21. Conv., 19.5.20.

NITRIC acid obtained from the nitrogen of the air is concentrated to a strength of 90—95% monohydrate and mixed continuously with powdered limestone, *e.g.*, 13 pts. by weight of acid with 11—12 pts. of limestone, according to the purity of the latter. By maintaining the temperature at 60°—80° C. the product obtained leaves the apparatus in a pasty form and hardens on cooling; it contains 75—80% of pure calcium nitrate.—H. R. D.

Sodium cyanide; Process for production of ——. Deutsche Gold- und Silber-Scheide-Anstalt, vorm. Rössler. E.P. 164,719, 22.4.21. Conv., 10.6.20.

SOLUTIONS containing sodium cyanide and sodium chloride, as obtained, for example, in the production of sodium cyanide from calcium cyanamide, are cocentrated, with or without the addition of more sodium cyanide, until saturated with cyanide, whereupon the bulk of the sodium chloride is deposited leaving a solution which can be used as such or treated for the recovery of solid sodium cyanide.—H. R. D.

Slate; Treatment of —— [for recovery of potassium and aluminium salts]. C. R. Hayward and H. M. Schleicher, Assrs. to The American Metal Co., Ltd. U.S.P. 1,415,346, 9.5.22. Appl., 4.3.20.

POTASSIFEROUS slate is treated with sulphuric acid at an elevated temperature, the soluble sulphates thus formed are leached out with water, and potassium alum recovered from the solution by crystallisation.—F. G. P. R.

Sulphur dioxide; Process for enriching metallurgical gases containing ——. G. C. Howard, Assr. to American Smelting and Refining Co. U.S.P. 1,417,066, 23.5.22. Appl., 29.11.18.

FURNACE gases containing a relatively low proportion of sulphur dioxide are mixed with sulphur dioxide expelled from an aqueous solution.
—B. M. V.

Sulphur dioxide; Process for recovering —— from waste metallurgical gases. G. C. Howard, Assr. to American Smelting and Refining Co. U.S.P. 1,417,067, 23.5.22. Appl., 6.3.19.

A SOLUTION containing sulphur dioxide is passed counter current through a mixture of sulphur dioxide gas and water vapour, and the sulphur dioxide subsequently recovered from the solution.
—B. M. V.

Sodium carbonate sulphate; Process of recovering —— from saline waters. G. B. Burnham. U.S.P. 1,417,139, 23.5.22. Appl., 30.6.19.

Searles Lake brine is slowly evaporated until saturated with sodium carbonate sulphate, which crystallises out on continuing the evaporation. —H. R. D.

Sulphur; Recovery of —— from gases [containing hydrogen sulphide]. H. Frischer. G.P. 350,271, 26.11.19.

Gases containing hydrogen sulphide, either alone or mixed with oxygen, are passed through strongly acid solutions of cupric salts capable of reduction by hydrogen sulphide. The formation of sulphur may be accelerated by the addition of salts, *e.g.*, alkaline-earth salts, which are not attacked by hydrogen sulphide.—L. A. C.

Sulphur; Recovery of —— from gases. Hinselmann, Koksofenbauges. m.b.H. G.P. 350,272, 17.9.20.

Material for removing sulphur from gases is kept in motion and in suspension in the gas during the process and during subsequent regeneration by treatment with air.—L. A. C.

Hydrogen sulphide; Removal of —— from gases. Ges. für Kohlentechnik m.b.H. G.P. 350,325, 25.3.20.

Gases are scrubbed with ammoniacal solutions of copper salts, and the sulphides produced in the liquor are oxidised at normal temperature to sulphates by treatment under pressure with gases containing oxygen.—L. A. C.

Percarbonates and perborates; Electrolytic process of manufacture of —— from solutions of alkali carbonates and borates. Deutsche Gold- u. Silber-Scheide-Anstalt, vorm. Rössler. G.P. 350,986, 25.3.19.

Substances, such as fluorides or perchlorates, which increase the anode potential, are added to the electrolyte.—J. S. G. T.

Potassium salts; Process and apparatus for manufacturing —— of varying grain size by cooling hot liquors in vacuo. Maschinenbau A.-G. Balcke. G.P. 351,281, 25.2.19.

Hot stagnant liquor is cooled in shallow vessels, and the pressure in the cooling chamber is gradually reduced to the highest vacuum attained. The period taken in reducing to the highest vacuum is controlled by a throttle valve or similar device disposed between the cooling chamber and the condenser employed, and is determined according to the size of crystal to be produced.—J. S. G. T.

Nitrous gases; Manufacture of concentrated ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. E.P. 156,799, 7.1.21. Conv., 6.10.15.

See U.S.P. 1,291,909 of 1919; J., 1919, 285 A.

Nitric acid; Process of converting nitrous gases into concentrated ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. E.P. 156,800, 7.1.21. Conv., 22.5.15.

See U.S.P. 1,197,295 of 1916; J., 1916, 1260.

Aluminium chloride; Production of ——. Armour Fertilizer Works, Assees. of E. C. Baum and D. O. Jones. E.P. 160,759, 11.2.21. Conv., 24.3.20.

See U.S.P. 1,372,332 of 1921; J., 1921, 346 A.

Sulphur; Process for making —— from sulphur dioxide. G. C. Howard, Assr. to The American Smelting and Refining Co. U.S.P. 1,417,068, 23.5.22. Appl., 9.9.18. Renewed 28.11.21.

See E.P. 144,306 of 1920; J., 1921, 735 A.

Separating solids by crystallisation. E.P. 179,287. *See* I.

Water-glass. G.P. 346,237. *See* IIB.

Lime kiln. U.S.P. 1,416,657. *See* IX.

VIII.—GLASS; CERAMICS.

PATENTS.

Glass composition. H. T. Bellamy and B. T. Sweely Assrs. to Western Electric Co. U.S.P. 1,415,980, 16.5.22. Appl., 20.3.20.

A **binder** for compositions of high resistance is made of a non-electrolytic glass composed of barium and calcium silicates and borates.—A. B. S.

Silica bricks; Manufacture of ——. H. Koppers. G.P. 345,949, 17.4.20.

Impure quartzite rock and "crater cement" are finely ground with water, and the mixture made into bricks which have a high silica content. —A. R. P.

Bauxite; Manufacture of objects of dense structure from ——. Dynamidon-Werke Engelhorn und Co. G.P. 346,944, 24.10.15.

Burnt bauxite in a finely-ground condition is moulded into the desired shape and the object burnt in a reducing atmosphere. A portion of the burnt bauxite may be replaced by finely-ground raw bauxite.

Enamels, glazes and like substances; Coating heat-resisting articles by spraying with ——. N. Meurer. E.P. 179,216, 27.11.20.

Articles are glazed or enamelled by spraying them with a powdered material, which is forced by means of gases under pressure through a flame which melts the powder and raises the temperature of that part of the article on to which the spray impinges to the melting point of the enamel or glaze. The spraying device consists of a container for the powder, an arrangement resembling a blowpipe, and pipes which deliver compressed oxygen or air into the container, stirring up the powder and then carrying it downward through other tubes to the flame extending from the nozzle of the blowpipe, and so on to the articles to be coated.—A. B. S.

Enamel for coating the surfaces of steam-engines liable to corrosion. H. Willmer. G.P. 350,770, 27.10.20.

An enamel which is not decomposed by steam contains either no alkalis, or only such as are introduced by the felspar or cryolite used.—L. A. C.

Tungsten or molybdenum carbide; Process for making blocks of any form or desired size from —— or from a mixture of this carbide for tools and articles of all kinds. Process for the manufacture of pieces of tungsten or molybdenum carbide of any desired size. Lohmann-Metall G.m.b.H., formerly Voigtländer und Lohmann Metall Fabrikations Ges. E.P. 157,747 and 157,750, 10.1.21. Conv., 2.1.14 and 16.4.14.

See G.P. 289,066 and 286,184; J., 1916, 423; 1915, 1250.

IX.—BUILDING MATERIALS.

Patents.

Mortar, cement, concrete and the like; Process for rendering —— suitable for the execution, in a durable and reliable manner, of waterproofing, hydraulic and like work, such as preventing water from percolating through walls and the like. K. Winkler. E.P. 167,138, 1.2.21. Conv., 26.7.20.

Mortar, cement, or concrete is gauged with a solution of calcium chloride of 26° B. (sp. gr. 1·22) instead of with water. A small proportion of one or more of the following may also be added: strontium, potassium, and manganous chlorides, calcium, strontium, and magnesium nitrates, manganese dioxide, barium peroxide, chromic oxide, antimony oxide, butter of antimony, manganese borate, sugar, coal, cinders, calcspar, felspar, bauxite, fluorspar. A cement so treated begins to set in 2—5 mins., and is hard within half an hour. Its resistance to compression after 3 days is equal to that of ordinary cement after 20 days and continues to increase. Its resistance to bending is about double that of ordinary cement. Its constancy of volume is exceptional, and it is completely waterproof.—A. B. S.

Rotary [cement] furnaces. S. B. Newberry. E.P. 179,272, 31.1.21.

A rotary kiln is provided with an inner cylinder of refractory material, which is attached to and rotates with the outer cylinder. The inner cylinder may extend about half-way along the outer cylinder, and beyond it through a chamber at the base of the chimney. The material to be heated passes through the inner cylinder, and the hot kiln gases pass through the annular space between the cylinders so as to preheat the contents of the inner cylinder. The gases and volatile matter in the inner cylinder are drawn out by means of a fan, and any useful products in them may be recovered. The object of the device is to enable a mixture of fuel and cement material or fireclay to be burned in a rotary kiln, and to recover any condensable products, particularly oil and ammonia. A supplementary supply of fuel can be used at the discharge end of the kiln.—A. B. S.

[Lime] kiln. R. K. Meade. U.S.P. 1,416,657, 16.5.22. Appl., 23.6.21.

A shaft kiln for burning lime or the like is provided with a stoking grate having rocking sections, a drop bar for operating them, and a hopper for supplying fuel to the grate. The furnace is closed normally and during stoking to prevent the admission of an excess of air.—A. B. S.

Road surfaces; Process for making ——. A. Miller. E.P. 179,480, 3.9.21.

Roads are sprayed with sulphite-cellulose waste liquor of 60°—70° Balling (sp. gr. 1·29—1·51), and allowed to dry; a thin layer of tar is then applied and rolled in. The process may be repeated several times.—A. B. S.

Slag; Method of obtaining granular ——. W. Schumacher. U.S.P. 1,416,069, 16.5.22. Appl., 29.3.12.

A granular slag substantially free from water is made by applying water to the surface of the slag as it issues from the furnace, and separating the water from the slag before the latter becomes cool enough to permit the water to exist in liquid form adjacent to its surface. The hot slag is then passed into a receptacle and cooled.—A. B. S.

Wood; Process for seasoning ——. A. O. Crail. U.S.P. 1,416,269, 16.5.22. Appl., 26.11.20.

The wood is boiled in a 5% solution of common salt for 6 hrs. and then transferred immediately to a kiln where it is heated for 42 hrs. at 250° F. (120° C.).—A. R. P.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron-carbon-oxygen and iron-hydrogen-oxygen; Equilibria in the systems —— and the free energies of the oxides of iron. E. D. Eastman. J. Amer. Chem. Soc., 1922, 44, 975—998.

Ferric oxide and ferrosoferric oxide at 1100° C. and above form a continuous series of solid solutions, though there are indications that below 1000° C. they may not be soluble in each other in all proportions. Ferrosoferric oxide and ferrous oxide up to 1100° C., at least, do not form a series of solid solutions though they do dissolve in each other to a limited extent. Ferrous oxide appears to be soluble in iron to the extent of 20—25 mol.% (6—8% of oxygen), though metallic iron is not appreciably soluble in the oxide. Ferrous oxide is unstable with respect to ferrosoferric oxide and iron below about 565° C., and ferrosoferric oxide shows an inversion point in the same region. When carbon monoxide reacts with pure iron in a closed tube above 500° C., carbon is not ordinarily deposited as a separate phase. At temperatures above 800° C. a trivariant equilibrium with iron containing dissolved carbon or carbide as the solid phase may be established, or one in which the solid phase contains dissolved oxygen as well as carbon, and the gas is richer in carbon dioxide than in the former case. With a stream of carbon monoxide acting on iron in the vicinity of 650° C. separate phases consisting of carbon, ferrous oxide, and iron containing dissolved oxygen and carbon (or carbide) are probably formed. At higher temperatures the oxide and separate carbon phases do not appear, and the amount of dissolved carbon decreases. Carbon dioxide acting on iron in a closed tube probably produces a trivariant system. At temperatures near 600° C. and lower, carbon is present in the solid phase, decreasing in amount as the temperature is increased. —J. F. S.

Cast iron; Estimation of phosphorus in ——. F. Graziani und L. Losana. Giorn. Chim. Ind. Appl., 1922, 4, 148—153.

The most exact method of estimating phosphorus in cast iron consists in weighing it as magnesium pyrophosphate and this should always be used for the purposes of accurate control. For ordinary routine work, use may be made of the lead molybdate method, which is accurate and rapid; good results are obtainable also by either weighing as ammonium phosphomolybdate or converting the latter into phosphomolybdic anhydride by calcining at a temperature not exceeding 500° C. The alkalimetric method, which is based on titration of ammonium phosphomolybdate with sodium hydroxide solution, is applicable to cast irons of all types and is rapid and yields satisfactory results. When the percentage of phosphorus in the metal is less than 0·5, use may be made of the colorimetric method of Namias based on the stable blue coloration obtained when ammonium phosphomolybdate is treated with hot sodium thiosulphate solution. If a high degree of accuracy is not desired and if the proportion of phosphorus present does not exceed 0·25%, Jüptner's method of centrifuging the liquid containing the precipitated ammonium phosphomolybdate in a suitable tube and measuring the volume of the precipitate may be used.—T. H. P.

Chromium and nickel in steel; Proposed method of determining the ——. F. Simion. Chem.-Zeit., 1922, **46**, 504.

The following method is suggested for separating the chromium and nickel from a nickel-chromium steel. 2 g. of the turnings is dissolved in *aqua regia*, and the solution is neutralised and poured into an excess of caustic soda solution containing hydrogen peroxide or sodium peroxide. After boiling to convert the chromium salts into chromate and destroy excess of peroxide, the precipitate is collected on a suction filter, well washed, rinsed back into the original beaker, and digested with ammonia and ammonium carbonate to dissolve the nickel leaving the iron insoluble. The chromate in the first and the nickel in the second filtrate are determined by any convenient method.—A. R. P.

Chromium-steel; Heat treatment of special steels, especially ——. E. Maurer and R. Hohage. Mitt. Kaiser Wilhelm-Inst. Eisenforsch. Düsseldorf, 1921, **2**, 91—105. Chem. Zentr., 1922, **93**, II., 1129—1130.

In the heat treatment of chromium steels, for a given rate of cooling, the ageing temperature is lower the higher the quenching temperature. Tests carried out on steels containing 1—3% Cr and 0·25—0·52% C show that the tensile strength of the alloy quenched from 850° C. depends to a greater extent on the carbon than on the chromium content. The proportion of pearlite increases with the percentage of carbon, whilst chromium causes the larger ferrite and pearlite complexes to coalesce and the metal then has a uniform fine-grained structure which, however, does not always result in high elastic limit and resistance to shock compared with the tensile strength, owing to either too low a temperature, or total lack, of ageing. Determination of the change point and the effect of hardening at different temperatures on the structure and properties showed that quenching from an excessively high temperature did not have the same deleterious effect on chromium-steels as on other tool steels. The bad effect of too high a temperature of forging on the latter may be overcome by a second hardening operation, whereas the structure of a constructional steel, especially if its tensile strength is high, is ruined by forging at too high a temperature. The most useful steel in the above range is that containing 0·4% C and 1·8% Cr. In the notched bar impact tests it was found that with a definite amount of carbon an increase of chromium reduces the toughness of the metal and *vice versâ*. Temper-brittleness is due to the state of the carbide present, material quenched from above 650° C. showing a higher maximum magnetic permeability than that subsequently annealed at 550° C., and it is therefore suggested that there are two forms of the carbide, one stable above 650° C., which is converted into the other normal form by prolonged annealing at 500°—550° C. No difference in the two structures could be discerned, but the grain boundaries of slowly cooled alloys developed more rapidly on deep etching than those of quenched alloys.—A. R. P.

Zinc; Electrolytic extraction of ——. L. Cambi. Giorn. Chim. Ind. Appl., 1922, **4**, 133—147.

Descriptions are given of the various processes for the electrolytic extraction of zinc and of the plants erected, especially in America, for working them, the results obtained being compared with those of the ordinary smelting method. Works experience gained in Italy shows that most of the Italian zinc ores are suitable for electrolytic treatment, the sulphate process giving the best results.—T. H. P.

[*Copper and brass;*] *Relation between the compression force and reduction in height* [*of* ——]. F. Doerinckel. Z. Metallk., 1922, **14**, 189—194.

The relation between the compression force and the reduction in height of test-pieces of copper and various brasses has been determined for temperatures between 0° and 700° C., and the results plotted. In every case up to a reduction of 60% in the height the curve is a straight line; after this it becomes curved convex to the axis of height reduction. The author discusses the subject from a theoretical point of view and evolves a formula for calculating the pressure required to produce any reduction in height, which gives sufficiently close results for practical work.—A. R. P.

Aluminium alloys; Use of molybdenum for improving the properties of ——. H. Reimann. Z. Metallk., 1922, **14**, 195—204.

In continuation of earlier work (J., 1922, 331 A) the author has investigated the effect of small additions of molybdenum to commercial aluminium alloys containing copper, zinc, magnesium, or nickel. Up to 1% Mo has very little effect on the hardness of alloys with the last three metals, but in the case of copper-aluminium alloys containing up to 3% Cu the addition of molybdenum increases the hardness up to 0·7% Mo, then decreases it. The effect of molybdenum on the resistance to shock is not very marked and depends to a great extent on the nature and quantity of the other alloying metal, while no appreciable improvement was made in the tensile strength or ductility of any of the alloys by up to 1% Mo. In all cases the microstructure of the alloys revealed characteristic needles of the peritectic Al-Mo crystals more or less finely disseminated throughout the alloy. Molybdenum does not reduce the temperature range of solidification, the amount of piping, or the tendency of the third constituent to segregate, and, in general, the results obtained by the addition of molybdenum to aluminium alloys do not seem to justify the extra cost.—A. R. P.

Nickel; Analysis of technical ——. K. Breisch and K. Chalupny. Chem.-Zeit., 1922, **46**, 481—482.

10 g. of the metal is dissolved in nitric acid, the solution evaporated repeatedly with hydrochloric acid to dryness on the water bath, the silica filtered off, ignited, and weighed, and the filtrate diluted to 750 c.c. and treated with barium chloride for the determination of the sulphur. A second 10 g. of the metal is dissolved in nitric acid and the solution electrolysed at 4—4·5 volts for 15 mins. with rotating electrodes, whereby copper is obtained on the cathode and lead as peroxide on the anode. Iron and manganese are determined by dissolving 5 g. of the sample in nitric acid and treating the solution with ammonia and bromine. The precipitate, which contains appreciable amounts of nickel, is dissolved in hydrochloric acid, the solution exactly neutralised with ammonium carbonate, treated with 10 c.c. of 10% ammonium formate solution, diluted to 300—400 c.c., and boiled for 15 mins. The precipitate contains all the iron, which is determined as usual. Hydrogen sulphide is passed through the solution to remove the nickel, and the filtrate is treated with bromine in excess, then with ammonia to precipitate manganese. Oxygen is determined by the loss in weight on ignition in hydrogen, arsenic and antimony by distillation, and zinc as described prevously (J., 1922, 256 A).—A. R. P.

Silver amalgam of the composition, Hg_3Ag_2; Preparation of a —— *by precipitation from a solution of silver nitrate in pyridine.* R. Müller and R. Hönig. Z. anorg. Chem., 1922, **121**, 344—346.

Metallic needles of Hg_3Ag_2 were formed by keeping a drop of mercury in contact with a solution of silver nitrate and cuprous iodide in anhydrous pyridine. Using silver nitrate solution alone, crystals of mercurous nitrate were deposited and a liquid amalgam formed. For the formation of the crystals the addition of an approximately equal amount of cuprous iodide (1:1) is necessary. The addition of a much smaller amount (1:10) causes the precipitation of finely divided black silver, whilst with too large amounts of cuprous iodide (5:1) the drop of mercury changes into a granular powder. Cuprous iodide can be replaced by cerous chloride, the separation of crystals being, however, much slower.—W. T.

Flue-dust; Pyrophoric —— [from iron blast furnaces]. J. W. Gilles. Stahl u. Eisen, 1922, 42, 884—889.

The very finely-divided flue-dust from the dry gas-purifying chambers from iron-smelting furnaces, if exposed to the air while warm, commences to glow and changes colour from light grey to red-brown, at the same time emitting vapour consisting of a mixture of ammonia, carbon dioxide, and cyanogen compounds having a very objectionable odour. The dust is not pyrophoric when quite cold, but is easily ignited with a glowing piece of charcoal, a temperature of 167°—220°C. only being required to initiate glowing, while the highest temperature reached in the combustion is about 600° C., each gram of dust emitting 400—500 cals. A number of samples of pyrophoric and non-pyrophoric dust from various works were analysed in order to ascertain the cause of the phenomenon, but no concordant results were obtained. It, however, appears highly probable that the cause is the presence of a large amount of manganese oxide (MnO) which in the finely divided form glows when heated above 180° C. in air, forming the oxide Mn_3O_4. The glowing is increased by the combustion of other substances, *e.g.*, carbon and sulphides of iron or zinc, when the temperature rises high enough.—A. R. P.

Attack of minerals by bacteria. Helbronner and Rudolfs. *See* VII.

Patents.

[Iron;] Electrolytic methods of depositing metals [especially ——]. The British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 179,675, 14.2.21.

Sound homogeneous ribbons of electrolytic iron, as thin as 0·00025 in., may be obtained by electrodeposition from a bath of ferrous chloride or other salt by the use of an iron anode and a cathode consisting essentially of a revolving wheel partly immersed in the electrolyte, the rim of the wheel, on which the iron is deposited, being formed of a narrow band of tungsten or molybdenum or of an alloy of these elements with one another, or with other elements. The deposit does not adhere to the cathode, and is readily stripped therefrom as it leaves the bath.—A. R. P.

Iron and steel; Method of pickling —— in acid baths. O. Vogel. G.P. 350,771, 31.3.20. Addn. to 309,264 (J., 1921, 853 A).

In the process described in the chief patent, organic compounds containing the quinoline nucleus are added to the pickling bath.—L. A. C.

Crucible furnaces [for melting metals]. F. G. Penny. E.P. 179,463, 7.7.21.

A number of melting pits, each provided with a blast pipe, are connected with a corresponding number of preheating pits by flues which gradually expand from the tops of the former to the bottoms of the latter. The final outlet flues from the top of the latter are provided with ejector jets connected with the main blast.—B. M. V.

Furnace [; Crucible ——]. J. A. Gaskill. U.S.P. 1,417,478, 23.5.22. Appl., 28.5.20.

The refractory body of the furnace which contains the crucible is mounted on trunnions and provided with a jacket in which the air for combustion is preheated. The air is admitted tangentially at the bottom of the jacket and passes from the top to a pair of mixing chambers situated on the trunnion shafts outside the bearings, where it is mixed with fuel. The mixture then passes through the hollow trunnions to burner jets and enters the interior of the furnace tangentially. —B. M. V.

Furnaces; Continuous re-heating or annealing ——. Façoneisen-Walzwerk L. Mannstaedt und Co., A.-G., and H. Bansen. E.P. 179,638, 7.2.21.

In continuous annealing furnaces, where the waste gases are removed through a recess in the roof and down through side passages, the hearth is extended beyond the recess so as to form a preheating zone, the roof of which is progressively lower from the recess to the charging door. —B. M. V.

Composite metal articles. British Thomson-Houston Co., Ltd., Assees. of C. Steenstrup. E.P. 158,565, 26.1.21. Conv., 26.1.20.

Two metal parts (*e.g.*, high-speed steel and carbon steel) are joined by a more fusible metal (*e.g.*, copper). The parts are heated in a reducing atmosphere and maintained in such close contact that the joining metal, applied, for example, in the form of wire or ribbon, is practically all used up in forming an alloy with the surfaces to be joined. The parts may be held together under great mechanical pressure and temporarily locally welded, so that the pressure will be maintained on removal of the clamp, before being permanently joined by means of the alloying metal. Composite articles constructed in this manner can be subjected to mechanical working and heat treatment as a whole.—B. M. V.

Metallic ores aid residues containing metallic oxides; Purification of ——. W. H. Dyson and L. Aitchison. E.P. 179,201, 28.10.20 and 27.7.21.

The process described in E.P. 176,428 and 176,729 (J., 1922, 332 A) is extended to cover the recovery of cobalt, manganese, copper, lead, zinc, etc., from their ores. Details of the temperatures necessary in these cases are given.—A. R. P.

[Copper-aluminium] alloys. I. Iytaka, and Mitsubishi Zosen Kaisha, Ltd. E.P. 179,261, 28.1.21.

Non-oxidisable alloys that retain their lustre up to 500° C. and do not corrode in air or sea water consist of 77—97% Cu, 2—11% Al, and 3—12% Sn, or 1—12% Zn, the zinc or tin being present in approximately the same proportion as the aluminium.—A. R. P.

[Iron-aluminium] alloys. The British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 179,306, 3.2.21.

An alloy that will withstand temperatures of 1200°—1500° C. for long periods without oxidation or scaling consists of 10—15% Al and at least 35% Fe and 30% Ni. Addition of chromium up to a maximum of 5% reduces the grain size and renders the metal harder and tougher.—A. R. P.

Osmium alloys. W. C. Heraeus G.m.b.H. G.P. 350,703, 22.6.19.

Hard alloys highly resistant to chemical action, and suitable for the manufacture of the points of gold pens, compasses, and prisms, contain at least 70% of osmium, another metal of the platinum group, especially iridium, platinum, or palladium, together with 1—10% of a third metal of the platinum group, especially rhodium or ruthenium. —L. A. C.

Zinc alloy. J. Zufall. G.P. 350,704, 4.4.19.

An alloy suitable for use as bearing metal and for the manufacture of ornaments, containing 84·1% Zn, 1·8% Cu, 1·0% Al, 4·9% Sn, and 8·2% Pb, is prepared by melting together 1 pt. of an alloy containing 11 pts. of zinc and 3 pts. of copper, 0·6 pt. of an alloy containing 8 pts. of zinc and 2 pts. of aluminium, 9 pts. of zinc, 0·6 pt. of tin, and 1 pt. of lead.—L. A. C.

Sulphide ores; Method of treating ——. C. J. Reed. U.S.P. 1,415,897, 16.5.22. Appl., 9.6.20.

The ore is heated under non-oxidising conditions to volatilise sulphur, then leached with sulphuric acid, and the metallic sulphate formed is finally converted into metal oxide and sulphur trioxide. —B. M. V.

Ores; Method of concentrating —— [by flotation] Concentration of ores. R. Luckenbach, Assr. to Luckenbach Processes, Inc. U.S.P. 1,417,261—3, 23.5.22. Appl., (A) 31.12.19, (B) 3.1.21, and (C) 13.1.21.

The pulp of finely divided ore and water is agitated with (A) the product of the reaction between a bitumen and an alkali and sufficient acid to render the pulp neutral, (B) the product of the reaction between an alkali and lac, or (C) an alkali and a liquid, normally unsaponifiable resin; and the resulting froth is separated.—A. R. P.

Aluminium; Composition of matter for and method of soldering and welding ——. P. de Clamecy, Assr. to B. F. Sturtevant Co. U.S.P. 1,415,925, 16.5.22. Appl., 8.7.19.

The solder consists of aluminium, tin, silver nitrate, and silver chloride.—B. M. V.

Aluminium; Soldering composition for ——. F. A. Albertus, Assr. to C. S. Flint. U.S.P. 1,416,924, 23.5.22. Appl., 3.12.19.

A solder for aluminium consists of relatively large proportions of tin and zinc, and relatively small proportions of aluminium, antimony, and phosphor-tin, the proportions of antimony and phosphor-tin being less than the proportion of aluminium. —J. S. G. T.

Copper; Method of and apparatus for recovering —— [from solutions of copper sulphate]. H. M. Wilcox, Assr. to F. C. L. D'Aix. U.S.P. 1,416,147, 16.5.22. Appl., 14.7.17.

Strong copper sulphate solution is continuously admitted to the bottom, and spent liquor removed from the top, of a precipitating tank, the precipitated copper being withdrawn from the bottom without stopping the operation.—B. M. V.

Copper; Process and apparatus for extracting —— from slag in reverberating furnaces. P. P. Butler and H. H. Stout, Assrs. to Phelps Dodge Corp. U.S.P. 1,416,262, 16.5.22. Appl., 7.7.19.

The slag is tapped from the smelting chamber of a reverberatory furnace into a second chamber where it is heated to a much higher temperature after addition of a "washing ore."—A. R. P.

Diamagnetic minerals; Process and apparatus for the concentration and separation of ——. W. C. Hall. U.S.P. 1,416,634, 16.5.22. Appl., 4.8.21.

The ground ore is passed through an intensified magnetic field formed between the pole of a stationary electromagnet and a movable magnetic roller, whereby the diamagnetic material in the ore is attracted and becomes attached to the roller. —A. R. P.

Metal or metals and other material [especially graphite]; Production of a mixture containing a ——. G. Ising and H. Borofski. G.P. 351,022, 2.6.20.

Material which does not form alloys with metals, *e.g.*, graphite, is added to a metal or mixture of metals in a semi-liquid, pasty condition, and the mixture is stirred or beaten until the metal content assumes a fine, granular condition, the temperature of the mixture being simultaneously lowered to a point at which the pasty condition is still maintained, but the metallic particles are harder than the added material. The mixture maintains its structure on subsequent treatment in presses or the like.—L. A. C.

Copper-plating metal parts; Process of manufacturing a solution for ——. W. Narr, sen. G.P. 351,251, 22.3.21.

A mass of pure copper or copper scrap is treated for 12—14 days with a solution containing 1¼ pt. of hydrochloric acid to 8¾ pts. of water. The resulting solution is especially suitable for copper-plating iron and steel goods, and the coating is more quickly produced and is more adherent than that afforded by the use of a copper sulphate solution. —J. S. G. T.

Electrolytic apparatus and method [for production of laminæ of electrolytic iron]. C. Dantsizen, Assr. to General Electric Co. U.S.P. 1,416,692, 23.5.22. Appl., 21.5.20.

See E.P. 179,675 of 1921; preceding.

Metallic surfaces; Coloration of ——. T. Rondelli and Q. Sestini, Assrs. to Sestron (Foreign Patents), Ltd. U.S.P. 1,417,413, 23.5.22. Appl., 30.6.20.

See E.P. 164,127 of 1920; J., 1921, 516 A.

See also pages (A) 501, *Gases containing sulphur dioxide* (U.S.P. 1,417,066—7). 503, *Granular slag* (U.S.P. 1,416,069). 507, *Electrolysis* (U.S.P. 1,416,929); *Preserving electric furnace linings* (U.S.P. 1,416,584); *Electrical heating element* (U.S.P. 1,416,436).

XI.—ELECTRO-CHEMISTRY.

Electrical precipitation in wood distillation. Hawley and Pier. *See* IIB.

Patents.

Electric conductors; Method of insulating ——. The British Thomson-Houston Co., Ltd. From The General Electric Co. E.P. 179,460, [illegible]7.21.

Electrical conductors covered with insulating fibrous material, *e.g.* cotton, are passed through a bath of insulating liquid, *e.g.* molten asphalt, maintained at a temperature sufficiently high to eliminate air and moisture from the covering, and then passed through a coagulable oil, preferably China wood (tung) oil, at a temperature high enough to coagulate the oil. The coated wire is finally passed through a finely-divided mineral material, *e.g.* powdered talc, and if desired through a die. Conductors so treated are substantially non-combustible under operating conditions. —J. S. G. T.

Insulating metal particles; **Method of** ——. G. W. Elmen, Assr. to Western Electric Co. U.S.P. 1,383,703, 5.7.21. Appl., 21.1.20.

Iron particles to be used in the manufacture of magnet cores are mixed with sufficient of an oxidising agent, such as water or a weak solution of hydrogen peroxide, to produce a black oxide on the surface, but not enough to convert the particles completely into oxide or to produce a coating of red oxide. The mixture is then heated and agitated in a container at a temperature below that at which the magnetic properties of the metal change, until the desired surface oxidation is effected. The process may also be applied to cobalt, nickel, and alloys.

Platinum anodes [*for electrolysis*]. Deutsche Gold u. Silber-Scheide-Anstalt vorm. Rössler, and O. Liebknecht. E.P. 179,636, 7.2.21.

In electrolytic processes in which active oxygen is evolved at the anode, zinc is used as a stiffening and current-conducting support for the platinum anodes employed. Thus, platinum net or foil may be clamped in a zinc frame or by zinc bars. —J. S. G. T.

Electrolysis; Art of ——. W. E. Bailey. U.S.P. 1,416,929, 23.5.22. Appl., 7.11.21.

The electrolyte flows past one electrode and impinges through a movable nozzle as a jet upon an article forming a second electrode of an electrolytic cell, the electrodes being connected with the appropriate poles of a source of current. Electrolytic action thus occurs at and near the point of impingement of the jet. The method is applicable to the electrodeposition of metals to form patterns or designs.—J. S. G. T.

Batteries; Depolariser for [*alkaline*] *primary* ——. R. C. Benner and H. F. French, Assrs. to National Carbon Co. U.S.P. 1,415,860, 16.5.22. Appl., 22.8.18.

A depolariser for alkaline cells consists of a mixture of cuprous oxide and sulphur.—J. S. G. T.

Storage battery; [*Mixture for use in*] *electric* ——. E. Hacking, Assr. to Electrol Mfg. Co. U.S.P. 1,416,195, 16.5.22. Appl., 30.4.18.

A mixture for use in storage batteries provided with lead plates, consists of sodium silicate, sulphuric acid solution, and a smaller proportion of a liquid hydrocarbon miscible with the other constituents and not oxidised by the acid.—J. S. G. T.

Battery construction. [*Electrolyte for alkaline battery.*] A. L. Muren. U.S.P. 1,416,738, 23.5.22. Appl., 11.1.19.

An alkaline battery electrolyte contains an alkali tungstate.—J. S. G. T.

Storage-battery separator. G. Steerup, Assr. to U.S. Light and Heat Corp. U.S.P. 1,416,761, 23.5.22. Appl., 11.8.19.

Electric current is passed through a mass of conducting material interspersed with non-conducting material and containing a substance which gasifies when the current passes, the whole mass being fused into a coherent block.—J. S. G. T.

Paste [*spongy lead for storage batteries*]; *Method of preparing* ——. C. C. Carpenter, Assr. to U.S. Light and Heat Corp. U.S.P. 1,416,787, 23.5.22. Appl., 19.4.20.

Spongy lead is ground to a definite fineness and treated with sulphuric acid in definite proportion to control the proportions of spongy lead and lead sulphate in the resulting product.—J. S. G. T.

Electric storage batteries; Process of making ——. H. M. Williams, Assr. to Electrol Mfg. Co. U.S.P. 1,417,007, 23.5.22. Appl., 19.8.20.

Lead plates used in storage batteries employing sulphuric acid in a solid filling medium as electrolyte are charged and discharged in a solution of sulphuric acid of customary specific gravity until the specific gravity of the acid in the pores of the plates is approximately 1·200. The free electrolyte is then replaced by a mixture containing, by volume, 1 pt. of liquid sodium silicate, 3 pts. of water, and 5 pts. of sulphuric acid of sp. gr. 1·400. The resulting electrolyte consists of sulphuric acid of sp. gr. approximately 1·200 contained in a gelatinous mass of colloidal silica.—J. S. G. T.

Crucible furnace; Three-phase [*electric*] ——. C. H. Carpenter, Assr. to Westinghouse Electric and Mfg. Co. U.S.P. 1,415,989, 16.5.22. Appl., 22.5.20.

The furnace chamber is surrounded by a resistor, and terminal electrodes are provided in a number of wells placed symmetrically around the chamber, and containing granular conducting material in contact with the resistor.—J. S. G. T.

Electric-furnace linings; Method of preserving ——. H. C. Sicard, Assr. to United States Ferro Alloys Corp. U.S.P. 1,416,584, 16.5.22. Appl., 12.2.20.

A mixture of titaniferous and metallic ores is smelted in a furnace provided with a titanic oxide lining.—J. S. G. T.

Heating element; Electrical ——. P. A. E. Armstrong. U.S.P. 1,416,436, 16.5.22. Appl., 1.5.19. Renewed 1.10.21.

An electrical heating element contains over 4% of chromium and over 0·1% of carbon, the remainder being principally iron.—J. S. G. T.

Ozone; Apparatus for producing ——. H. E. Ellis. U.S.P. 1,417,046, 23.5.22. Appl., 10.12.20.

An auxiliary vessel filled with water is disposed within an outer vessel by means of a flange engaging a flange on the latter. An electrode is disposed within the inner vessel, being suspended from a member extending across its upper end, this member also securing the two vessels together. An electrode is likewise provided in the space between the two vessels near the lower end thereof. Air to be ozonised is forced through the outer vessel. —J. S. G. T.

Electric furnace. H. de Nolly, Assr. to La Soc. Métallurgique du Frayol. U.S.P. 1,417,303, 23.5.22. Appl., 8.4.20.

See E.P. 157,051 of 1920; J., 1921, 225 A.

Electric furnace regulators. British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 179,595, 31.1.21.

See also pages (A) 491, *Electric classifier* (U.S.P. 1,416,089); *Electrical separation of suspended material* (U.S.P. 1,416,769 and G.P. 348,377). 502, *Percarbonates and perborates* (G.P. 350,986). 516, *Fodder from straw* (G.P. 351,051).

XII.—FATS; OILS; WAXES.

Corn (maize) oils, obtained by expression and benzol extraction methods; Comparison of ——. A. F. Sievers. Bull. No. 1054, U.S. Dept. of Agric., 11.3.22. 20 pp.

A review of previous investigations on maize oil is given, with a table of physical and chemical constants. The material used was obtained from typical plants making hominy and glucose, the former producing dry-process germs and the latter wet-process germs. The extraction of both germs and oil cake was undertaken. The benzol extraction was carried out by treating 50lb. of ground germs or oil cake in a galvanised iron can with a false bottom. The benzol used distilled completely at 85° C. 90% of the benzol was removed by heating on a steam bath under a partial vacuum, the last portions by passing a current of dry steam into the mixture under reduced pressure. Considerable difficulty was caused by the foaming of the oil during the removal of the solvent. This was most troublesome in the case of the dry-process germs, and is ascribed to the presence of starchy matter. The oils from the dry-process material were somewhat lighter in colour than the other oils, and uniformly lower in free fatty acids. There was no difference between the free fatty acidity of the extracted oil and expressed oil from the dry-process germs. In the case of the oils from the wet-process germs the extracted oils contained more free fatty acids than the expressed oil. All the oils were refined in the same manner with the exception of the extracted oil from the dry-process germ-cake, which required a greater quantity of sodium hydroxide owing to sediment, and all were deodorised by treatment with steam at 225° C. for 2 hrs., under 25 in. vacuum. The expressed oils showed the lowest refining loss. There were no striking differences in the physical and chemical constants of the oils from the two types of germs by the two different methods of extraction. No material difference could be noted in the finished oils from the germs immediately after their preparation, but upon standing some deterioration took place, and this was more noticeable in the extracted oils than in the expressed oils. All oils were sufficiently light in colour for use as salad oils and for cooking purposes. The oils obtained by benzol extraction of the two types of oil-cake were inferior in all respects to the oils from the germs, that from the cake from the wet-process germs being the poorer of the two. —H. C. R.

Liver oil of the tope. A. C. Chapman. Analyst, 1922, 47, 203—204.

Oil obtained from the livers of tope (*Galeus galeus*) has the following characters: Sp. gr. at 15°/15° C., 0·9249; iodine value (Wijs), 152·2; saponif. value, 185·1; n_D^{15} =1·4803; unsaponif. matter, 1·14%; brominated glycerides insoluble in ether, 42·5%. The oil has a pale yellow colour and is used for the dressing of leather and for medicinal purposes. —W. P. S.

Food [fat] analysis; Use of semi-microchemical and microchemical methods in ——. H. Lührig. Pharm. Zentralh., 1922, 63, 218—221, 227—232.

Methods are described for determining various analytical constants of fats and oils, very small quantities of the substance being used for the purpose; *e.g.*, the Reichert-Meissl value is determined on 0·5 g. of fat, the saponif. value on 0·1 g., and the iodine value on 0·03 g. The Polenske value is obtained on the quantity of fat used for the Reichert-Meissl value.—W. P. S.

Fatty acids of rape oil. E. Raymond. Bull. Soc. Chim., 1922, 31, 414—419.

In the mixture of fatty acids obtained by the saponification of a sample of Indian rape oil the author has identified the following fatty acids: erucic acid, linolic or linolenic acids giving soluble bromides, palmitic, oleic, and stearic acids, and small amounts of linolic or linolenic acids giving insoluble bromides.—W. G.

Sativic acid. E. Reinger. Ber. deuts. Pharm. Ges., 1922, 32, 124—131.

The progressive elimination of hydroxyl groups from sativic acid (tetrahydroxystearic acid) prepared by the oxidation of linolic acid was effected by heating the acid with 60% sulphuric acid, whereby 1 mol. of water was eliminated, the unsaturated acid $C_{18}H_{34}O_5$ produced being then converted by hydrogenation into a trihydroxystearic acid. By repeating the operation with this acid a dihydroxy unsaturated acid, $C_{18}H_{34}O_4$, and finally a dihydroxystearic acid were obtained from which a monohydroxy unsaturated acid and finally 12-monohydroxystearic acid were prepared. The constitution of each of the unsaturated acids was determined by an examination of their oxidation products, and that assigned by Eckert (J., 1917, 892), to the original sativic acid was confirmed, namely, $CH_3.(CH_2)_4.[CH(OH)]_2.CH_2.[CH(OH)]_2.(CH_2)_7.CO_2H$. The position of the double bonds in linolic acid follows accordingly. (*Cf.* J.C.S., 1922, i., 623.) —G. F. M.

Soaps; Spontaneous heating of ——. A. Welter. Chem. Umschau, 1922, 29, 151—152.

Powdered or flaked soaps with a low water content prepared wholly or partly from drying or semi-drying oils, show a tendency to rise in temperature. Differences in temperature of 20°—30° C. have been observed between the exterior and interior of quantities of soap flakes stored in wooden chests after passage through the drying machines in the case of soaps prepared from unsaturated fatty acids, whereas there is no difference in temperature when saturated fatty acids have been employed. The zinc oxide often added to the soap to render it opaque and to improve its appearance exerts an anti-catalytic action, and diminishes the rise in temperature. Pure olive oil yields soaps with no tendency to rise in temperature, but cottonseed oil and other semi-drying oils often used to adulterate olive oil have the effect of inducing this tendency in soap prepared from adulterated oil. The author cites a case in which a pile of 500—600 kg. of cold, dry powdered soap prepared from cottonseed oil developed such a rapid rise in temperature that in ½ hr. it was reduced to a black coke-like mass. —L. A. C.

Enzymic synthesis of fat. Spiegel. *See* XVIII.

Patents.

Oils and fats from oily and fatty substances; Process of squeezing —— and device for working such process. O. A. Fankhauser. E.P. 158,844, 2.2.21. Conv., 3.2.20.

The substance, a fluid mass of, *e.g.*, cocoa, is fed continuously under high hydraulic pressure into one end of a filter chamber, the oil or fat is expelled through the filter, and the spent material is expelled from the other end of the chamber by the same hydraulic pressure. The filter is formed of small wooden blocks, with the fibres disposed radially, mounted around a hollow piston provided with radial holes, the inner surface of the blocks being formed with annular and longitudinal grooves. The piston is moved to close the outlet end of the chamber during the expulsion of the oil etc., and to open the outlet for the expulsion of the spent material.—H. H.

Cholesterol materials, such as wool-fat; Treatment of crude ——. F. G. Conyers, O. Reynard, and Lanoline Extractors, Ltd. E.P. 179,241, 22.1.21.

The crude material is agitated in direct contact with nitric acid, *e.g.*, of sp. gr. 1·20—1·50, at a temperature of, *e.g.*, 60° to 120° C., until no further reaction occurs and all the water has been expelled, and the product is washed and cooled. The products are neutral, and vary in character from a hard wax-like substance to a highly viscous elastic substance. They may be used for leather-dressing, waterproofing, etc.—H. H.

Soya bean; Process for preparing odourless and colourless oil and flour from ——. Y. Yamamoto and I. Mizusawa. E.P. 179,776, 1.4.21.

The raw bean, coarsely broken and deprived of its bran, it steeped in a weak solution of an organic acid, such as acetic acid, to remove the substances to which the odour and colour are due. The beans bran, is steeped in a weak solution of an organic are then washed free from acid and dried, the oil is extracted, and flour is manufactured from the residue. The acid solution may be warmed slightly, and the washed beans may be treated with a dilue solution of sodium bicarbonate to neutralise any remaining acid. The pulverised bean, after the oil has been extracted, may be warmed with steam to a temperature below the coagulating temperature of the albumin contained in it.—H. C. R.

Edible fatty product from fixed oils and fats and process of manufacturing same. E. Klein. U.S.P. 1,381,564, 14.6.21. Appl., 5.11.18.

Crude cottonseed oil, maize oil, or the like, after treatment with steam and heated air to remove volatile impurities and destroy enzymes, is treated with sodium bisulphite and hydrosulphite together with steam and sterilised air, then treated with alkali, decanted, filtered, and treated with cold sterilised air to separate higher-melting fat and obtain a "winter oil," or until the mass forms an edible fat of solidif. pt. -10° to 15° C. The product should give no blue colour when 10 g. of the melted fat is shaken with 4—5 drops of a 3% solution of hæmoglobin, 10 drops of guaiacum tincture, and 10 c.c. of saturated salt solution.

Fats and oils; Process for separating fatty acids, resins, bitter and mucilaginous substances from ——. H. Bollmann. G.P. 350,698, 31.8.20. Addn. to 345,350 (*cf.* E.P. 164,115; J., 1921, 519 A).

Fat or oil is fed into one side of a vessel provided with division plates and packed with, *e.g.*, Raschig rings, and is treated therein with a counter-current of a purifying liquid, such as a mixture of water with methyl, ethyl, or amyl alcohol, or acetone, or ethyl acetate, which enters the apparatus at the opposite side. One half of the vessel thus contains a high proportion of the solvent, and the other of the fat, while the intimate contact effected between the fat and solvent causes complete removal of impurities without emulsification.—L. A. C.

Catalysts for hydrogenation. G.P. 346,949. *See* XX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Sublimed white lead; Graphic analysis of ——. B. Paxton. Chem. and Met. Eng., 1922, **26**, 989.

Zinc oxide is determined by boiling 1 g. of the pigment with 6 c.c. of hydrochloric acid, 5 g. of ammonium chloride, and 30 c.c. of water, diluting the solution to 250 c.c. with hot water, adding a little sodium sulphite, and titrating with ferrocyanide, using ammonium molybdate as outside indicator. Lead is determined by boiling 1 g. of the pigment with acid ammonium acetate, diluting the solution to 200 c.c., and titrating with ammonium molybdate. A chart is constructed, by which, from the percentages of zinc oxide and metallic lead, the content of lead sulphate and lead oxide may be ascertained without determining the sulphur trioxide present, assuming that the sum of the zinc oxide, lead oxide, and lead sulphate is 99·7%.—A. R. P.

Resins; Constituents of ——. *VIII. Amyrins from elemi resin. II. α-Amyrin.* A. Zinke, A. Friedrich, O. Johannsen, and R. Richter. Monatsh., 1921, 42, 439—445. (*Cf.* J., 1921, 19 A.)

α-Amyrin benzoate when distilled gives a hydrocarbon, α-amyrene, $C_{30}H_{48}$, which forms a crystalline dibromide, m.p. 259°—260° C. When oxidised with chromic acid, α-amyrin forms a ketone, $C_{30}H_{48}O$, which with benzoyl chloride forms the benzoate of the corresponding enolic compound, α-amyrenol. Bromo-α-amyrin behaves in a similar manner. (*Cf.* J.C.S., 1922, i., 667.)—E. H. R.

Resins; Constituents of ——. *IX. Decomposition of d-siaresinolic acid and lubanyl benzoate.* A. Zinke, F. Hanselmayer, and W. Ehmer. Monatsh., 1921, 42, 447—452.

By oxidation of *d*-siaresinolic acid (*cf.* J., 1919, 187 A) or of its decomposition product, *l*-prabangic acid, $C_{27}H_{40}O_4$, a new crystalline dibasic acid, $C_{21}H_{30}O_5$, was obtained, m.p. 285°—286° C. (decomp.). The formula suggested for lubanyl benzoate by Zinke and Dzrimal (J., 1921, 153 A) has been confirmed by fusion of the benzoate with potassium hydroxide, when protocatechuic acid is formed.—E. H. R.

Patents.

Zinc white [zinc sulphide]; Manufacture of ——. C. Clerc and A. Nihoul. E.P. 157,860, 10.1.21. Conv., 15.11.19.

Precipitated zinc carbonate or zinc oxide obtained from it by treatment with a caustic alkali is suspended in a solution of a zinc salt or of a small proportion of acid, *e.g.*, hydrochloric acid. Hydrogen sulphide is introduced and converts the dissolved zinc salt into zinc sulphide; the liberated acid continuously forms a further quantity of dissolved salt until conversion into sulphide is complete. The product is free from polysulphide and oxysulphide.—D. F. T.

Carbon [black] and similar materials; Process for solidifying ——. C. J. Randall, Assr. to The Goodyear's Metallic Rubber Shoe Co. U.S.P. 1,384,089, 12.7.21. Appl., 30.7.20.

Carbon black or other very finely divided material is placed in a bag of pervious material, the bag is immersed in water in a closed container, air is exhausted from the container, and then gas under pressure is admitted to compact the carbon, thus making it more suitable for transportation and handling.

Carbon [lampblack]; Process for refining crude ——. C. F. C. Herting. U.S.P. 1,416,955, 23.5.22. Appl., 4.10.21.

Crude lampblack is boiled in an alkaline liquid, and the product heated with sulphuric acid until it thickens to a paste, when it is added to a saline solution.—H. R. D.

Plastic materials; Manufacture of ——. W. Petersen and E. V. Clark. E.P. 179,586, 11.1.21.

The initial liquid condensation product of phenol and formaldehyde is mixed with commercial lactic acid of 50—60% concentration, *e.g.*, in the proportions 80:45 by weight, and heated at 100°—110° C. until condensation has proceeded so far that the product no longer adheres firmly to a clean metallic surface. In this condition at 16° C. it forms a very viscous syrup and with filling materials such as

asbestos, wood flour, or china clay, gives mixtures suitable for the production of moulded articles which can be hardened subsequently by baking.
—D. F. T.

Condensation products of benzene derivatives halogenated in the side chain and aromatic hydroxy compounds; Preparation of ——. Kalle und Co. A.-G. G.P. 346,384, 10.5.17.

Oily products, suitable for softening leather and for the preparation of wood stains, or hard resinous products, suitable for use as substitutes for natural acid resins, *e.g.*, in sizing paper, are prepared by treating benzene derivatives halogenated in the side chain with phenols, naphthols, or their derivatives, in the absence of catalysts, until evolution of hydrogen chloride ceases. Benzyl chloride yields oily products with phenol and α- and β-naphthol, while benzyl chloride or xylyl chloride and salicylic acid yield viscous products which harden on standing.—L. A. C.

Coumarone resin and process of making same. L. Rabinovitz, Assr. to Ellis-Foster Co. U.S.P. 1,416,062, 16.5.22. Appl., 12.8.19.

A hard coumarone resin with an iodine value below 50 is made by polymerising the coumarone contained in solvent naphtha by sulphuric acid of 66° B. (sp. gr. 1·84) in the absence of substantial quantities of more dilute acid, agitating the mass thoroughly and then hardening the resin by heating it to about 180° C. in a high vacuum.—A. B. S.

Inks, printing colours, and the like; Manufacture of a binding agent for —— from solutions of glycerin pitch. Chem. Fabr. Plagwitz-Zerbst, G.m.b.H., and J. von Bosse. G.P. 345,141, 30.5.20.

Impurities such as dissolved colloidal substances are precipitated from solutions of glycerin pitch by the addition of salts of heavy metals and/or compounds of the alkaline-earth metals.—L. A. C.

Lime; Production of adherent —— for paints. O. Mielcke. G.P. 346,825, 17.4.20.

Quicklime is slaked by treatment with an alkaline solution, *e.g.*, waste liquor containing alkali hydroxide from the manufacture of soda-cellulose, and after or during the slaking, alum or sodium chloride, and pigments are added.—L. A. C.

Paint; Manufacture of —— for ships' bottoms. E. Arié. G.P. 346,898, 18.2.16.

About 5% of the alkali salts of coconut oil fatty acids, or other saturated monobasic fatty acids of the series C_4 to C_{14}, is added, *e.g.*, to melted colophonium.—L. A. C.

Paint; Water-resistant ——. Manufacture of a binder for coloured carbolineum paint. Plönnis und Co. G.P. (A) 347,707, 11.8.20, and (B) 348,166, 29.5.21. (A) Addn. to 301,783 (J., 1921, 311 A).

(A) The stability and covering power of the paint described in the chief patent are improved by the addition of sulphite-cellulose waste liquor. (B) A mixture of carbolineum with alkalis and water-glass (potassium or sodium silicate, or double water-glass) is employed as a paint, either alone or after the addition of dry colours or other materials.
—L. A. C.

Drying oils, lacquers, varnishes, anti-rust coatings, lubricating oils, etc.; Production of a substitute for ——. W. O. F. Schilsky. G.P. 349,926, 14.7.17. Addn. to 348,087 (J., 1922, 382 A).

Furfural, or a derivative or homologue, is heated under pressure with metal compounds capable of yielding oxygen.—L. A. C.

Lacquers; Manufacture of flexible —— from nitrocellulose. L. Bing and A. Hildesheimer. G.P. 350,973, 17.1.19.

Mono- or diglyceryl esters of non-drying oils, such as the monoglyceryl esters of castor oil or rape oil fatty acids, or the diglyceryl esters of the fatty acids of marine animal oils, are added to solutions of nitrocellulose for use as lacquers.—L. A. C.

Lacquers; Production of flexible —— from cellulose esters. F. Medicus. G.P. 351,228, 14.12.17.

Cinnamic acid esters, *e.g.*, the amyl ester, are added to cellulose esters either before or after solution, yielding flexible, elastic lacquers.—L. A. C.

Resin oils; Preparation of products resembling ——. F. Sichel, Komm.-Ges., and E. Stern. G.P. 351,003, 5.4.21.

Anhydrous zinc chloride is added to resin before or during distillation, or 2—6% of zinc chloride is added to molten resin at a temperature of at least 180° C. The oily products obtained have a saponif. value of 50—40, and are suitable for use in the manufacture of printing colours, lubricating oils, and substitutes for linseed oil.—L. A. C.

Pigment; White ——. H. R. Rafsky. U.S.P. 1,415,391, 9.5.22. Appl., 29.3.16. Renewed 2.6.21.

See E.P. 178,896 of 1921; J., 1922, 474 A.

Sulphurs and vermilions of antimony; Manufacture of gold-coloured ——. P. Chaillaux. U.S.P. 1,417,033, 23.5.22. Appl., 23.6.20.

See E.P. 151,422 of 1919; J., 1920, 756 A.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

[*Rubber;*] *Sodium silicofluoride as a mould preventive* [*for* ——]. H. P. Stevens. Bull. Rubber Growers' Assoc., 1922, 4, 227—228.

The addition of 0·06% of sodium silicofluoride to standardised latex should be sufficient to inhibit mould growth in the finished smoked sheet rubber. Samples produced in this way were satisfactory, the tensile strength after vulcanisation being good and the rate of vulcanisation slightly less than the average for smoked sheet rubber.—D. F. T.

[*Rubber*] *manufacture; Use of* [*sodium*] *bisulphite in sheet ——.* H. P. Stevens. Bull. Rubber Growers' Assoc., 1922, 4, 228—229.

Latex treated with a small quantity of sodium bisulphite yields sheet rubber with an attractive glossy appearance; otherwise bisulphite is unnecessary and indeed the resulting sheet rubber may dry exceptionally slowly. With the addition of 0·1% and 0·2% of sodium bisulphite to latex, the resulting sheets needed smoking for 18 days; the rate of vulcanisation was somewhat reduced, but the tensile strength of the vulcanised product was satisfactory.—D. F. T.

Patents.

Rubber; Treatment of raw ——. S. C. Davidson. E.P. 179,622, 5.2.21.

Rubber coagulum is freed from much of its water by kneading between three rolls. It is then further dehydrated by wrapping the block of rubber tightly, whilst it is still in position between the rolls, in a piece of webbing. This prevents the retraction of the rubber and causes the remaining water to ooze out slowly.—D. F. T.

Rubber substitute, and process for producing same. Western Rubber Co., Assees. of H. H. Hazeltine and M. Gregory. E.P. 157,836, 10.1.21. Conv., 16.3.18.

See U.S.P. 1,360,744 of 1920; J., 1921, 52 A.

XV.—LEATHER; BONE; HORN; GLUE.

Chrome tanning. IX. Relation between the properties of chrome liquors and the leather they produce. D. Burton. J. Soc. Leather Trades Chem., 1922, 6, 157—180.

The effect of the nature of the chrome liquor on the properties of the leather produced is complicated by several factors. The time elapsing between flaying and soaking of the hide should not be prolonged. The preparation of the pelt for the tanning liquor influences the feel of the resulting leather. The initial basicity figure, age, temperature, rate of increase in strength, and the rate of neutralisation of the liquor are important in chrome tanning. The basicity does not always indicate the hydrion concentration of the liquor, which should be controlled. The acidity of the liquor affects the boiling test of the leather and is altered by the presence of neutral salts. The leather is improved by "ageing." It should not be over-neutralised. The feel rather than the absence of shrinkage of the neutralised leather under the boiling test should be used as the criterion of complete tannage. The properties of any sample of leather depend on the condition of the fibre at the moment of fixation by the chromium, the nature of the salt on the fibre and the kind of combination with the pelt, and the mechanical treatment used for softening the leather. There are probably three reactions taking place during chrome tanning, viz., absorption of the liquor by the pelt; chemical combination of the pelt with the free acid; the removal of free acid leads to further hydrolysis, so that the basic chromium salt becomes insoluble in water and is deposited on the fibres. If the chromium compound is negatively charged, due to the adsorption of SO_4 ions which are in excess in the liquor between the fibres, there will be coprecipitation with the positively charged pelt, and chrome tanning will be subject to the same laws as those governing the process of vegetable tanning. A complete bibliography of chrome tanning is appended.—D. W.

Protective agent for animal fibres. Edge. *See* V.

Ultra-violet light in analysis. Kitching. *See* XXIII.

Patent.

Hides; Process of deliming ——. W. Savage. U.S.P. 1,382,124, 21.6.21. Appl., 26.4.19.

Depilated hides are subjected to the action of a paste made from an earth capable of adsorbing bases, preferably fuller's earth. Zeolites may be used in place of fuller's earth, but in that case, after removing the paste, the hides must be washed to remove soluble alkali soaps formed by base exchange with the zeolite.

XVI.—SOILS; FERTILISERS.

Soils; Classification of —— on the basis of mechanical analysis. C. L. Whittles. J. Agric. Sci., 1922, 12, 166—181.

A discussion of various methods of classifying soils on the basis of their mechanical composition. The author proposes a graphical method of classification by means of triangular co-ordinates in which the three variables are the fine gravel + coarse sand, the fine sand + silt, and the fine silt + clay. The application of this method to the correlation of mechanical composition and agricultural properties is shown by actual examples. A very full bibliography of the subject of soil classification is appended.—G. W. R.

Sulphates in soil; Factors influencing the determination of ——. C. T. Hirst and J. E. Greaves. Soil Sci., 1922, 13, 231—249.

The chromate volumetric method of estimating sulphates was compared with the gravimetric barium sulphate method, and was shown to be far less inaccurate than is generally supposed. The average recovery of sulphates by the chromate method was found to be 97% of that by the gravimetric method, and where very small quantities were to be estimated the former was found to be the better method. The whole of the sulphate was removed from soil by a 1:5 water extraction after shaking for 40 mins., except where excessive amounts of gypsum were present. The extracts should be cleared by means of a Pasteur-Chamberland filter or by centrifuging. The sulphates were precipitated by excess of a hydrochloric acid solution of barium chromate. The solution was maintained practically at boiling temperature for 30 mins., whereupon the excess of barium chromate was precipitated by the addition of ammonia. After cooling the liquid was made up to standard volume, and allowed to settle and a portion withdrawn for the volumetric determination of the remaining chromate. The presence of nitrates and of salts of iron and aluminium if in considerable quantity tends to produce irregular results.—A. G. P.

Soil; Influence of moisture and soluble salts on the bacterial activities of the ——. J. E. Greaves and E. G. Carter. Soil Sci., 1922, 13, 251—270.

Soil was treated with various salts and the relationships between moisture content and ammonifying and nitrifying powers were determined. The moisture content corresponding to maximum ammonifying power varied with the nature of the salt used. The relative toxicity of sodium chloride, and of the carbonates of sodium, potassium, and calcium decreased as the water content increased. With all other salts used the reverse was the case, indicating that with the latter, other factors than osmotic pressure governed the toxicity. The toxicity of salts towards nitrifying organisms decreased with increasing water content. Optimum moisture content for nitrification was in general a little lower than that for ammonification. (*Cf.* J., 1921, 20 A.)—A. G. P.

Bacteriological activities in soil; Effect of tree products on ——. I. Ammonification and nitrification. W. M. Gibbs and C. H. Werkman. Soil Sci., 1922, 13, 303—322.

Soils were treated with ground sawdust, pine cones and needles, etc., and the effects on ammonification and nitrification studied. All substances examined were injurious to the organisms concerned. The addition of chalk did not destroy the toxicity, although it improved nitrification. Cedar sawdust, followed by maple, larch, ash, and red fir, proved the most inhibitive materials. The miscellaneous débris forming the "forest floor" also reduced formation of ammonia and nitrate in soils. The depression of nitrate accumulation was due to actual toxicity towards the organisms concerned, and was not the result of increased denitrification. —A. G. P.

Nodule formation of soya-beans; Effect of different reactions on the growth and ——. O. C. Bryan. Soil Sci., 1922, 13, 271—302.

Soya-bean plants were grown in sand and solution cultures which were adjusted to various hydrogen

ion concentrations and inoculated with suspensions of nodule bacteria. Shive's solution (Physiol. Res., 1, 327) was suitable for sand but not for solution cultures. Crone's nutrient solution (12 g. of a mixture of KCl 100, $CaSO_4,2H_2O$ 25, $MgSO_4,7H_2O$ 25, $Ca_3(PO_4)_2$ 25, and $FePO_4$ 25 pts. to 8 l. of water) was the more favourable for both sets of experiments. The most favourable reaction for growth and inoculation of soya-beans was p_H 6·5. The limits for inoculation were p_H 4·6—8, and for the growth of the plants p_H 3·9—9·6. Injurious p_H values were within those of very acid soils. Different strains of soya-bean bacteria showed small differences in critical H-ion concentration. The reaction of nutrient solutions in contact with growing plants did not remain constant except when they were initially at the optimum figure. The rate of change of reaction was greater in the alkaline range than in the acid range, and was influenced by the rate of growth of the plant. Maize tolerated greater extremes of reaction than the soya-bean or cowpea, while the last-named showed a greater range of reaction at which nodules formed than the soya-bean. The reaction of plant juices varied with that of the nutrient medium, except the juice of maize leaves, which showed little variation. Root juices followed changes in the nutrient solution reaction more closely than did leaf juices.
—A. G. P.

Phosphates; Citric solubility of mineral ——. J. F. Tocher. J. Agric. Sci., 1922, **12**, 125—143.

The citric solubility of mineral phosphates and slags is dependent on the relative amount of slag or phosphate used, the amount of citric acid used, and the volume of extracting liquid. As a test of the agricultural value of a phosphatic material, citric solubility is unreliable, and the only standard tests to be accepted are total phosphate, fineness of grinding, and freedom from injurious substances. (*Cf.* J.C.S., July.)—G. W. R.

Selenium, sulphur, and tellurium salts; Action of —— *on plants.* B. Turina. Biochem. Zeits., 1922, **129**, 507—533.

The author has examined the action of selenites, selenates, sulphites, sulphates, tellurites, and tellurates on the germination of plants and on the mature plant. From the deposition of selenium and tellurium by reduction in the tissues it is concluded that neither selenium nor tellurium salts enter the system in appreciable quantity, *via* the root hairs, but that the root cap plays the important function of point of entry and of filtration of nutritive salts.—H. K.

Patents.

Mixed fertiliser; Preparation of a stable ——. Badische Anilin- und Soda-Fabrik. G.P. 351,130, 27.3.17.

Superphosphate is mixed with ammonium nitrate and a basic substance, such as ammonium carbonate. The mixture is a fine powder which is not hygroscopic.—A. R. P.

Fertiliser dryer. P. J. Hamler. Reissue 15,362, 23.5.22, of U.S.P. 1,321,628, 11.11.19. Appl., 14.2.21.

See E.P. 143,846 of 1920; J., 1921, 190 A.

Fungicide. G.P. 349,870—1. *See* XIXb.

XVII.—SUGARS; STARCHES; GUMS.

Nipa-sugar manufacture; Recent improvements in ——. A. H. Wells and G. A. Perkins. Philippine J. Sci., 1922, **20**, 45—56.

The rapid disappearance of crystallisable sugar from the juice or *tuba* of the nipa palm is due in part to enzymes, but without the help of micro-organisms they are not very effective. This fermentation can be largely checked if the tuba is collected in clean receptacles which have been disinfected with lime. This, however, does not retard the conversion of the sugar by inversion into a non-crystallisable mixture of dextrose and lævulose. Preservation of the syrup with toluene was tried on a small scale, and also found to be effective. A very heavy liming of the receptacles with milk of lime containing 600 g. per litre was found very effective in preventing both fermentation and inversion, but was, however, not practicable owing to the accumulation of lime on the receptacles, the formation of calcium saccharate, and other reasons. If only a thin lime cream is used the top layers of tuba become acid and ferment, but this difficulty can be overcome by leading the juice, as it drips from the tree, to the bottom of the receptacle by means of a funnel, and the lime required is thereby reduced to a very small amount.
—G. F. M.

Starch; Determination of the technically recoverable —— *in starch-pulp.* E. Parow. Z. Spiritusind., 1922, **45**, 149.

Estimations of the technically recoverable starch in twelve samples of starch-pulp gave very variable results by the methods usually employed for the purpose, *i.e.*, Klopf's method, the usual washing method, washing with air agitation, total starch by Reinke's method, polarisation, and washing with ammonia. The moisture in six samples each of moist and dry pulp varied from 43·1 to 53·4% and from 13·48 to 15·29% respectively. Polarimetric estimations gave the most consistent results compared with the total starch in the dried samples, as estimated by the Märcker-Delbrück method, except in the case of three dark-coloured samples in which a preliminary decolorisation by treatment with charcoal was necessary before polarimetric readings could be taken. None of the methods gives consistently reliable results.
—L. A. C.

Starch; Dakamballi ——. J. A. Goodson. Analyst, 1922, **47**, 205—206.

This starch is prepared in British Guiana from the fruit of the tree *Aldina insignis*. The powder has a pale brown colour, and consists of granules varying from 11 to 42 μ in diameter. The small granules are mostly circular and the larger roughly ovate in form; the hilum is at the larger end, and the concentric rings are well marked.—W. P. S.

Starch. V. Methyl and acetyl derivatives of the "polyamyloses." H. Pringsheim and W. Persch. Ber., 1922, **55**, 1425—1433.

Octamethyltetra-amylose, in which the third hydroxy group is highly resistant towards methylation, is converted by acetic anhydride and pyridine into octamethyltetra-amylose tetra-acetate, $[\alpha]_D^{20} = +118{\cdot}62^{\circ}$ in ethyl alcohol. Diamylose resembles tetra-amylose in that it is transformed by successive treatment with methyl sulphate and sodium hydroxide and with methyl iodide and silver oxide into tetramethyldiamylose, $[\alpha]_D^{20} = +143{\cdot}74^{\circ}$ in ethyl alcoholic solution. Attempts to methylate the third hydroxy group were unsuccessful. The behaviour of the polyamyloses of the β-series towards methylation is peculiar. With hexa-amylose, reducing action towards Fehling's solution is observed after a single treatment with sodium hydroxide and methyl sulphate. With triamylose the phenomenon is noticeable only after the first treatment with methyl iodide and silver oxide, and becomes more marked after a second treatment with the same reagents. If the "slime" obtained by the degradation of starch with *B. macerans* be treated with pyridine and acetic anhydride, dodeka-α-acetylhexa-amylose, $[\alpha]_D^{20} = +95{\cdot}77°$ in glacial acetic acid solution, is obtained. It is reconverted by alcoholic potassium hydroxide solution into the initial material, which is thus charactertised as α-hexa-amylose. (*Cf.* J.C.S., 1922, i., 632.)—H. W.

Starch. VI. Polyamyloses. H. Pringsheim and D. Dernikos. Ber., 1922, 55, 1433—1445.

α-Tetra-amylose is converted by acetic anhydride and pyridine into α-tetra-amylose dodeka-acetate, $[C_6H_7O_2(OC_2H_3O)_3]_4$, $[\alpha]_D^{18} = +115{\cdot}8°$ in glacial acetic acid solution, which is re-converted by alcoholic potassium hydroxide solution into α-tetra-amylose. Possibly by reason of necessarily more drastic experimental conditions, β-hexa-amylose is depolymerised by acetic anhydride and pyridine and converted into the same triamylose monoacetate as is obtained by acetylation in the presence of zinc chloride. Arguments are brought forward against Karrer's view of the identity of triamylose and β-hexa-amylose (J., 1922, 304 A). (*Cf.* J.C.S., 1922, i., 632.)—H. W.

Starch. VII. Relationship of the α- and β-polysubstance of the starch granule. H. Pringsheim and K. Goldstein. Ber., 1922, 55, 1446—1449.

It has been shown by Samec and his co-workers (J., 1921, 272 A) that starch can be separated by electrodialysis into erythroamyloses and amyloamyloses. The close relationship of these substances to the β- and α-polyamyloses is illustrated by the colorations which they give with iodine and the readiness with which additive compounds are produced with this halogen, by the relative specific rotations, and by the ratio of the molecular weights. In the fermentation of the amylopectins and amyloses by *B. macerans* β-polyamyloses are obtained in larger yield from the erythro-, and α-polyamyloses from the amylo-amyloses. (*Cf.* J.C.S., 1922, i., 633.)—H. W.

Inulin. II. Inulin and glycogen. H. Pringsheim and M. Lassmann. Ber., 1922, 55, 1409—1414.

Re-determinations of the molecular weight of inulin acetate dissolved in glacial acetic acid by the method of Barger (Trans. Chem. Soc., 1904, 85, 286) as modified by Rast (Ber., 1921, 54, 1979) have confirmed previous measurements (*cf.* J., 1921, 523 A), but the process cannot be applied in the cases of the acetates of glycogen or soluble starch. The method does not appear to be practicable for the determination of molecular weights exceeding 3000. Glycogen is transformed by acetic anhydride in the presence of pyridine into its acetate, $C_{12}H_{16}O_8$, m.p. (indefinite) 165° C., $[\alpha]_D^{18} = +159{\cdot}6°$ when dissolved in pyridine. Soluble starch likewise yields an acetate, which differs from that of glycogen, whereas the substances give the same product when methylated (Karrer, J., 1922, 27 A). The possibility that the differing behaviour of glycogen and starch towards iodine is attributable to the presence of impurities (*loc. cit.*) is greatly discounted by the observation that the substances obtained by the de-acetylation of glycogen and starch acetates give the same colorations as the initial materials.—H. W.

Inulin. III. H. Pringsheim and A. Aronowsky. Ber., 1922, 55, 1414—1425.

Attempts to confirm the identity of inulin regenerated from its acetate with natural inulin by fermentative hydrolyses with *Penicillium glaucum* show that the behaviour of the ferment depends greatly on its mode of culture. A specimen nourished with glucose did not hydrolyse inulin, whereas a similar specimen nourished with inulin was active towards the latter only and one nourished with de-acetylated inulin acetate hydrolysed natural and artificial inulins. Inulin (1 pt.) is converted by glacial acetic acid (2 pts.) and acetic anhydride (2 pts.) into an inulin acetate which could not be caused to solidify but was transformed by sodium ethoxide in the presence of absolute alcohol into trifructose-sodium, $(C_6H_{10}O_5)_3$,NaOH. Trifructose could not be isolated in substance, nor could other derivatives of it be prepared. It appears therefore that inulin in the solid condition and in its colloidal solution is the product of a trebly polymerised anhydrotrifructose. Inulin-sodium has the composition $(C_6H_{10}O_5)_3$,NaOH, whether obtained by precipitating a solution of inulin in sodium hydroxide (10%) by alcohol or by the hydrolysis of inulin acetate with sodium ethoxide. It is, however, pointed out that the first method for the preparation of the additive compounds of polysaccharide and sodium hydroxide is unreliable; the sodium content depends entirely on the concentration of the sodium hydroxide solution from which they are precipitated by alcohol, or on the quantity of water with which they are treated for the removal of adherent sodium hydroxide. (*Cf.* J.C.S., 1922, i., 635.)—H. W.

Patent.

Corn [maize] starch; Manufacture of —— and products therefrom. A. W. H. Lenders, Assrs. to Penick and Ford, Ltd. U.S.P. 1,417,467, 23.5.22. Appl., 18.11.18.

See E.P. 149,374 of 1919; J., 1920, 700 A.

XVIII.—FERMENTATION INDUSTRIES.

Saccharomyces Marxianus and top-fermentation yeasts. R. H. von Euler and K. Josephson. Z. physiol. Chem., 1922, 120, 42—60.

Saccharomyces Marxianus failed to ferment maltose even on the addition of an excess of co-enzyme. It also does not ferment this sugar at a higher temperature, namely, 40°C. Its fermenting capacity is diminished on drying and increases again as the cells imbibe. It ferments sucrose and dextrose with the same velocity. The development of the yeast in dextrose and in maltose solutions is of approximately the same order and follows the ordinary exponential law. Its inverting capacity is about 100 times lower than that of culture yeasts. In the case of the top-fermentation yeast R both treatment with alcohol and drying diminish its activity. The inverting capacity of yeast R is greater than that of the top-fermentation yeast S B.—S. S. Z.

Fat; Enzymic synthesis of ——. L. Spiegel. Z. physiol. Chem., 1922, 120, 103—109.

On incubating cellulose, dextrose, and starch with enzyme preparations from certain oil-bearing seeds a small production of fatty substances was observed.
—S. S. Z.

Diastase; Regeneration of —— and its dependence on oxygen. W. Biedermann. Biochem. Zeits., 1922, 129, 582—593.

If active filtered saliva be heated just to 100° C. it becomes turbid. The diastatic activity of the solution is small, but is regenerated to a considerable extent by vigorous shaking with air. If, however, the heated saliva be again filtered the filtrate, free from oxygen, is practically inactive, but is slightly activated by shaking with air. This activation is attributed to oxygen, although the finely divided coagulated protein plays a part.
—H. K.

Oxalic acid and ammonia; Formation of —— in cultures of Aspergillus niger on peptone. W. Butkewitsch. Biochem. Zeits., 1922, **129**, 445—454.

The proportion of ammonia and oxalic acid formed from cultures of *Aspergillus niger* on peptone corresponds to ammonium oxalate with about 10% excess of ammonia. Of the ammonia formed over a period of 40 days 90% appeared in the first 10 days during the vigorous growth of the mould.—H. K.

Peptone as source of carbon for species of Citromyces. W. Butkewitsch. Biochem. Zeits., 1922, **129**, 455-463.

Citromyces glaber and *citricus* grown on peptone media produce ammonia and oxalic acid (not citric acid), the proportion of ammonia being 12 to 20% greater than that required for ammonium oxalate. As in the case of *Aspergillus niger* (*cf. supra*), the major portion of the ammonia is produced in the first period of growth, and the ratio of the yield of mould to ammonia nitrogen falls off with the age of the cultures.—H. K.

Oxalic acid; Formation and accumulation of —— in cultures of Citromyces on salts of organic acids. W. Butkewitsch. Biochem. Zeits., 1922, **129**, 464—476.

Salts of organic acids are utilised by species of *Citromyces* with production of oxalic acid, the sodium salts being more conducive to growth than the ammonium salts. *Aspergillus niger* converts tartaric acid rapidly into oxalic acid; *Citromyces* are unable to do this, but on salts of citric, succinic, and quinic acids there is considerable formation of oxalic acid.—H. K.

Wine; Estimation of the various acids in ——. T. von Fellenberg. Z. Unters. Nahr. Genussm., 1922, **43**, 217—255.

The scheme of analysis described permits of the estimation in wine of the separate proportions of weak organic acids (tannic acids), tartaric, malic, succinic, and lactic acids. The most important feature in the scheme consists in the means adopted to estimate the last four acids. These acids are converted into their silver salts, silver lactate remaining in solution, whilst the other three silver salts are precipitated. The tartaric acid is estimated by the official Swiss method, so that the sum of the malic and succinic acids may be calculated. The aqueous solution containing these two acids is shaken with ether, the proportions of the separate acids being determined from their distribution between the water and ether and the known values of the separate distribution coefficients. Full details of the procedure are given.—T. H. P.

Attack of minerals by bacteria. Helbronner and Rudolfs. *See* VII.

Ultra-violet light in analysis. Kitching. *See* XXIII.

Patents.

Glycerin; Production of —— from sugar. Vereinigte Chem. Werke, A.-G. G.P. 343,321, 14.2.17.

In the production of glycerin from sugar, the fermentation is carried out in the presence of salts with an acid or neutral reaction, *e.g.*, ferrous sulphate, aluminium sulphate, ammonium chloride, or calcium chloride, as well as a considerable excess of nutrient salts such as ammonium sulphate, sodium phosphate, potassium sulphate, and magnesium phosphate. Fermentation is allowed to proceed until the whole of the sugar has been decomposed.—L. A. C.

Alcoholic fermentation; Production of material from pancreas or yeast for accelerating ——. J. D. Riedel, A.-G. G.P. 350,640, 5.11.20.

Pancreas or yeast powder is triturated with *liquor ferri sesquichlorati*, dried below 105° C., washed until no more iron salts dissolve, boiled from ¼ to ½ hr. with a 2% alkali solution, and filtered. The solution may be treated with acids to precipitate metabolin, or may be used direct for the preparation of the products described in G.P. 345,695 (J., 1922, 430 A).—L. A. C.

Products from lupins. G.P. 350,100. *See* XIXA.

XIXA.—FOODS.

Dairy practice; Significance of surface tension for ——. O. Rahn. Kolloid-Zeits., 1922, **30**, 341—346. (*Cf.* J., 1921, 746 A, 866 A; 1922, 114 A.)

The foam which forms when skim milk flows from the cream separator is due to a reduction of the surface tension caused by the accumulation in the surface of an albuminous substance which passes into the walls of the foam cells. On standing the walls of the foam cells contain a solid substance and the drying of such material is similar to the drying of many albuminous substances in the sense that it is irreversible. It is probable that this solid albuminous substance is the main constituent of the skin which forms on the surface of milk that has been heated to 60° C. or above. The formation of whipped cream is explained as follows:—On whipping the cream a network of foam is produced, which is stiffened by the solidified fat so that it does not fall like the foam but retains its form. Whipped cream consists of a solid structure of albumin penetrated by layers of solid fat, which has the same form as the foam. On warming whipped cream above the melting point of the fat the structure collapses but remains somewhat frothy because the solid albumin cannot melt. Butter formation is explained as follows:—Cream contains much of the foam-producing albumin; this surrounds the particles of fat and on churning a large volume of air is entrapped by the cream so that the surface is very much enlarged. The albumin passes into the walls of the foam and takes the fat with it, so that a foam rich in fat stands above a liquid poor in fat (buttermilk). The fat particles lie very close together in the foam walls and are compressed into conglomerates by the surface pressure. This causes the albumin in the walls to solidify, and further churning breaks up the foam and mixes the fat conglomerates with the solid albumin to form lumps of butter.—J. F. S.

Butter; Formation of ——. Pt. II. Effect of temperature on butter formation. O. Rahn. Forsch. Geb. Milchwirtsch. und Molkereiw., 1922, **2**, 76—94. Chem. Zentr., 1922, **93**, II., 1147.

The explanation of the process of butter formation advanced previously (*cf.* J., 1922, 114 A) according to which butter can be produced at any temperature, is fundamentally different from Soxhlet's coagulation theory, which states that the butter fat must solidify before it can cohere into lumps. Tabulated data, collected by the author and Hittcher, are given showing the effect of temperature and duration on the process of butter formation. Butter can be produced as long as the liquid froths, even if the fat is liquid in the cream particles, but under these conditions the agglomerates of liquid fat break again, owing to the agitation, and hence the yield of butter is small. The time necessary for the formation of butter decreases with increasing temperature; between 25° and 30° C. it is only 3·5 mins., at lower temperatures a longer time is required, and at 5° C.

probably no butter is formed. In the case of cream from animals fed on pasturage, the solidified fat particles begin to soften at about 11° C., and the softer they are, the more rapidly can the agglomerates of particles coalesce into lumps. When the animals have been fed on roots, the particles are unable to coalesce below about 15°—17° C. The fat content of buttermilk rises gradually with increasing temperature up to about 14°—16° C., and rapidly above that temperature, and is usually a minimum if the duration of the process of butter formation is 30—45 mins.—L. A. O.

Milk; Effect on the percentage composition of —— of variations in the daily volume and variations in the nature of the diet. W. Taylor and A. D. Husband. J. Agric. Sci., 1922, **12**, 111—124.

The percentage composition of milk is apparently determined by the rate of secretion and not by diet, except in the case of non-protein nitrogen, which is not a product of the mammary gland. The percentages of protein, fat, and ash vary inversely and the percentage of lactose directly as the daily volume. It is suggested that the quantity of lactose elaborated by the mammary gland controls the rate of milk secretion.—G. W. R.

Milk; Relation of fat to total solids not fat in ——. F. Reiss. Milchw. Zentr., 1922, **51**, 121—124.

From the statistical study of a number of data as to the composition of milk, it is concluded that there is no strict proportionality between the content of fat and of solids-not-fat.—G. W. R.

Animal bodies; Chemical composition of ——. J. A. Murray. J. Agric. Sci., 1922, **12**, 103—110.

A statistical examination of the relationships between water and the non-fatty matter of animal bodies. From existing data an empirical formula is derived connecting the percentage of water in the fat-free empty weight and the fat-free empty weight. (The "empty weight" is the "live weight" minus the weight of the contents of the stomach, intestines, and urinary bladder.) The formula is applicable to cattle and pigs, and, with slight modification, to sheep. The ratio of protein to ash is the same in sheep and cattle, but higher in pigs. It is not altered with age, but may be affected by food.—G. W. R.

Monoamino-acids [in proteins]; Detection and estimation of ——. R. Engeland. Z. physiol. Chem., 1922, **120**, 130—140.

The author estimated proline in glutin and elastin by means of his betaine method. The former protein showed a content of 10·9% and the latter of 4·3% of proline. The same method was applied in the case of ascitic fluid. Six and a half litres of ascitic fluid yielded 0·06 g. of the chloroaurate of the betaine of leucine and 0·025 g. of the chloroaurate of the betaine of lysine by this method. —S. S. Z.

Proteins; Colloid chemistry of ——. A. Fodor. Kolloid-Zeits., 1922, **30**, 313—336.

The dehydration of protein gels leads, exactly as with a large number of inorganic gels, to the formation of new and more stable molecular structures which are characterised by a reduced tendency to enter into reactions, whilst peptisation of such structures gives, owing to combination with water, reactive disperse particles. The larger or smaller particles obtained by precipitating proteins are not to be regarded as accidental, but as structures containing different amounts of water and of different reactivity. (*Cf.* J.C.S., July.)—J. F. S.

Foods; Examination of —— for the presence of sulphites. A. C. Chapman. Analyst, 1922, **47**, 204—205.

Foods containing onions or mustard yield appreciable quantities of sulphuric acid when they are distilled with phosphoric acid and the distillate is oxidised with bromine; if, however, hydrogen peroxide is used in place of bromine, the volatile sulphur compounds derived from the onions etc. are not oxidised and any sulphuric acid then found is due to the oxidation of sulphur dioxide derived from sulphites contained in the food.—W. P. S.

Allyl mustard oil [allyl isothiocyanate]; Method of estimating —— in mustard. E. Luce and A. Doucet. J. Pharm. Chim., 1922, **25**, 458—464.

In estimating allyl mustard oil in mustard by Dieterich's method (Pharm. Zeit., 1900, 767) the time of maceration of mustard with water should be reduced to 1 hr., and the time of contact with the ammoniacal silver nitrate should be 6 hrs. in the cold or 1 hr. at 80°—85° C. under a reflux condenser. The time of contact and the temperature of maceration are of importance, as rise in temperature or an extension of the maceration beyond one hour results in a secondary reaction occurring with consequent loss of allyl mustard oil.—W. G.

Patents.

Rice; Parboiling, gelatinising, and similarly treating —— and apparatus therefor. H. Simon, Ltd., C. Raeburn, and A. G. Simpson. E.P. 179,206, 2.11.20.

Soaked rice is heated under atmospheric pressure by contact with, and the radiation of heat from, the walls of externally heated containers through which the rice descends under gravity, and the discharge is controlled, *e.g.*, by a reciprocating grid, to regulate the duration of heating. Air may be passed upwards through the rice to carry off the moisture. A number of such containers of small cross-section may be combined in parallel in one apparatus, and each container may be in the form of a corrugated or indented tube.—H. H.

Milk and cream; Process of extracting butter fat or oil from ——. C. E. North. U.S.P. 1,416,053, 16.5.22. Appl., 4.9.20.

Cream is agitated to agglomerate the fat particles and then mixed with water at such a temperature that the agglomerated particles are liquefied, and in such amount that the fat rises as an oily layer. —H. H.

Nut kernels; Process of treating —— to produce food ingredients. H. R. and L. E. Scott. U.S.P. 1,416,128, 16.5.22. Appl., 1.7.20.

Prune, peach and apricot kernels are subjected to the action of the enzyme emulsin existing therein, in the presence of water, to decompose the amygdalin. The aqueous solution is separated by filtration and distilled to recover benzaldehyde and hydrocyanic acid products, while the meal is washed to remove remaining soluble constituents.—L. A. C.

Fibrous vegetable material, especially wood; Process for decomposing ——, e.g., for the production of fodder. P. Waentig. G.P. 349,842, 19.9.17.

Moist vegetable material cut up into small pieces is treated with chlorine, washed, treated at the ordinary temperature with a dilute alkaline solution free from sulphur, and again washed.—L. A. C.

Fodder; Manufacture of —— from straw. J. Paechtner. G.P. 351,051, 1.10.20. Conv., 4.10.19. Addn. to 338,920 (J., 1921, 714 a).

By-products obtained in the utilisation of agricultural products, such as molasses, vinasse, beet slices, and the like, and which contain electrolytes, are added to finely divided straw previous to electrolysis as described in the chief patent. The straw can also be treated with a direct current in the presence of water without the addition of electrolytes.—L. A. C.

Lupins; Preparation of products containing albumin and free from bitter constituents from ——. C. F. Hildebrandt. G.P. 350,100, 11.12.17.

Lupins are ground with water after removal of the husks, and after separation of the aqueous extract, the residue, which contains the greater part of the albuminous constituents, is washed until free from all bitter substances. The albumins in the aqueous extract are precipitated and separated from the solution, which can then be employed for the production of alcohol and yeast.—L. A. C.

Lupins; Removal of bitter substances from —— *by means of hot water and sodium chloride solution.* P. Bergell. G.P. 350,956, 18.1.21. Addn. to 335,646 (J., 1921, 599 A).

Extraction of bitter substances from lupins by the process described in the chief patent is accelerated and rendered more complete by carrying out the extractions with water at 60° C. under pressure, and with salt solution at 40° C. under reduced pressure.—L. A. C.

Potatoes, onions, tomatoes, apples, or the like; Preparation of dried products from ——. M. Mann. G.P. 350,470, 20.1.20. Addn. to 318,980 (J., 1920, 464 A).

Vegetables and fruits in small pieces are dipped in hot vegetable mucilage, heated to about 100° C. to evaporate the water in the coating, and subsequently dried at progressively lower temperatures.—L. A. C.

Soya bean flour. E.P. 179,776. *See* XII.

Edible fatty product. U.S.P. 1,381,564. *See* XII.

XIXb.—WATER PURIFICATION; SANITATION.

Rock dust in air. Fieldner and others. *See* XXIII.

Patents.

Filters [for boiler-feed water]. J. F. Crawford and W. J. Kelly. E.P. 179,355, 24.2.21.

A gravity filter for boiler-feed water, or for other liquids in large quantity compared with the solid matter, is formed of a series of hollow perforated discs or grids covered with filtering medium and forming a hollow vertical column, down the centre of which the filtrate flows by gravity to a tank at a somewhat lower level than the filtering tank, which is in turn rather lower than a tank in which settling may take place previous to filtration.
—B. M. V.

Fungicide and insecticide. Farbenfabr. vorm. F. Bayer und Co. G.P. 349,870—1, 28.2 and 19.3.15.

A fungicide and insecticide consists of a saturated monocylic ketone, such as cyclohexanone or cyclopentanone or one of their homologues. The substance can be used in the form of vapour, in chemical combination with other substances, such as sodium bisulphite, or in mechanical admixture with soaps, powders, and the like, absorbed in porous substances or dissolved in any suitable solvent.—A. R. P.

Animal membranes; Process for removing poisonous material from ——. H. Braun. G.P. 350,275, 28.8.20.

Animal membranes are treated with a halogen in the presence of a weak acid. The use of *e.g.*, a 5—10% aqueous solution of an acid causes the membrane to swell considerably, and this accelerates the action of the halogen.—L. A. C.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Morphine. E. Speyer and G. Becker. Ber., 1922, 55, 1329—1339.

The conversion of morphine oxide by acetic anhydride and sulphuric acid into morphinehydrateoxidesulphonic acid and reduction of the latter by sulphurous acid to morphinehydratesulphonic acid has been described previously. Since, however, the latter substance loses a molecular proportion of water without suffering further decomposition at 170°—180° C. and is catalytically reduced to α-dihydromorphinesulphonic acid it is established that the water is present as solvent of crystallisation and the nomenclature must accordingly be modified to bimolecular morphineoxidesulphonic acid and morphinesulphonic acid respectively. (*Cf.* J.C.S., 1922, i., 675.)—H. W.

Cinchona alkaloids; Action of hydrogen peroxide on ——. E. Speyer and A. G. Becker. Ber., 1922, 55, 1321—1329.

Quinine is converted by hydrogen peroxide (30%) into an amine-oxide which is characterised by its ability to liberate iodine from acidified potassium iodide solution and its re-conversion into quinine by the action of sulphurous acid. Since pyridine and analogous bases do not react with hydrogen peroxide in this manner, the oxygen atom in the oxide is probably attached to the trivalent nitrogen atom of the piperidine complex. Similar oxides are obtained from dihydroquinine, quinidine, dihydrocupreine, and ethyldihydrocupreine, but not from cinchonine. (*Cf.* J.C.S., 1922, i., 674.)
—H. W.

Cinchona series; Syntheses in the ——. *VII. 5.8-Diaminodihydroquinine and 5.8-diamino-6-methoxyquinoline and their conversion into the corresponding aminohydroxy and dihydroxy bases.* W. A. Jacobs and M. Heidelberger. J. Amer. Chem. Soc., 1922, 44, 1073—1079.

Like the amino groups in the aminoazo dyestuffs derived from 5-aminodihydroquinine and 5-amino-6-methoxyquinoline, those in the 5.8-diamino compounds obtained from the dyestuffs by reduction are easily replaceable by hydroxyl groups (*cf.* J., 1921, 96 A). There is evidence that the amino group in position 5 is more labile than that in position 8, and that the substitution of a methoxyl group in position 6 is a determining factor as regards the lability of the amino groups. Certain of the intermediate and end products of this transformation are described. (*Cf.* J.C.S., 1922, i., 671.)—W. G.

Cinchona series; Syntheses in the ——. *VIII. Hydrogenation of dihydrocinchonine, cinchonine, and dihydroquinine.* W. A. Jacobs and M. Heidelberger. J. Amer. Chem. Soc., 1922, 44, 1079—1090.

Dihydrocinchonine, when reduced with sodium in amyl alcohol, yielded a mixture of hexahydrocinchonine and two epimeric hexahydrocinchonanes, in the last of which the alcohol group as well as the quinoline ring had suffered reduction. The relationship of these compounds to the products obtained by reduction with zinc and hydrochloric acid and by the reduction of cinchonine has been elucidated. (*Cf.* J.C.S., 1922, i., 672.)—W. G.

Cinchona series; Syntheses in the ——. IX. Certain quinicine and benzoylcinchona salts, crystalline ethyldihydrocupreine (optochin) base and other derivatives. M. Heidelberger and W. A. Jacobs. J. Amer. Chem. Soc., 1922, **44**, 1091—1098.

A number of miscellaneous crystalline cinchona derivatives are described, many of which were used as initial materials for various researches. (*Cf.* J.C.S., 1922, i., 673.)—W. G.

Cinchona series; Syntheses in the ——. X. Dihydrocinchonicinol and the dihydroquinicinols. M. Heidelberger and W. A. Jacobs. J. Amer. Chem. Soc., 1922, **44**, 1098—1107.

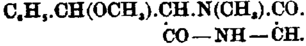
It has been found possible to reduce the ketonic group in cinchona alkaloids of the type of cinchonicine and quinicine by means of palladium and hydrogen, the products being mixtures of stereoisomers of a new type of alkaloids to which the authors have assigned the names dihydrocinchonicinols and dihydroquinicinols. In general the *d*-forms proved easier to isolate, and a number of *d*-bases, one of the *l*-bases, and numerous salts of the *d*- and *l*-forms are described. (*Cf.* J.C.S., 1922, i., 673.)—W. G.

Alkaloids; Methods for the quantitative estimation of ——. P. Herzig. Arch. Pharm., 1922, **259**, 249—308.

The author gives a comprehensive, critical survey of all the known methods—gravimetric, volumetric, colorimetric, refractometric, and polarimetric—for the estimation of alkaloids. Direct weighing has many obvious advantages, but also the great disadvantage that it is difficult without loss to isolate the alkaloid in a sufficiently pure condition. Of all the methods suggested for weighing as insoluble salts or as double salts, only precipitation by picric acid, phospho- or silico-tungstic acid, or picrolonic acid (dinitrophenylmethylpyrazolone) have any practical value. Of these only the last-named is considered to be at all useful, and even here comparative estimations made on *nux vomica* seeds and extracts showed that the results obtained were always 2·5—5% low. Of the volumetric methods, titration with standard acid is the most generally employed. Iodometric estimations are not recommended, but iodometric estimation with iodide-iodate of the excess of acid unneutralised by the alkaloid gives good results except in the case of feeble bases, the sulphates of which are much dissociated, *e.g.*, narcotine, pilocarpine, and purine derivatives, and it is particularly useful if much colouring matter is present. Volumetric precipitation methods using Mayer's reagent, phosphomolybdic acid, potassium ferrocyanide, or picric acid, are regarded as inexact except in special cases such as ferrocyanide for strychnine in presence of brucine, and picric acid for the cinchona alkaloids. Quantitative colorimetric and optical methods all demand the isolation of the alkaloid in a colourless condition, and are in general of little practical value.—G. F. M.

Picrorocellin, a diketopiperazine derivative from Roccella fuciformis; Constitution of ——. M. O. Forster and W. B. Saville. Chem. Soc. Trans., 1922, **121**, 816—827.

By heating at the melting point, or treatment with aqueous sodium hydroxide, picrorocellin, $C_{20}H_{22}O_4N_2$, is converted into anhydropicrorocellin, $C_{20}H_{20}O_3N_2$, while more protracted heating gives xanthorocellin, $C_{19}H_{16}O_2N_2$, by loss of water and methyl alcohol. Methylxanthorocellin, which has been prepared from diketopiperazine, is shown to be 2.5-diketo-3.6-dibenzylidene-1.4-dimethylpiperazine. Xanthorocellin is therefore 2.5-diketo-3.6-dibenzylidene-1-methylpiperazine, which is in accord with the production of benzaldehyde and tetraketo-1-methylpiperazine from it on oxidation with nitric acid. Polarimetric evidence lends further support to the formula



$$\begin{array}{l}C_6H_5.CH(OCH_3).\dot{C}H.N(CH_3).\dot{C}O\\ \qquad\qquad\qquad \dot{C}O-NH-\dot{C}H.CH(OH).C_6H_5\end{array}$$

for picrorocellin, which, however, remains indeterminate regarding the position (1 or 4), of the N-methyl group.—P. V. M.

Melampyritol and aucubin; Presence of —— in the foliated stems of Melampyrum arvense. M. Bridel and M. Braecke. J. Pharm. Chim., 1922, **25**, 449—457. (*Cf.* J., 1921, 674 A.)

The glucoside, aucubin, and the hexahydric alcohol melampyritol (dulcitol) have been isolated from the entire plant of *Melampyrum arvense.* More than 2% of the glucoside was found in a specimen of the plant collected after it had completed its life cycle and when the stem was devoid of leaves.—W. G.

Sensitiveness of cells to poisons as a function of their colloid-chemical condition. H. Handovsky. Kolloid-Zeits., 1922, **30**, 336—341.

The sensitiveness of cells to poisons is closely connected with the stability and variability of the colloid-chemical condition of the protoplasm colloids. The difference of the sensitiveness of red blood corpuscles to poisoning in solutions of sucrose and in solutions of salts is explained as follows:—The sucrose brings about, in the continuously changing sol ⇄ gel system of the protoplasm a more gelatinised condition, which is accompanied by a decrease in the degree of dispersion, and this makes the blood corpuscles less sensitive to surface active poisons. Solutions of salts act in the opposite sense; they make the blood corpuscles in sucrose solution sensitive again, and in those cases where the salt has no hæmolytic action of its own it increases the sensitiveness according to the laws which govern the increase in adsorption brought about by salts.—J. F. S.

Ambergris; Identification of ——. H. I. Cole. Philippine J. Sci., 1922, **20**, 105—109.

A careful microscopical examination often proves of greater value in the identification of substances suspected of being ambergris than the ordinary physical or chemical methods. Genuine ambergris will be found to contain embedded in it thin, dark brown, opaque, finely striated pieces of chitinous material varying from 0·04—0·1 mm. in thickness, derived from the internal shell or gladius of the cuttle fish. Samples of supposed ambergris, resembling in all physical appearances the genuine article, were examined and found to be of vegetable origin. Instead of the horny material above-mentioned, fragments of moss, leaves, and bark were found occluded, and both in this respect and also in m.p. (100°—120° C.) and the character of the ether extract the material closely resembled the latex of *Artocarpus elastica.* True ambergris melts at about 65° C., and the ether extract (ambrein) at 82°—88° C.—G. F. M.

Xanthosterol. H. Dieterle. Arch. Pharm., 1922, 259, 244—245.

The phytosterol, xanthosterol, isolated from the bark of *Xanthoxylon Budrunga* (J., 1920, 81 A) is, apparently, not identical with the lupeol isolated by Goodson (Biochem. J., 1921, 15, 123) from *X. macrophyllum*, for the m. pts. of xanthosterol, its benzoate, and monobromide are below those of lupeol and its corresponding derivatives and mixtures of xanthosterol and lupeol give melting points lower than that of xanthosterol.—G. F. M.

Arsphenamine [salvarsan] solution; Stability of ——. P. Masucci. Amer. J. Pharm., 1922, 94, 338—341.

The oxidation and increase of toxicity of solutions of salvarsan in *N*/1 sodium hydroxide solution (1 mol: 4 mols.) were followed quantitatively by titration with iodine and by injections into white rats. The solutions were prepared in an atmosphere of nitrogen and kept in ampoules filled with that gas. For control purposes solutions of similar concentration in contact with air were also kept. The solutions kept under nitrogen at 0° C. showed no noticeable change of colour, increase in oxidation or toxicity after four months. Solutions kept at ordinary room temperature began to change in colour from yellow to a reddish tinge in about two weeks, and after eight weeks 10% had been oxidised with a marked increase in toxicity. The temperature at which the solutions are kept is therefore a very important factor.—G. F. M.

Neoarsphenamine [neosalvarsan]; Toxicity of ——. M. C. Hart and W. B. Payne. J. Amer. Chem. Soc., 1922, 44, 1150—1160.

The toxicity of commercial samples of neosalvarsan was found to range from 200 to 360 mg. per kg. body weight for rats. In making such tests the variability of the test rats is of importance, as it was found that, in some cases, 40—100 mg. per kg. difference was obtained by the same test made on different rats. An apparatus is described for preparing standard solutions of neosalvarsan and it is suggested that the selection of test rats should be controlled by tests against such a standard. The toxicity of the salvarsan is shown to have only a negligible effect on the toxicity of the neosalvarsan prepared from it. In the condensation of salvarsan to neosalvarsan the influence of solvents, dilution, time and temperature on the toxicity and the introduction of the methylene-sulphinic group and sulphur distribution has been examined. A curve is given showing the lethal activity of a freshly prepared solution of neosalvarsan. The introduction of a methylene-sulphinic acid group in the salvarsan molecule increases the tolerated dose of the material from 110 to 320 mg. per kg. (20% As), but the introduction of the second group was complicated by side reactions giving a higher toxicity.—W. G.

Mercuration in the aromatic series. I. Acetates and hydroxides of mercuryphenol and their derivatives. E. Mameli. Gazz. Chim. Ital., 1922, 52, I., 352—368.

Descriptions are given of the preparation and properties of various ortho- and para-mercuryphenol salts of the form, $HO.C_6H_4.HgX$, where X represents an acid radicle. (*Cf.* J.C.S., July.)
—T. H. P.

Nitroguanidine; Action of sulphuric acid on ——. T. L. Davis. J. Amer. Chem. Soc., 1922, 44, 868—872.

Nitroguanidine is decomposed quantitatively by hot concentrated sulphuric acid, half of the nitrogen being liberated as ammonia and the whole of the carbon as carbon dioxide. Solubility curves are given for nitroguanidine in varying strengths of sulphuric acid at 0° C. and 25° C.—W. G.

Aminoalcohols. Homologues of novocaine. E. Fourneau and J. Puyal. Bull. Soc. Chim., 1922, 31, 424—435.

Hydrocarbons of the ethylene series may be prepared by passing the vapours of the corresponding alcohols over infusorial earth at 400° C. The hydrocarbons may be converted into their bromohydrins by the action of bromine water, and these in turn by the action of dimethyl- or diethylamine give the substituted aminoalcohols, from which certain benzoyl derivatives have been prepared. A commercial sample of amylene, sold under the name of "Pental," was found to contain at the most 20% of β-methyl-Δα-butylene. The hydrochlorides of aminobenzoyldiethylaminopropanol (methylnovocaine) and of aminobenzoyldiethylaminobutanol have a more pronounced anæsthetic action than novocaine. The hydrochloride of *p*-aminobenzoyldimethylaminodimethylethylcarbinol (aminostovaine) has a very intense anæsthetic action. (*Cf.* J.C.S., 1922, i., 639.)—W. G.

Mononitrophenols, mononitrobenzoic acids, and mononitrocinnamic acids; Application of the Kjeldahl method to ——. B. M. Margosches and E. Vogel. Ber., 1922, 55, 1380—1389.

A continuation of previous work (J., 1920, 82 A) in which it was shown that the Kjeldahl-Gunning method gives accurate results only for the ortho derivatives when applied to the mononitrophenols and mononitrobenzoic acids. Decomposition of mononitrophenols and mononitrobenzoic acids by sulphuric acid without addition of potassium sulphate gives correct values for the ortho, low values for the meta and para compounds; the latter are considerably higher than those obtained by the Kjeldahl-Gunning method. Decomposition in stages according to the Kjeldahl-Gunning method shows that in the cases of *o*-nitrophenol and *o*-nitrobenzoic acid the greater part of the nitrogen is converted into ammonia at the period of initial darkening and that the conversion is practically quantitative at the point of most violent action. With *p*-nitrobenzoic acid at the corresponding stages but little conversion has occurred, and during the course of the action the nitrogen gradually undergoes such change that it can no longer be converted into ammonia after addition of phenol. In the case of *p*-nitrobenzoic acid, the replacement of potassium sulphate in the Kjeldahl process by copper oxide or mercuric oxide leads to analytical results which are in harmony with the calculated values. The activity of copper oxide is not affected by the presence of potassium sulphate, whereas that of mercuric oxide is depressed greatly. The activity of sodium sulphate is inferior to that of potassium sulphate and approximately equal to that of lithium sulphate. During the Kjeldahl-Gunning process *p*-nitrobenzoic acid yields a volatile nitrogenous compound, the nitrogen of which can be converted into ammonia by sulphuric acid, phenol, and copper oxide, whereas *p*-nitrophenol undergoes far more complex decomposition with the formation of products which do not yield ammonia under the described conditions. In striking contrast to the nitrobenzoic acids, the three nitrocinnamic acids yield almost the whole of their nitrogen as ammonia when treated with sulphuric acid and potassium sulphate. Satisfactory results are also obtained with sulphuric acid alone or mixed with copper oxide.—H. W.

Alkylbenzylbarbituric acids. A. W. Dox and L. Yoder. J. Amer. Chem. Soc., 1922, 44, 1141—1145.

A series of ethyl alkylbenzylmalonates have been prepared either by alkylating the monobenzylmalonic esters or by benzylating the monoalkylmalonic esters. From these esters the corresponding alkylbenzylbarbituric acids have been obtained by the veronal synthesis with urea and sodium ethoxide. In this series of substituted barbituric acids ethylbenzylbarbituric acid was found to have the strongest physiological action, but, contrary to expectations, the hypnotic effect was accompanied by symptoms of tetanus instead of the antispasmodic effect commonly attributed to the benzyl group. (*Cf.* J.C.S., July.)—W. G.

Acetylsalicylic acid [*aspirin*]; *Commercial* ——. M. V. del Rosario and P. Valenzuela. Philippine J. Sci., 1922, **20**, 15—22.

The methods adopted for the examination of a number of samples of aspirin were titration in alcoholic solution with *N*/5 sodium hydroxide using phenolphthalein as indicator; addition of excess of *N*/5 sodium hydroxide to the neutralised solution, hydrolysis by boiling for 30 minutes, and estimation of the excess of alkali by titration; determination of the bromine value of the hydrolysed solution (1 mol. =3 atoms Br); estimation of free acetic acid by washing 1 g. on a filter with 25 c.c. of cold water and titration of the filtrate; estimation of free salicylic acid colorimetrically with ferric chloride, 0·1 g. of the sample being dissolved in 5 c.c. of alcohol and subsequently diluted to 25 c.c. with water. The authors consider that the requirements of purity should be modified to suit the special climatic conditions of the Philippines, as very few of the samples examined would otherwise conform to them.—G. F. M.

Ammonium carbamate; Transformation of —— [*into urea*]. C. Matignon and M. Fréjacques. Bull. Soc. Chim., 1922, **31**, 394—412.

A résumé of work already published (*cf.* Comptes rend., 1920, **170**, 462; J., 1921, 25 A; 1922, 231 A). —W. G.

Malic acid; Formation of ——. [*Detection of maleic acid in admixture with fumaric and malic acids.*] J. M. Weiss and C. R. Downs. J. Amer. Chem. Soc., 1922, **44**, 1118—1125.

A preliminary study of the equilibrium of maleic, fumaric, and malic acids in aqueous solution over the temperature range, 140°—200° C. At the lower temperature, in aqueous solution, an equilibrium exists among the three acids, but at the higher temperature maleic acid substantially disappears and the equilibrium is between fumaric and malic acids. Further, at the higher temperature approximately the same end-point is reached whether one starts with maleic, fumaric, *i*-malic, or *l*-malic acid. By simple boiling at atmospheric pressure malic acid solutions are practically unchanged. For the detection of small amounts of maleic acid in mixtures with fumaric and malic acids, the solution is saturated with respect to fumaric acid at 25° C., and then the maleic acid is converted into fumaric acid by the addition of a little bromine and the action of the light from a mercury vapour quartz lamp. The solution is again brought to 25° C. and well stirred, and the amount of fumaric acid which separates out is estimated.—W. G.

Acetic anhydride; Analysis of ——. A. Reclaire. Perf. Essent. Oil Rec., 1922, **13**, 148—149.

Ten grams of acetic anhydride is diluted with 75 c.c. of water free from carbon dioxide, heated for 15 mins. under a reflux condenser on a water bath, diluted to 500 c.c. with more water free free from carbon dioxide, and 50 c.c. titrated with *N*/2 potassium hydroxide. The percentage of acetic anhydride present is—

(17·144×c.c. *N*/2 KOH used) - 570·45.

The necessity for using water free from carbon dioxide and potassium hydroxide solution free from carbonate is emphasized. The latter is readily obtained by mixing 1 l. of potassium hydroxide solution with 50 c.c. of milk of lime and allowing to stand for one or more days.—G. F. M.

Ethyl ether; Autoxidation of ——. A. M. Clover. J. Amer. Chem. Soc., 1922, **44**, 1107—1118.

Ether absorbs oxygen from the air slowly at first with the formation of a peroxide by direct addition. The rate of peroxidation becomes much greater in time, however, owing to the catalytic influence of the acetaldehyde, which is formed by the spontaneous decomposition of the peroxide. The peroxide is acidic in character, is volatile, and is slowly decomposed under the influence of light, giving carbon dioxide, methane, acetaldehyde, and alcohol. Hydrogen peroxide is not the primary product of the oxidation of ether, but is formed quantitatively by the decomposition of the peroxide by acidified water. To the peroxide the author assigns the constitution $C_2H_5O.CH(CH_3).O.OH$.—W. G.

Gelatin as a protective colloid. Colloidal silver. A. Gutbier, J. Huber, and A. Zweigle. Kolloid-Zeits., 1922, **30**, 306—316.

Chloroform, toluene, acetone-chloroform, and ethyl acetate are exceedingly good stabilisers for gelatin solutions. The stability of colloidal silver obtained by reduction with hydrazine is increased by the addition of small concentrations of gelatin, but an excess of gelatin has a disturbing effect on the stability of the silver sol. An exceedingly stable and concentrated silver sol was prepared by reducing with hydrazine 10 pts. of *N*/10 silver nitrate in 30 pts. of 0·42% gelatin solution and immediately dialysing for 6 hrs. This sol was red-dish-brown by transmitted light and olive by reflected light; after dialysing for 10 days the preparation contained 40·45% of silver and was stable for three-quarters of a year. Colloidal silver prepared by reduction with sodium hydrosulphite was much less stable than that prepared with hydrazine. The protected silver sols were rapidly coagulated by chlorides (hydrogen, sodium, barium, and magnesium chlorides), *N*/1 sulphuric acid coagulated the sols slowly, but the action was incomplete in 5 days, sodium thiosulphate caused slow sedimentation, whilst sodium hydroxide and sodium carbonate in *N*/1 solutions were without coagulating action.—J. F. S.

Ointments; Examination of B.P. ——. N. Evers and G. D. Elsdon. Analyst, 1922, **47**, 197—201.

Cantharidin ointment. Thirty g. is dissolved in a mixture of equal parts of ether and chloroform, and the solution is extracted three times with 5% sodium carbonate solution; the alkaline solution is acidified with sulphuric acid, extracted three times with chloroform, the extract is evaporated to dryness, the residue washed with a small quantity of a mixture of equal parts of petroleum spirit and absolute alcohol saturated previously with cantharidin, then dissolved in chloroform, the solution filtered through cotton wool, the filtrate evaporated, and the residue dried over sulphuric acid, and weighed. *Calomel ointment.* Five g. of the sample is dissolved in ether, filtered, the insoluble portion washed with ether until free from fat, then dissolved in an excess of standard iodine solution, and the excess of iodine titrated. *Creosote ointment* and *eucalyptus ointment.* The loss in weight when the sample is heated at 100° C. until practically free from odour gives the content of creosote or eucalyptus oil respectively. *Gall ointment.* The amount of powdered galls present is represented by the portion of the sample which is insoluble in petroleum spirit. *Iodine ointment.* The sample is dissolved in chloroform, water is added, and the free iodine is titrated with thiosulphate solution. *Iodoform ointment.* Five g. of the ointment is boiled under a reflux condenser for 2 hrs. with 50 c.c. of *N*/10 silver nitrate solution, the mixture then diluted to 110 c.c., filtered, and

100 c.c. of the filtrate is titrated with thiocyanate solution. The loss in weight when the sample is heated at 100° C. also gives the iodoform content. *Mercury ointment.* Three g. of the sample is heated with 20 c.c. of concentrated nitric acid, the mixture then diluted, and the aqueous liquid separated from the fat; the latter is washed with water, and the united aqueous liquids are oxidised with potassium permanganate solution. Excess of the latter is destroyed by the addition of dilute ferrous sulphate solution and the mercury is then titrated in an aliquot portion of the solution by means of thiocyanate solution. *Compound mercury ointment.* The mercury is determined as described under mercury ointment; the camphor content is determined by heating the sample for 2 hrs. at 100° C. *Resin ointment.* The resin content may be calculated approximately from the formula $(a-5{\cdot}9)\times 100/167$, where a is the acid value of the sample. *Sulphur ointment.* The sulphur is determined by oxidising a portion of the sample with nitric acid and bromine, separating residual fat with ether, and precipitating the sulphuric acid with barium chloride. Except in a few cases, the refractive index does not give much indication as to the amount of active constituent in an ointment.
—W. P. S.

Pollen grain of Pinus silvestris; Constituents of the ——. A. Kiesel. Z. physiol. Chem., 1922, **120**, 85—90.

The ripe pollen contains potassium 0·59%, calcium 0·12%, trace of guanine, adenine 0·002%, little histidine, arginine 0·52%, choline 0·021%, little colamine, and sucrose. The unripe pollen yielded very little in the nuclein bases fraction, traces of histidine, some arginine and choline.—S. S. Z.

Blumea Malcomii; Essential oil from ——. J. L. Simonsen and M. G. Rau. Chem. Soc. Trans., 1922, **121**, 876—883.

The essential oil from *Blumea Malcomii*, from India, has sp. gr. 0·9296 at 30°/30° C., $n_D^{30}=1{\cdot}4749$, $[\alpha]_D^{30}=+46{\cdot}76°$, acid value 0·11, saponification value 22·93, saponification value after acetylation 60·63. It consists mainly of two ketones, *d*-carvotanacetone (Δ^6-menthen-2-one), 82%, and 1-tetrahydrocarvone (*p*-menthen-2-one), 16%, which are readily separated by means of normal sodium sulphite with which the former ketone alone reacts. The sparingly soluble semicarbazone of 1-tetrahydrocarvone is suitable for the separation of this compound from the residual liquors. A trace of yellow oil boiling between 160° and 180° C. at 100 mm. remains after removal of the ketones. The oil contains small quantities of butyric or isobutyric and *n*-octoic acids, and about 0·1% of a phenol.
—P. V. M.

Agastache pallidiflora; Oil of ——. J. F. Couch. Amer. J. Pharm., 1922, **94**, 341—343.

The flowers of the giant hyssop, *Agastache pallidiflora*, contain 0·2—0·3% of a volatile oil having an odour recalling a mixture of thyme and peppermint, whilst the leaves contain a lesser amount of the same or a similar oil, which has an odour of thyme only. The oil isolated by steam distillation of the flowers had the following characters:—Sp. gr. at 20° = 0·91924, $[\alpha]_D^{25}=-8{\cdot}60°$, $n_D^{25}=1{\cdot}4865$. On cooling to −10° C. no crystals separated, hence the amount of free menthol, if present, cannot be very large. Phenols, pulegone and other ketones were not present in the oil.—G. F. M.

Ultra-violet light in analysis. Kitching. *See* XXIII.

Patents.

α-Dialkylaminoethyl-β-aracyl-[hydr]oxybutyric acid esters; Manufacture of ——. Farbw. vorm. Meister, Lucius, und Brüning. E.P. 161,539, 9.4.21. Conv., 10.4.20.

Dialkylaminoethyl halides are caused to react with sodio-ethyl acetoacetate, and the resulting ketonic acid esters are reduced, *e.g.*, by means of sodium amalgam, to α-dialkylaminoethyl-β-hydroxybutyric acid esters of the general formula,

$$CH_3.CH(OH).CH(COOR').CH_2.CH_2.NR_2,$$

where R is an alkyl group and R′ an alkyl or aryl group. Ethyl α-diethylaminoethyl-β-hydroxybutyrate obtained in this way, is a colourless liquid, b.p. 135°—136° C. at 10 mm., soluble in water to an alkaline solution. When this ester is treated with an aromatic acid chloride, *e.g.*, benzoyl chloride, the desired ethyl α-diethylaminoethyl-β-benzoxybutyrate is produced. It is a nearly colourless oil forming a crystalline hydrochloride, m.p. 130°—131° C., readily soluble in water, and possessing valuable local anæsthetic properties.—G. F. M.

Photochemical apparatus. W. O. Snelling. U.S.P. 1,382,252, 21.6.21. Appl., 6.3.17.

A transparent dome rests upon a shallow tray which is provided with an inlet and outlet for gases, one of such conduits being provided with a tube of larger diameter surrounding and extending beyond it. The apparatus is suitable for the chlorination of methane, which together with chlorine enters the dome at one side, the other side of the dome being exposed to an external light source. The reaction products leave the dome at the side nearer the light source, and hence the light has to traverse partially combined gases before meeting the entering gases, whereby the actinic rays are partially absorbed, thus diminishing the reaction velocity and avoiding danger of explosions.—B. M. V.

[Allyl] ether of ethenylparadi[hydr]oxydiphenylamidine; Unsaturated ——. J. Schuler, Assr. to Soc. of Chem. Ind. in Basle. U.S.P. 1,384,637, 12.7.21. Appl., 9.3.21.

Ethenyl-*p*-diallyloxydiphenylamidine, m.p. 85°—86° C., readily soluble in alcohol and ether, insoluble in water, and of value as a local anæsthetic, especially for ophthalmological practice, is obtained by condensing *p*-aminophenyl allyl ether with acet-p-aminophenyl allyl ether in presence of phosphorus halides, phosphorus oxyhalides, or phosphorus pentoxide, and if desired with addition of a solvent or diluent. The hydrochloride of the new ether melts at 152°—153° C., is readily soluble in alcohol, less soluble in water, and insoluble in ether.

Hexamethylenetetramine; Chlorine derivatives of ——. R. Buratti. U.S.P. 1,416,606, 16.5.22. Appl., 18.6.18.

A solution of hexamethylenetetramine is added to a solution of a hypochlorite of a metal classified in the first two metal groups, which has previously been neutralised by the addition of an acid.
—L. A. C.

Hexamethylenetetramine; Preparation of derivatives of ——. *Preparation of addition products of hexamethylenetetramine with monohalogen-fatty acid esters.* J. D. Riedel, A.-G. G.P. (A) 346,383, 14.8.19, and (B) 346,462, 22.7.19.

(A) Non-hygroscopic compounds of therapeutic value and resembling choline are prepared by the action of ethylenehalogenhydrins on hexamethylenetetramine at temperatures above normal in the presence or absence of solvents. The addition products of hexamethylenetetramine with ethylenechlorohydrin and ethyleneiodohydrin have m.p. 135° C. and 149° C. respectively; the product from the latter contains 40·7% of iodine, and is prepared by reaction between the constituents in aqueous solution, or by the addition of sodium iodide to a concentrated aqueous solution of the corresponding chlorine compound. (B) Addition products are formed by reaction between hexamethylenetetramine and esters of monobromoacetic acid with alcohols or phenols which are insoluble or only slightly soluble in water, *e.g.*, borneol and thymol. Aqueous solutions of the compounds hydrolyse slowly on heating, and thus on injection into the body liberate the phenol and the addition product of hexamethylenetetramine with monobromoacetic acid, which has valuable antiseptic properties.—L. A. C.

Benzyl alcohol; Process of producing ——. R. E. Montonna, Assr. to Semet-Solvay Co. U.S.P. 1,416,859, 23.5.22. Appl., 18.5.21.

Benzyl alcohol free from chlorine is prepared by combining crude benzyl alcohol with calcium chloride and subsequently decomposing the compound and separating benzyl alcohol from the residue.—L. A. C.

Nitrophenols; Mercury nitrate as a reagent for the preparation of ——. *Process for the preparation of guanidine.* T. L. Davis. U.S.P. (A) 1,417,368 and (B) 1,417,369, 23.5.22. Appl., 16.4.21.

(A) An aromatic compound is treated with nitric acid and mercury nitrate to produce a complex compound, which is subsequently decomposed to nitrophenol by treatment with nitric acid. (B) Ammonia is used as a hydrolytic agent in the preparation of guanidine from dicyanodiamide. —L. A. C.

Urea; Production of —— *from* [*calcium*] *cyanamide.* Farbw. vorm. Meister, Lucius, und Brüning. G.P. 301,278, 17.3.16.

Iron oxide sludge containing about 83% Fe_3O_4, obtained in the reduction of organic nitro compounds by iron, is added to solutions of calcium cyanamide in, *e.g.*, sulphuric acid, at about 80° C. Conversion to urea is complete after agitation for about an hour. The use of ferrosoferric oxide as catalyst prevents formation of dicyanodiamide, and a smaller quantity of the catalyst is required than if ferric oxide or hydroxide is employed. —L. A. C.

Diethylbarbituric acid and its homologues; Preparation of water-soluble compounds of ——. J. A. Wülfing. G.P. 345,361, 10.10.20.

Solutions of diethylbarbituric acid or its homologues, *e.g.*, phenylethylbarbituric acid, are heated with the calculated quantity of calcium hydroxide, magnesium hydroxide, or freshly precipitated magnesium carbonate. The solutions obtained are filtered and evaporated to dryness *in vacuo*. The products are of therapeutic value, and yield stable mixtures with the alkaline-earth salts of acetylsalicylic acid.—L. A. C.

Fatty acid esters; Preparation of enolic alkali metal compounds of simple ——. W. Scheibler. G.P. 346,698, 16.12.19.

A simple fatty acid ester is added to an alkali metal covered with an inactive solvent, such as ether, benzene, or the like, at a temperature such that the reaction product does not form condensation products, but the hydrogen liberated by the reaction escapes immediately.—L. A. C.

Aminoacetic acid arylides; Preparation of ——. Chem. Fabr. auf Aktien (vorm. E. Schering), and H. Emde. G.P. 346,809, 1.11.19.

Aminoacetic acid arylides, *e.g.*, aminoacetanilide, N-aminoacetyl-*p*-phenetidine, and N-aminoacetyl-*p*-toluidine, m.p. 94° C., are prepared by treating the corresponding isonitrosoacetarylides, Ar.NH.CO.CH:N.OH, with a reducing agent, such as stannous chloride and acetic acid, in the presence of a stream of dry hydrogen chloride, or with tin and dilute acetic or formic acid.—L. A. C.

Sulphonamides; Preparation of mono-substituted ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 346,810, 17.2.20.

Compounds of the general formula, $R'.SO_2.NH.R''$, are prepared without simultaneous formation of di-substituted products by treating sulphonamides with alkylating agents and arylating agents in the presence of metal carbonates. The N-ethylamide and N-benzylamide (m.p. 115°—117° C.) of *p*-toluenesulphonic acid are prepared respectively from *p*-toluenesulphonamide by heating with sodium carbonate and sodium ethylsulphate to 170°—200° C., and by gently boiling with sodium or calcium carbonate and benzyl chloride.—L. A. C.

Cinchona alkaloids; Preparation of mixed carbonic acid esters of ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 346,889, 6.2.20.

Quinine alkaloids are either added to acetoneglycerolchlorocarbonic acid esters, or acetoneglycerol is added to chlorocarbonic acid esters of quinine alkaloids, yielding tasteless compounds which are readily hydrolysed and are nearly equal in value to quinine as febrifuges. A solution of carbonyl chloride in benzene on addition to a solution of acetoneglycerol in dimethylaniline yields acetoneglycerolchlorocarbonic ester, an oil of b.p. 95°—97° C. at 8 mm., which on treatment with a solution of quinine in carbon tetrachloride yields acetoneglycerolquininecarbonic acid ester, m.p. 125°—126° C. Solutions of the ester in dilute acid hydrolyse completely into quinine, acetone, and glycerol. The corresponding ester from cinchonine is an oil.—L. A. C.

Citric acid, tartaric acid, and other organic acids which form calcium salts soluble with difficulty in water; Preparation of ——. F. Mach and P. Lederle. G.P. 346,946, 9.1.20.

Aqueous solutions containing the theoretical weight of oxalic acid are added to cold suspensions of calcium citrate, tartrate, or the like, the mixture is stirred and calcium oxalate is separated by filtration. Pure citric or tartaric acid crystallises out after evaporation of the solution, preferably *in vacuo*. Slight excess of oxalic acid or calcium hydroxide in the solution may be neutralised by the addition of calcium hydroxide or oxalic acid respectively. The ammoniacal residues from the estimation of phosphoric acid by the citric acid method are treated with magnesium sulphate or chloride to precipitate phosphoric acid, and with hydrogen sulphide to precipitate iron; hydrochloric acid is added to the solution, and calcium citrate is precipitated by the addition of concentrated calcium chloride solution. The precipitate is converted into citric acid by treatment as above. —L. A. C.

Santonin; Preparation of —— *from indigenous species of Artemisia.* Soteria G.m.b.H., Chem. pharmazeutische Fabr. G.P. 346,947, 21.9.20.

In extracting santonin from *Artemisia maritima* the whole plant is finely divided, ground for a prolonged period with milk-of-lime, and calcium santoninate is extracted with water or dilute alcohol. The solution is evaporated to dryness, and the residue is acidified and extracted with chloroform; after removing resinous compounds by agitation with dilute ammonia, a syrupy residue of santonin is obtained by evaporating the chloroform. —L. A. C.

α-Ketotetrahydronaphthalene; Preparation of ——. G. Schroeter. G.P. 346,948, 21.1.20.

A solution of chromium trioxide in dilute acetic acid is added to a cooled solution of tetrahydronaphthalene in acetic acid. When the solution, which is at first brown, has changed to a clear green, the acetic acid is separated by distillation, and α-ketotetrahydronaphthalene (α-tetralone) is separated from the residue by distillation in a current of steam. The product, $C_6H_4\left\langle\begin{array}{l}CH_2\cdot CH_2\\ CO\cdot CH_2\end{array}\right.$ is a colourless liquid with an aromatic odour, sp. gr. at 17° C. 1·095, $n_D^{17}=1·570$, b.p. 257° C. at 760 mm. and 132°—134° C. at 15 mm.; it condenses with aldehydes in the presence of alkalis yielding alkylidene-tetralones, *e.g.*, benzylidene-tetralone of m.p. 105° C.; and on reduction with sodium and aqueous or absolute alcohol yields *al*-α-tetrahydronaphthol, b.p. 83°—85° C. *in vacuo*, which decomposes on distillation under normal or slightly reduced pressure into water and Δ′-dihydronaphthalene. α-Tetralone can be used for the preparation of drugs and perfumes, and mixed with tetrahydronaphthalene as a solvent for lacquers.

—L. A. C.

Sulphinides; Preparation of metal [gold] compounds of ——. Farbenfabr. vorm. F. Bayer und Co. G.P. (A) 347,139, 20.5.19, and (B) 348,070, 24.6.19.

Alkali metal compounds of benzoic acid sulphinides or their derivatives are treated with (A) gold hydroxide or (B) gold halides, yielding products of therapeutic value. An aqueous solution of sodium benzoic acid sulphinide is heated to 100° C. with moist gold hydroxide in the absence of light until nearly the whole of the gold hydroxide has dissolved, and the solution is evaporated *in vacuo* in the absence of light at 40° C. Unchanged benzoic acid sulphinide is separated from the residue by solution in warm acetic acid; on cooling the benzoic acid sulphinide crystallises out, and after separating the crystals, gold benzoic acid sulphinide is precipitated by the addition of ether. The product contains 26·91% Au. Gold sulphoaminobenzoic acid sulphinide, $(NH_2SO_2\cdot C_6H_4<{}^{CO}_{SO_2}>N)_3Au$, contains 20·5% Au.

—L. A. C.

Substances containing a low percentage of hydrogen; Production of organic compounds from ——. [*Catalysts for use in reducing and hydrogenating organic compounds.*] C. Paal and C. Amberger. G.P. 346,949, 10.10.19.

Organic compounds are hydrogenated in the presence of a catalyst consisting of an organosol of platinum or palladium, or their hydroxides, with wool fat or its constituents, *i.e.*, cholesterol or isocholesterol, or their derivatives. Compounds which are insoluble in water or in mixtures of water and organic solvents can be reduced in the presence of these catalysts. Reduction can be effected in the presence of all solvents in which wool fat is soluble, and is promoted by the presence of water or mixtures of water and organic solvents. Organic solvents not miscible with water or aqueous solvents, such as aliphatic or aromatic hydrocarbons, ether, solid and liquid fats, olefinic and true terpenes, or their derivatives, may also be employed, but liquids with an anti-catalytic action, such as sulphur compounds, are unsuitable for use as solvents. Reduction readily takes place at room temperature and under normal or reduced pressure, and is accelerated by increased temperature or pressure. Ethylene and acetylene groups, Schiff's bases, hydrazones, osazones, nitriles, azoxy-, azo-, nitroso-, and nitro groups are capable of direct reduction by hydrogen in the presence of these catalysts. Examples are given of the hydrogenation of oils such as castor oil, linseed oil, and cottonseed oil; the hydrogenation of geraniol in stages to citronellol (dihydrogeraniol) and to tetrahydrogeraniol; the preparation of the dihydroderivatives of cinchona alkaloids, such as quinine, cinchonine, and quinidine, by treating the alkaloids dissolved in freshly distilled amyl acetate with hydrogen at 50°—60° C. under an excess pressure of 2—4 atm. in the presence of platinum or palladium hydroxide wool fat organosols; of the conversion of morphine, diacetylmorphine, and codeine in solution in freshly distilled amyl acetate and acetic acid, or of phenetol, to their dihydro derivatives; and of the reduction of benzylideneaniline to benzylaniline, benzylidenephenylhydrazine to benzylphenylhydrazine, and *m*-dinitrobenzene to *m*-nitraniline and *m*-phenylenediamine, with the use of amyl acetate or ethyl caprate as solvent.—L. A. C.

Acetic acid; Recovery of chemically pure —— *from acetic acid containing mercury, e.g., synthetic acetic acid prepared with mercury as catalyst.* Chem. Fabr. Griesheim-Elektron, and N. Grünstein. G. P. 347,190, 17.4.15.

Acetic acid containing small quantities of mercury is heated with material capable of reacting with the mercury, *e.g.*, reducing or oxidising agents, strong acids, salts, etc. The acetic acid may be boiled for a prolonged period with small quantities of organic material, such as cork or rubber, and purified by distillation, after separation of the mercury deposited. Separation of the mercury is more rapid if the acid is heated with concentrated sulphuric or phosphoric acid, or alkali, heavy metal, or aluminium sulphates, or with permanganates, bichromates, or persulphates, or reducing agents such as formic acid. If strong oxidising agents are employed, such as mixtures of sulphuric acid with bichromates, chromates, or permanganates, the acetic acid is purified by removal of impurities such as acetaldehyde, and the mercury is partially converted into salts, which are separated from the acetic acid by distillation *in vacuo*.—L. A. C.

3-*Nitroquinoline and its derivatives; Preparation of* ——. Badische Anilin- und Soda-Fabr. G.P. 347,375, 8.2.20. Addn. to 335,197 (J., 1921, 463 A).

β-Nitroethylidenearylamino-*o*-carboxylic acids, or their derivatives, prepared by treating *o*-aminoarylcarboxylic acids, or their derivatives, with methazonic acid, are treated with condensing agents. 2-β-Nitroethylideneaminobenzene-1-carboxylic acid, m.p. 196°—197° C., 2-β-nitroethylideneamino-5-bromobenzene-1-carboxylic acid, m.p. 182° C. (decomp.), and 2-β-nitroethylideneaminonaphthalene-3-carboxylic acid, prepared by the action of methazonic acid on anthranilic acid, 5-bromo-2-aminobenzene-3-carboxylic acid, and 2-aminonaphthalene-3-carboxylic acid respectively, on heating with acetic anhydride and anhydrous sodium acetate yield respectively 3-nitro-4-hydroxyquinoline, m.p. above 300° C., 3-nitro-4-hydroxy-6-bromoquinoline, m.p. above 300° C., and 3-nitro-4-hydroxy-α-anthrapyridine, m.p. above 300° C.

—L. A. C.

Gold compounds of the Methylene Blue group; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 347,376, 20.5.19.

Compounds of the Methylene Blue group, such as Methylene Blue, dimethyldiethyl-, or tetraethyldiaminophenazthionium, combine in alcoholic solution with gold compounds, *e.g.*, gold chloride

or nitrate, yielding compounds with a strong antiseptic action against *Bacillus pyocyaneus* and *Gonococci*, *Spirochaete*, and tubercle bacilli.
—L. A. C.

Amino-alcohols; Preparation of ——. P. Karrer. G.P. 347,377, 24.8.20.

AMINO-ALCOHOLS are prepared by the reduction of N-acyl derivatives of aminocarboxylic acid esters, or mixtures of the same, with sodium and ethyl alcohol. A mixture of acetylleucine with absolute ethyl alcohol is added slowly to sodium, the mixture is heated gently, and finally boiled for 3 hrs. The solution is diluted with water, alcohol is separated by distillation with simultaneous hydrolysis of the acetyl group, and 1-isobutylethyl-1-aminoalcohol-2, $(CH_3)_2.CH.CH_2.CH(NH_2).CH_2OH$, is extracted by shaking with ether, the solvent being subsequently removed by distillation, yielding a colourless, strongly basic oil of b.p. 194°—200° C. Optically active leucine (natural leucine) yields lævorotatory isobutylethylamino-alcohol. Acetylphenylalanine ethyl ester yields 1-benzyl-1-aminoethyl-alcohol-2, b.p., *in vacuo*, 150°—160° C. The mixture of acetylaminocarboxylic acid esters obtained from casein by hydrolysis and subsequent esterification and acetylation yields a mixture of products which can be separated by distillation *in vacuo* into fractions as follows: b.p. up to 175° C. containing colamine and alaninol; b.p. 105°—190° C. at 16 mm., containing valine alcohol, leucine alcohol, and phenylalanine alcohol; b.p. 190°—235° C. at 16 mm. The products are of therapeutic value.—L. A. C.

Ointments; Preparation of —— which leave no greasy appearance on the skin. Erdöl- und Kohle-Verwertung A.-G., and F. Zernik. G.P. 347,399, 12.4.19.

COLLOIDAL hydrogels of inorganic bases containing a high percentage of water, *e.g.*, colloidal aluminium hydroxide containing 90% of water, are mixed with oils or fats, *e.g.*, vaseline. The products serve as cooling ointments.—L. A. C.

Chloroform; Production of —— from acetaldehyde. Consortium für Elektrochem. Ind., G.m.b.H. G.P. 347,460, 3.3.14. Addn. to 339,914 (J., 1921, 828 A).

IN the process described in the chief patent alkaline-earth hypochlorites are preferably employed, and the mixture is heated during the reaction. A 20% aqueous solution of acetaldehyde is added gradually to a stirred solution of calcium hypochlorite at 45° C. containing 93 g. of active chlorine per l., and after stirring for a short time at the same temperature, and subsequently neutralising the calcium hydroxide with hydrochloric acid, chloroform is separated by distillation. A yield of 80% of chloroform is claimed.—L. A. C.

Kola extract; Preparation of a ——. A. Stephan. G.P. 347,482, 2.8.19.

COARSELY-GROUND, well washed kola nuts, free from dust, are covered with water and treated with carbon dioxide under slight pressure. The mixture is allowed to stand for eight days with occasional shaking, and is then filtered and either concentrated by evaporation or added to mineral waters or pharmaceutical preparations. The presence of carbon dioxide during the extraction inhibits the formation of mould.—L. A. C.

Arylides of aromatic hydroxycarboxylic acids; Preparation of ——. Chem. Fabr. Griesheim-Elektron. G.P. 347,607, 6.9.17.

AROMATIC hydroxycarboxylic acids on treatment with the aluminium or magnesium compounds of aromatic amines react as follows: $R^1.CO_2H+R.NH.M=R^1.CO.NH.R+M(OH)_2$ (R^1=hydroxyaryl, R=aryl, M=metal). Examples are given of the preparation of 2.3- and 1.2-hydroxynaphthoic acid anilides, m.p. of the 1.2-derivative, 145° C. (154° C. on recrystallisation from ether), and salicylic acid anilide, m.p 134° C.—L. A. C.

Bromodialkylacetylureas; Preparation of ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 347,609, 27.11.15.

DIALKYLMALONURIC acids of the general formula, $X_2C(COOH).CO.NH.CO.NH_2$(X=alkyl), are treated with bromine at 100° C., in the presence or absence of solvents, diluents, or bromine-carriers, such as aluminium chloride, until evolution of hydrogen bromide and carbon dioxide ceases. After removal of excess bromine, the products are stirred with water, neutralised with sodium bicarbonate, washed, and recrystallised from dilute alcohol. Diethylbromoacetylurea has m.p. 118°—120° C.
—L. A. C.

β-Nitropropenyl compounds; Preparation of ——. Preparation of ethers of aromatic nitro-alcohols. (A) E. Schmidt and A. Wagner, (B) E. Schmidt and W. Bäjen. G.P. (A) 347,818, 26.2.20, and (B) 348,382, 12.3.20.

(A) AROMATIC propenyl compounds are treated with tetranitromethane or hexanitroethane in the presence of compounds with an alkaline reaction, *e.g.*, tetranitromethane is added, drop by drop, to an ice-cooled solution of isosafrol in acetone and pyridine. When the smell of tetranitromethane has disappeared the solution is shaken with water and extracted with ether. The ether extract is washed successively with potassium hydroxide and dilute acid, dried over anhydrous sodium sulphate, and the ether is separated by distillation, yielding β-nitroisosafrol, $CH_2:O_2:C_6H_3.CH:C(NO_2).CH_3$, m.p. 98° C. The corresponding nitro compounds of anethol, isoeugenol, asaron, and isoapiol are obtained by a similar method. The compounds readily split off the elements of water, yielding nitro-alcohols which on reduction form amino-alcohols of therapeutic value. (B) If the reaction described in (A) is carried out in the presence of an alcohol instead of a compound with an alkaline reaction, such as pyridine, the unsaturated compounds formed thereby simultaneously form addition products with the alcohol, yielding ethers of nitro-alcohols. Thus, anethod on treatment with tetranitromethane in the presence of methyl or ethyl alcohol yields respectively the methyl ether or ethyl ether of 3-*p*-methoxyphenyl-2-nitropropanol. The methyl ether has m.p. 50°—51° C. Similar ethers can be prepared fro *o*-propenylanisol and isosafrol.—L. A. C.

Urea melts from carbonic acid compounds of ammonia; Treatment of ——. Badische Anilin- und Soda-Fabr. G.P. 350,051, 31.8.20.

UNDECOMPOSED ammonium salts present in urea melts are removed by heating the melts under pressure for a short time to such a temperature, *e.g.*, 200° C., that practically the whole of the ammonium salts are volatilised, after, if desired, removal of a portion of the salts by heating to a lower temperature, *e.g.*, 120° C., under pressure.—L. A. C.

Alcohol; Manufacture of ——. Badische Anilin- und Soda-Fabr. E.P. 158,906, 9.2.21. Conv., 9.2.20.

SEE U.S.P. 1,410,223 of 1922; J., 1922, 347 A.

Aralkyl ester of 2-phenylquinoline-4-carboxylic acid. A. Gams and O. Kaiser, Assrs. to Soc. of Chem. Ind. in Basle. U.S.P. 1,378,343, 17.5.21. Appl., 23.6.20.

SEE E.P. 167,066 of 1920; J., 1921, 717 A.

Silver Salts of α-amino-acids; Complex ——. M. Guggenheim, Assr. to The Hoffmann-La Roche Chemical Works. U.S.P. 1,417,167, 23.5.22. Appl., 30.9.19.

See G.P. 339,036 of 1919; J., 1921, 717 A.

Urea; Process of producing —— from lime nitrogen [calcium cyanamide]. O. Nydegger and H. Schellenberg. U.S.P. 1,417,277, 23.5.22. Appl., 6.11.20.

See E.P. 153,574 of 1920; J., 1922, 157 A.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

2-p-Dimethylaminostyrylpyridine methiodide, a new photographic sensitiser. W. H. Mills and W. J. Pope. Chem. Soc. Trans., 1922, **121**, 946—947.

By the condensation by boiling of *p*-dimethylaminobenzaldehyde with α-picoline methiodide and piperidine in alcohol, 2-*p*-dimethylaminostyrylpyridine methiodide, $C_{16}H_{19}N_2I$, bright red prisms with a blue reflex, m.p. 275° C., is produced. Aqueous solutions dye silk a bright orange-yellow, not fast to light. Such solutions are decolorised, but to a less extent than are the isocyanines, by mineral acids. Alcoholic solutions show absorption bands in the blue and green with obscurely marked maxima at about λ4750 and λ4600. The new substance is the most powerful sensitiser for green light yet known for gelatin-silver bromide photographic plates, which, after bathing in aqueous solutions containing 1 pt. of the dyestuff in 30,000 or 40,000 pts. of solution, show almost uniform sensitiveness to light of all wave-lengths from the blue to about λ5600; the photo-sensitiveness then falls off rapidly until it ends at about λ6200. A number of sensitising dyestuffs of this type may be prepared by replacing the α-picoline by its derivatives.—P. V. M.

Capillary attraction, diffusion and displacement [; Application of —— to washing photographic plates, etc.]. L. Lumière. Bull. Soc. Franç. Phot., 1922, **9**, 125—130.

When a band of fabric is suspended vertically so that its upper end dips into water or other liquid capable of wetting it, a slow stream passes down the band, which acts as a kind of capillary siphon. The rate of flow depends on the nature of the material and, up to a certain point, on the difference in level between the upper and lower ends of the band; after a certain value, any increase in this difference produces no difference in the rate of flow. This phenomenon is applied in an apparatus for washing photographic plates. In this the plates are gently pressed against a band of cotton fabric carrying a stream of water in the manner described. Further applications given are the washing of precipitates when only very small quantities of wash water may be allowed, and the extraction of soluble contents of powdered materials.—W. C.

Patents.

Photographic films with a carrier permeable to water. J. E. Brandenberger. E.P. 179,250, 26.1.21.

In order to produce a layer of photo-sensitive material on one surface only of cellulose films permeable to water, the films are first soaked in a solution of one of the reacting salts, then doubled and bathed in a solution of the other reacting salt. As a result of the doubling only one surface of the film is exposed to the second bath.—W. G.

Light rays, cathode rays, Röntgen rays or the like; Process of and apparatus for treating ——. R. Bengough. E.P. 165,790, 13.9.21.

When a beam of light passes through another beam, the second set of rays acts like a filter, influencing the complementary colour in the first. By means of a tube having side windows, all kinds of rays can be treated.—W. C.

Photographic films with a carrier permeable to water. J. E. Brandenberger. E.P. 179,500, 26.1.21.

Films of viscose or the like which are permeable to water are first thoroughly moistened with water. Ordinary photographic emulsions with a gelatin base can then be coated very uniformly on the films. —W. C.

Photographic papers; Means [drying apparatus] for use in manufacture of ——. J. W. Davies. E.P. 179,832, 25.5.21.

The paper, after being chemically treated on one side only, passes through a drying chamber without being touched on its coated side. The chamber is of approximately cylindrical shape and is heated from the inside; the paper enters from the coating machine and passes round the chamber, and emerges again close to the entrance. The apparatus is specially suitable for ferro-prussiate paper.—W. C.

XXII.—EXPLOSIVES; MATCHES.

Detonating and priming mixtures; Analysis of ——. C. A. Taylor and W. H. Rinkenbach. U.S. Bureau of Mines Tech. Paper 282, 1922, 33 pp.

Lists of inorganic and organic materials used in detonating compositions are given and methods of removing the charges from detonators. Details are given of the analysis of mixtures of mercury fulminate and potassium chlorate, and of the analysis of mixtures containing trinitrotoluene, tetryl, nitromannitol and nitrocellulose. Methods are also given for the analysis of priming compositions containing chlorate and picric acid, lead azide and tetryl, and lead azide and trinitrotoluene. Lists are given of inorganic and organic materials used in primer compositions and methods are given for the analysis of single primers and typical priming mixtures, including complex non-corrosive mixtures. —H. C. R.

Patents.

Explosive. J. R. Mardick, Assr. to Acheson Graphite Co. U.S.P. 1,415,889, 16.5.22. Appl., 29.7.21.

Black blasting powder is provided with a uniform glaze of finely-divided, amorphous graphite produced by electrical means whereby a product characterised by improved covering and moisture-resisting qualities, uniformity of carbon and mineral content, increased sensitiveness, uniform progression of burning and velocity of explosion is obtained. —L. A. C.

Primer for small-arms ammunition. H. T. Peck, Assr. to The Peters Cartridge Co. U.S.P. (A) 1,416,121, (B) 1,416,122, and (C) 1,416,123, 16.5.22. Appl., 20.7.21.

A priming composition contains trinitroresorcinol, a thiocyanate, and (A) potassium chlorate and normal lead trinitroresorcinol, (B) an oxidising agent and diplumbic trinitroresorcinol, and (C) an oxidising agent and mercury fulminate.—L. A. C.

XXIII.—ANALYSIS.

Gasometer for providing a continuous current of gas. R. Schleipen. Chem.-Zeit., 1922, **46**, 406.

Two bottle-shaped reservoirs are connected at the bottom by a short tube and at the top by a single neck which is provided with a four-way tap. The bores of the latter are so arranged that a supply of gas from a cylinder or other source of supply enters one reservoir, which is filled previously with water or other liquid; the water passes through the tubulure into the other reservoir, discharging gas from this through the other bore of the tap to the place where it is required. As soon as all the water has been forced into the second reservoir, the tap is turned so that the operation proceeds in the reverse manner. The water or other liquid simply passes from one reservoir to the other, alternately, and when once it has been saturated with the gas, solubility of the latter in the water does not affect the measurement of the gas.—W. P. S.

Gas analysis; The absorption meter, an apparatus for ——. L. Moser. Z. anorg. Chem., 1922, **121**, 313—315.

A simplified form of the apparatus previously employed for the gravimetric estimation of hydrogen phosphide (J., 1922, 327 A) is described. The apparatus has been tested and gives good results in the estimation of sulphur dioxide, cyanogen, hydrogen cyanide, silicon fluoride, the hydrides of arsenic and antimony, ozone, and chlorine. It is unsuitable for gases which require an absorption liquid affected by the air, *e.g.*, for the absorption of carbon dioxide by baryta water.—W. T.

Calorimetry; Maintenance of the adiabatic condition in ——. F. Barry. J. Amer. Chem. Soc., 1922, **44**, 899—937.

A closed calorimeter is described which may be used for the determination of heat changes which accompany slow chemical reactions. The calorimeter is used in a thermostat and all conducting parts which are in contact with the surrounding air are surrounded by air gaps. The accuracy with which the heat content of the calorimeter can be maintained is ±0·5 cal. in ten hours. (*Cf.* J.C.S., July.)—J. F. S.

Surface tension; Determination of —— from the maximum pressure in bubbles. S. Sugden. Chem. Soc. Trans., 1922, **121**, 858—866.

A simple form of apparatus for the measurement of surface tension by the method of maximum pressure in bubbles consists of a narrow cylindrical vessel immersed in a thermostat and fitted with a rubber stopper carrying two tubes, one 3 mm. in diameter with a sharp inner edge, the other drawn out to a fine capillary. A side branch connects this vessel with a water pressure gauge and a mercury suction bulb the capillary of which regulates the rate of formation of bubbles in either of the open tubes in the cylindrical vessel. Measurements of the surface tension of water and benzene made by this means show close agreement with values obtained by the method of capillary rise.—P. V. M.

Indicator; Use of a universal ——. F. H. Carr. Analyst, 1922, **47**, 196—197.

The indicator consists of a mixed solution of methyl red, naphtholphthalein, and phenolphthalein, to which are added bromothymol blue or thymolphthalein and cresolphthalein or cresol red; such a mixture exhibits a series of colour changes over a range of p_H from 3 to 11.—W. P. S.

Ultra-violet light; Use of —— in analysis. A. F. Kitching. Analyst, 1922, **47**, 206—207.

The fluorescent effects produced by the action of ultra-violet light may be used to distinguish one substance from another; for instance, cotton is readily distinguished from wool or silk, casein from gelatin, certain kinds of paper from others, etc. Acetone can be detected in alcohol, 1% giving a distinct effect. With quinine, 1 in one hundred million parts of water, with uranine, 1 in one thousand million, and with æsculin, 1 in ten thousand million, distinct fluoresence is shown under favourable conditions.—W. P. S.

Arsenic, antimony, and bismuth; Invisible "mirrors" [in the detection] of ——. H. Scheucher. Monatsh., 1921, **42**, 411—420.

Bettendorff's reaction provides an extremely delicate microchemical test for arsenic. Into a fine capillary tube are introduced about 2 cub. mm. of the solution to be tested and four times as much of a solution of 1 pt. of stannous chloride in 2 pts. of fuming hydrochloric acid. One end of the tube is sealed to a point and it is then heated for a short time in a bath of boiling amyl alcohol. The tube is centrifuged and the arsenic appears in the point of the tube as a brown precipitate. In this way 0·01γ of arsenic (γ=0·001 mg.) can be detected at a dilution of 1 in 250,000. The test is not interfered with by antimony, tin, lead, copper, or cadmium. The magnesium ammonium arsenate test, applied microchemically, is only sensitive to 0·1γ. The Marsh test, using Lockemann's method (Z. angew. Chem., 1905, **18**, 416) is sensitive to 0·1γ of arsenic. With less arsenic the "mirror" becomes invisible but if the tube which should contain the mirror is treated with bromine vapour to oxidise the arsenic and then subjected to the above test, much smaller quantities of arsenic can be detected. Invisible mirrors of antimony can also be detected by applying the flame test described by Paneth (Ber., 1918, **51**, 1739). The supposed mirror is dissolved with a drop of nitric acid which is then transferred to a piece of pure ignited calcium carbonate held in a platinum loop. When this is then placed in the edge of a hydrogen flame, a sky-blue colour shows the presence of antimony. This reaction is sensitive to 0·001γ. The reaction can also be applied to a bismuth mirror prepared from bismuth hydride as described by Paneth (*loc. cit.*). Bismuth gives a cornflower blue luminescence in the hydrogen flame. (*Cf.* J.C.S., July.)—E. H. R.

Microanalysis; Pregl's ——. F. Holtz. Ber., 1922, **55**, 1496—1497.

The use of a bomb furnace in the estimation of halogen and sulphur is avoided by placing the bomb tubes in brass tubes, closed at one end and stoppered at the other, which are heated in the vapour of boiling diphenylmethylamine, b.p. 205° C. The estimation of nitrogen in difficultly combustible substances is effected in silica tubes which are filled in the following order: asbestos plug, oxidised copper wire (7 cm.), reduced copper wire (11 cm.), asbestos plug, copper oxide powder mixed with the substance and a little potassium chlorate (4 cm.), oxidised copper wire (5 cm.). The tube is supported at either end on gutters lined with asbestos in such a manner that the portion of it which contains the reduced copper is exposed to the direct heat of the burner. This part of the tube is doubly protected on its upper side. After displacement of the air by carbon dioxide, the reduced copper is raised to a white heat and, after a second passage of carbon dioxide, the heating of the remainder of the tube is effected very gradually in the direction towards the reduced copper. In this manner, the decomposition of oxides of nitrogen is effected with certainty. Substances may be dried conveniently in a hollow copper cube the walls of which are 1 cm. thick and 6·5 cm. long internally.—H. W.

Copper and iron; Estimation of —— in the presence of one another by means of trivalent titanium. W. M. Thornton, jun. J. Amer. Chem. Soc., 1922, 44, 998—1001. (*Cf.* J., 1921, 281 A.)

A MIXTURE of cupric and ferric sulphates in less than 100 c.c. of water is acidified with 10 c.c. of sulphuric acid (1:1), cooled to 15° C., and treated with a quantity of 10% ammonium thiocyanate solution (2·5—5·0 c.c.) depending on the amount of copper anticipated. The solution is titrated with a standard solution of titanium trisulphate until the pink colour just vanishes. The titre gives the sum of the copper and iron present. The whole is heated to incipient ebullition to coagulate the cuprous thiocyanate, cooled and filtered. The precipitate is thoroughly washed with cold water, and the filtrate and washings cooled to 15° C. The solution has by this time probably become pink again due to air oxidation. If so, the colour is bleached by the careful addition of titanium trisulphate and sufficient silver nitrate (2·5—5·0 c.c. of 25% solution) is added to precipitate the whole of the thiocyanate. The ferrous iron is then titrated with a standard solution of potassium permanganate. The method is accurate and trustworthy, but the precaution of testing the titanium solution for iron must be taken and if such is found the permanganate titre corrected for this amount. —J. F. S.

Arsenic; Qualitative reactions for ——. I. M. Kolthoff. Pharm. Weekblad, 1922, 59, 334—350.

THE reaction of Mayençon and Bergeret (J. Chem. Soc., 1874, 1008; reduction to arsine and detection with mercuric chloride paper), under suitable conditions will detect 0·001 mg. arsenic in 1 c.c. That of Bougault (reduction to free arsenic by means of hypophosphite) will detect 0·002 mg. (*Cf.* J.C.S., 1922, ii., 455.)—S. I. L.

Arsenic reaction; Aluminium for the ——. G. Romijn. Chem. Weekblad, 1922, 19, 177—179.

IN the Mayençon and Bergeret reaction (*cf.* Kolthoff, *supra*) aluminium is more suitable than zinc. (*Cf.* J.C.S., 1922, ii., 455.)—S. I. L.

Antimony; Detection of —— in analysis. T. Sabalitschka and H. Schmidt. Ber. deuts. Pharm. Ges., 1922, 32, 132—135.

To obviate the necessity of using platinum, antimony may be detected in the solution of the sulphides of antimony and tin in concentrated hydrochloric acid as ordinarily obtained in the course of analysis, by diluting a portion of this solution with an equal volume of water, adding a piece of arsenic-free zinc to the cooled liquid, in a test tube, and testing the issuing gases with a piece of filter paper freshly moistened with a 10% solution of silver nitrate. In presence of considerable amounts of antimony the paper immediately becomes black on the under side, or within 2 mins. with only minute amounts. A slight brownish coloration is not to be taken into account; and it is important that the silver nitrate solution is not too concentrated, otherwise small amounts of antimony hydride may cause only a brownish-yellow coloration instead of black as is obtained with dilute silver solutions.—G. F. M.

Rock dust in air; The sugar-tube method of determining ——. A. C. Fieldner, S. H. Katz, and E. S. Longfellow. U.S. Bureau of Mines, Tech. Paper 278, 1921. 40 pages.

A DETERMINATION of the dependence of the efficiency of sugar filters for very fine particles in air upon such factors as the size of filter tube, depth of sugar layer, size of sugar granules, and presence of moisture. Two methods of testing were employed. In one a suspension of tobacco smoke or silica dust was passed through the filter and the amount of smoke or dust present in the stream prior to and after passing the filter ascertained optically by means of the Tyndall effect. In the other method, the filtering efficiency was determined gravimetrically. The following results were obtained. The filtering efficiency of sugar tubes increases with the diameter of the tubes, and decreases with increasing velocity of air. Sugar wetted with water or 35% alcohol and tested as regards filtering efficiency with silica dust, showed an average increase of 4% for water and 5% for the alcohol by the optical method. The filtering efficiency of the sugar increased with increasing fineness. The efficiency of a layer of granulated sugar 1 inch deep, tested by means of tobacco smoke was 14%, while the efficiency of a layer 4 inches deep was 38%. Tests by the gravimetric method with silica dust showed higher efficiencies than tests by the optical method. For determining the filtering efficiencies of sugars, blank tests must be run for every lot. Tests by the gravimetric method showed filtering efficiencies ranging from 70% to 95%. A tube containing 65 g. of pulverised sugar, 48- to 150-mesh size, possessed an efficiency greater than 92% against tobacco smoke for 15 minutes.—J. S. G. T.

Ammoniacal nitrogen in nitrogenous organic substances; Determination of —— and particularly in proteins and their products of hydrolysis. J. Froidevaux. Comptes rend., 1922, 174, 1238—1240.

To 15 c.c. of the solution under examination 35 c.c. of 60% aqueous sodium hydroxide is added, and air, carefully freed from ammonia, is bubbled through at the ordinary temperature at the rate of 150—200 bubbles per minute. The issuing air is passed through a known volume of standard acid, which is renewed from time to time. The acid is titrated and the amount of ammonia absorbed is plotted against the time. The resulting curve consists of a line sharply inclined to the time axis and one slightly inclined to this axis, the two being joined by a curved portion. The first line corresponds to ammoniacal nitrogen and the second to ammoniacal nitrogen coming from the slow decomposition of protein or amino-acids, the curved portion being a combination of the two. The two straight lines are produced and their junction represents the total ammoniacal nitrogen originally present as such in the sample.—W. G.

Tyrosine, tryptophan, and cystine; Colorimetric methods for the separate estimation of —— in proteins. O. Folin and J. M. Looney. J. Biol. Chem., 1922, 51, 421—434.

CERTAIN defects in the method of Folin and Denis (J. Biol. Chem., 1912, 12, 239) for the estimation of tyrosine are remedied, and an extension is made to include the separate estimation of tryptophan and cystine. When tryptophan is to be estimated, the protein is hydrolysed by means of barium hydroxide to avoid loss due to humin formation. In the case of cystine, which is decomposed by boiling alkalis, acid hydrolysis is used. For the estimation of tyrosine and tryptophan, the hydrolysate, which must contain between 3·5% and 7·5% of sulphuric acid, is filtered from barium sulphate, and tryptophan is precipitated from an aliquot part of the filtrate by the addition of Hopkins and Cole's mercuric sulphate reagent (a solution containing 10% of mercuric sulphate and 5% of sulphuric acid). After separation by centrifuging, tyrosine is estimated colorimetrically in the supernatant liquid by means of Folin and Denis's phenol reagent in the presence of sodium carbonate and sodium cyanide.

The estimation of tryptophan is made similarly in the solution obtained by dissolving the mercuric sulphate precipitate in sodium cyanide. In the case of cystine, sodium carbonate is added to the hydrolysate, and the cystine is reduced by means of sodium sulphite. The colour produced on addition of the uric acid reagent is then compared with a standard. Results of the application of the method to a number of proteins are given. (The phenol reagent is prepared by boiling 15 g. of molybdic oxide and 10 g. of sodium hydroxide in 200 c.c. of water, adding 100 g. of sodium tnugstate, 50 c.c. of 85% phosphoric acid, 100 c.c. of concentrated hydrochloric acid, and enough water to bring the volume to 800 c.c., boiling the mixture for 10 hrs. in a flask fitted with a reflux condenser, then removing the condenser, adding a few drops of bromine to decolorise the solution, boiling off the excess of bromine, cooling, filtering, and diluting to 1 litre.)
—E. S.

See also pages (A) 493, *Benzene in petroleum spirit* (Schwarz). 497, *Acidity and alkalinity in cotton fabrics* (Coward and Wigley). 499, *Thiosulphates and polythionates* (Sieber); *Polythionates* (Kurtenacker and Fritsch). 500, *Vanadic acid* (McCay and Anderson). 503, *Phosphorus in iron* (Graziani and Losana). 504, *Chromium and nickel in steel* (Simion); *Technical nickel* (Breisch and Chalupny). 508, *Microchemical fat analysis* (Lührig). 509, *Sublimed white lead* (Paxton). 511, *Sulphates in soil* (Hirst and Greaves). 512, *Starch in starch pulp* (Parow). 514, *Acids in wine* (Von Fellenberg). 515, *Sulphites in foods* (Chapman); *Allyl mustard oil* (Luce). 517, *Alkaloids* (Herzig); *Ambergris* (Cole). 518, *Mononitrophenols etc.* (Margosches and Vogel). 519, *Maleic acid* (Weiss and Downs); *Acetic anhydride* (Reclaire); *Ointments* (Evers and Elsdon). 524, *Application of capillary attraction* (Lumière); *Detonating and priming mixtures* (Taylor and Rinkenbach).

Patent.

Carbon dioxide and combustible gases containing carbon; Means for quantitative detection of ——. Victoria Falls and Transvaal Power Co., Ltd., and W. O. Andrews. E.P. 179,696, 18.2.21.

Carbon dioxide present in gaseous mixtures or produced by combustion of the latter is determined by absorption in an aqueous solution containing a coloured indicator and subsequent comparison of the colour with standard tints.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given: they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Boberg, Testrup, and Techno-Chemical Laboratories. Drying moist materials. 16,818. June 17.

British Thomson-Houston Co. (General Electric Co.). Obtaining visible temperature records. 17,014. June 20.

Dickson and Mann, Ltd., and Thornton. Apparatus for wet separation of granular materials. 16,859. June 19.

Dunlop (Reid). Furnaces. 16,637. June 15.

Hase. Pyrometers. 17,461. June 24.

Knowles. Hydro-extractors. 17,194. June 22.

Mauclère. Plant for manipulating liquids. 16,945. June 19. (Fr., 20.6.21.)

Morison. De-aerating or degasifying liquids. 16,479. June 14.

Nordström. Drying-plants. 17,179. June 21.

Powdered Fuel Plant Co. Pulverising or grinding apparatus. 17,125. June 21. (Fr., 8.3.22.)

Power Specialty Co. Furnaces for oil stills, superheaters, etc. 16,740. June 16. (U.S., 2.7.21.)

Prior. Agitators and mixing-devices. 16,552. June 15.

Smith. Furnaces. 17,008. June 20.

Sweetland. Distillators. 16,943. June 19.

Complete Specifications Accepted.

34,919 (1920). Bohrmann. Evaporation of liquids. (181,406.) June 28.

167 (1921). Chenard. Apparatus for fractional distillation. (156,218.) June 21.

662 (1921). Bramwell. Filtration of liquids. (181,044.) June 21.

3965 (1921). Thorssell and Troell. Agglomerating pulverous material. (181,413.) June 28.

6863 (1921). Brown and Coldrey. Drying-apparatus. (181,082.) June 21.

7115 (1921). Dunlop Rubber Co. (Lewis and Green). Apparatus for drying materials carrying a volatile inflammable solvent and recovering the solvent. (181,100.) June 21.

7457 (1921). Mauss. Vacuum filtration of colloidal matter from liquid mixtures. (181,123.) June 21.

7818 (1921). Heylandt Ges., and Unruh. Cooling and liquefying air and other gases. (167,144.) June 21.

8019 (1921). Metallbank u. Metallurgische Ges., and Gensecke. Operation of evaporating plants heated with compressed vapours. (181,482.) June 28.

8296 (1921). Merz and McLellan, Weeks, and Baker. Heat interchangers. (181,501.) June 28.

8303 (1921). Steigner. Kilns. (181,502.) June 28.

11,860 (1921). Reynolds, Dickin, and Kenyon. Separation or grading of powdered materials and treatment thereof by air or other gases or vapours. (181,560.) June 28.

25,247 (1921). Lodge Fume Co. *See* XI.

27,841 (1921). Powdered Fuel Plant Co. Pulverising or grinding apparatus. (181,290.) June 21.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

British Thomson-Houston Co. (General Electric Co.). Filaments for electric incandescent lamps. 17,358. June 23.

Brown. Retorting shale oil. 16,524. June 14.

Browne. Carbonisation and distillation of coal etc. 16,816. June 17.

Elektrizitätswerk Lonza. Purification of acetylene. 16,389. June 13. (Switz., 18.8.21.)

Gas Research Co. Gas-producer system. 17,372. June 23. (U.S., 30.7.21.)

General Electric Co. Manufacture of filaments for electric incandescent lamps. 17,161. June 21. (Ger., 13.7.21.)

General Motors Research Corp. Fuels. 17,373. June 23. (U.S., 15.4.22.)

Higginbotham. Production of hydrocarbons. 16,364. June 13.

Munn, and Whitehall Petroleum Corp. Apparatus for chemically treating mineral oil products. 17,158. June 21.

Power Specialty Co. 16,740. *See* I.

Tooley and Tooley. Retorts for distilling coal etc. 16,621. June 15.

Whitehall Petroleum Corp. (Greenspan). Purification of hydrocarbons. 17,273. June 22.

COMPLETE SPECIFICATIONS ACCEPTED.

34,419 (1920). Persch. Treatment of petroleum and other hydrocarbon oils. (181,034.) June 21.

34,473 and 36,183 (1920) and 2372 (1921). Rigby. Drying peat etc. (181,035.) June 21.

34,874–5 (1920). Helps. Gas manufacture. (181,403–4.) June 28.

1510 (1921). Jackson. Improvement of inferior brown coals etc. (157,794.) June 21.

1511 (1921). Jackson. Production of a fuel for use as a gas-coal substitute. (157,795.) June 21.

2978 (1921). Haddan (Torfverwertungs-ges. Pohl u. Von Dewitz). Dry distillation and coking of raw peat etc. (158,513.) June 28.

4642 (1921). Cumberland Coal and Chemicals, Ltd., and others. *See* VII.

7139 (1921). Tulloch and Smith. Treatment of gas. (181,102.) June 21.

7557 (1921). Ginet. Treatment of bituminous shales. (181,126). June 21.

10,828 (1921). Trent Process Corp. *See* XII.

13,180 (1921). Booer, and District Chemical Co. Materials for purifying acetylene. (181,571.) June 28.

14,058 (1922). Helps. Gas manufacture. (181,665.) June 28.

III.—TAR AND TAR PRODUCTS.

APPLICATIONS.

Ellis, Goskar, Kissock, and Vivian. Treatment of tar etc. 16,704. June 16.

Higginbotham. 16,384. *See* II.

IV.—COLOURING MATTERS AND DYES.

APPLICATIONS.

Bloxam (Chem. Fabr. Griesheim-Elektron). Manufacture of azo dyestuffs. 17,272. June 22.

Ransford (Cassella u. Co.). Production of dyestuffs containing sulphur. 16,927. June 19.

COMPLETE SPECIFICATION ACCEPTED.

14,161 (1921). Johnson. *See* XIII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Briggs, Yorke, and British Cellulose and Chem. Manuf. Co. Apparatus for producing textile products. 16,597. June 15.

Dreaper. Apparatus for filtering solutions for making artificial silk etc. 17,186. June 22.

Erikson. Soda recovery process in sulphate paper-pulp manufacture. 16,687. June 16.

Haigh. Carbon etc. coated papers. 17,456. June 24.

Lilienfeld. Manufacture of cellulose derivatives. 16,307, 16,308, 16,310. June 12. (Austria, 13.6.21.)

Lilienfeld. Manufacture of artificial threads and textiles. 16,309. June 12. (Austria, 13.6.21.)

Marriott. Manufacture of artificial silk. 16,406. June 13.

Ott. Composition for coating celluloid films etc. 17,173. June 21.

Roberts. Steam-heated drying cylinders for fabrics etc. 16,967. June 20.

COMPLETE SPECIFICATIONS ACCEPTED.

852 (1921). Harnist. Treatment of crude cellulose. (156,777.) June 28.

8282 (1921). Carpmael (Bagley and Sewell Co.). Manufacture of paper. (181,140.) June 21.

27,245 (1921). Tomlinson-Haas, Ltd., and Smith. Apparatus for drying textile materials. (181,286.) June 21.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Auchinachie. Waterproofing fabrics. 17,338. June 23.

Dunnachie. Washing, bleaching, and/or dyeing. 16,843. June 19.

Halter. Dyeing-machines etc. 16,295. June 12.

Kent and Tither. Mercerising, bleaching, dyeing, or finishing cloth. 17,333. June 23.

Lilienfeld. Dyeing alkylcelluloses. 16,306. June 12. (Austria, 13.6.21.)

Wallis. Calico-printing machines. 17,086. June 21.

COMPLETE SPECIFICATIONS ACCEPTED.

8591 (1921). Lee and Sons, and Pinder. Machines for dyeing hanks of yarn etc. (181,506.) June 8.

11,272 (1921). Thornber and Henshilwood. Machines for bleaching, dyeing, finishing, etc. fabrics. (181,552.) June 28.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Baumgartner. Manufacture of chromate of soda. 16,651. June 15.

Chem. Fabr. Griesheim Elektron. Production of basic magnesium carbonate. 16,271. June 12. (Switz., 11.6.21.)

Chem. Fabr. Weissenstein. Manufacture of hydrogen peroxide. 17,381. June 23. (Austria, 3.8.21.)

Erikson. 16,681. *See* V.

Hurter. Manufacture of alumina from aluminium sulphate. 16,640. June 15.

Jacobson. Process of making anhydrous metallic chlorides. 16,197. June 12. (U.S., 10.6.21.)

Johnson (Badische Anilin u. Soda Fabr.) Production of formic acid derivatives. 17,032. June 20.

Jones. 16,528. *See* XIII.

Robinson. Purification or refining of sulphur. 16,289. June. 12.

COMPLETE SPECIFICATIONS ACCEPTED.

4419 (1921). Deuts. Gold- u. Silber-Scheideanstalt, and Liebknecht. Manufacture of prussic acid. (181,058.) June 21.

4642 (1921). Cumberland Coal Power and Chemicals, Ltd., West, and Jaques. Production of hydrogen. (181,062.) June 21.

7898 (1921). Stubbs. Bleaching stained earthy minerals. (181,132.) June 21.

8090 (1921). Cederberg and Backstrom. Catalytic oxidation of ammonia. (181,486.) June 28.

9025 (1921). Chem. Fabr. Griesheim-Elektron, and Reitz. Rendering calcium hypochlorite stable. (181,153.) June 21.

10,189 (1921). L'Air Liquide. Synthesis of ammonia. (161,195.) June 21.

19,142 (1921). Kelly. Production of phosphoric acid. (181,255.) June 21.

VIII.—GLASS; CERAMICS.

APPLICATION.

British Thomson-Houston Co. (General Electric Co.). Coating glass surfaces. 17,165. June 21.

COMPLETE SPECIFICATION ACCEPTED.

7149 (1921). Hailwood. Glass manufacture. (181,434.) June 28.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Brereton. Manufacture of compositions for paving, roofing, etc. 17,249. June 22.

Claxton. Manufacture of road paving material. 17,354. June 23.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Clerc and Nihoul. Extraction of tin. 16,636. June 15. (Fr., 15.6.21.)

Ellsworth. Recovery of zinc from complex ores. 17,159. June 21. (U.S., 12.7.21.)

Fertigguss Ges. Zinc alloy for casting in dies or chills. 17,244. June 22. (Ger., 25.6.21.)

General Electric Co. 17,161. *See* II.

General Electric Co. Transformation of crystal structure of drawn wires of tungsten etc. 17,162. June 21. (Ger., 13.7.21.)

General Electric Co. Manufacture of tungsten etc. 17,163. June 21. (Ger., 13.7.21.)

Hadfield. Manufacture of steel. 16,948. June 19.

Herman. Coating and treating materials having an iron base. 17,260. June 22.

Markham, and Staveley Coal and Iron Co. Blast-furnace slag. 16,291. June 12.

Marks (Electro Metallurgical Co.). Zirconium alloys. 17,261. June 22.

Metzl. Treatment of gold- and silver-bearing antimony ores. 16,695. June 16.

Mitsubishi Zosen Kabushiki Kaisha. Alloy for turbine blades. 17,263. June 22. (Japan, 28.7.21.)

Saltrick. Alloy castings. 17,019. June 20.

Wild and Wild. Manufacture of alloy steels and irons. 17,128. June 21.

Wood and Wood. Cupolas. 17,413. June 24.

COMPLETE SPECIFICATIONS ACCEPTED.

34,102 (1920). Andrews. Rustproofing articles of iron and steel. (181,399.) June 28.

34,707 (1920). White (Valley Holding Corp.). Manufacture of magnetic alloy sheets. (181,401.) June 28.

4230 (1921). Rosthorn. Manufacture of copper alloys. (158,882.) June 21.

7482 (1921). Stockport Furnaces, Ltd., Duckworth, and Mead. Gas- or oil-heated furnaces of the crucible type. (181,452.) June 28.

7906 (1921). Ampère Ges., Rothe, and Diefenthaler. Manufacture of molybdenum or iron-molybdenum alloys. (160,143.) June 28.

16,163 (1921). Elmore, and Chemical and Metallurgical Corp. Treatment of lead-bearing mattes. (181,239.) June 21.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Fuller, and Fuller's United Electric Works. Galvanic batteries. 17,150. June 21.

Jones. Electric furnace. 16,351. June 13.

Nyberg. Galvanic cells. 16,301. June 12. (Sweden, 28.3.22.)

Stephens (Grundy). Ozonisers. 16,925. June 19.

COMPLETE SPECIFICATIONS ACCEPTED.

20,059 (1921). Cheney. Storage battery electrolyte. (181,630.) June 28.

25,247 (1921). Lodge Fume Co. (Metallbank u. Metallurgische Ges.). Insulator for electrodes of electrical gas purifiers. (181,284.) June 21.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Eppenberger. Rendering fat-containing granular products impalpable. 16,623. June 15. (Ger., 19.4.22.)

Glabau and Travis. Emulsions and method of preparing same. 17,369. June 23. (U.S., 17.3.22.)

Levey. Continuous deodorisation of edible oils and fats. 16,213. June 12.

Rooke. Extraction of tallow, grease, oil, etc. from bones, fish, skins, etc. 17,458. June 24.

Rooke. Digesters, retorts, and drying-apparatus for extracting fat. 17,459. June 24.

COMPLETE SPECIFICATIONS ACCEPTED.

1322 (1921). Du Pont de Nemours and Co. Deodorising blown or polymerised vegetable or animal oils. (157,401.) June 28.

6787 (1921). Douglas and Sons, and Nicol. Treatment of edible fats. (181,077.) June 21.

8908 (1921). Gleitz. Removing free acids from glycerides. (181,509.) June 28.

10,828 (1921). Trent Process Corp. Separation of oils. (167,738.) June 21.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

British Thomson-Houston Co. (General Electric Co.). Plastic compositions. 17,015. June 20.

Consort. f. Elektrochem. Ind. Improving artificial resins. 17,380. June 23. (Ger., 29.6.21.)

Delclève and Dessemond. Manufacture of Prussian blue. 16,603. June 15. (Fr., 16.6.21.)

Exley, McGregor, and Rimmer. Paint etc. 16,200. June 12.

Jones. Manufacture of a zinc-oxide substance. 16,528. June 14.

Moosman and Trevor. Manufacture of paints. 16,270. June 12.

Ott. Waterproofing composition. 17,174. June 21.

COMPLETE SPECIFICATIONS ACCEPTED.

13,472 (1921). Dreyfus. Manufacture of artificial resin products. (181,575.) June 28.

14,161 (1921). Johnson (Badische Anilin u. Soda Fabr.). Manufacture of pigment-colours. (181,584.) June 28.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATION.

Carpmael (Bayer u. Co.). Treatment of caoutchouc etc. 16,926. June 19.

Fall. Curing rubber latex. 17,027. June 20.

Lennard. Incorporating rubber with tar. 17,046. June 20.

Marter. Treatment of indiarubber etc. 17,038. June 30.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATIONS.

Hell. Tanning skins and hides. 17,396. June 23.

Moeller. Bating and liming hides etc. 16,516. June 14.

Rooke. 17,458. *See* XII.

Complete Specifications Accepted.

288 (1921) Chem. Fabr. u. Asphaltwerke. Tanning materials. (156,254.) June 21.

626 (1921). Niessen. Extraction of glue by means of water. (156,645.) June 28.

6221 (1921). Carmichael and Ockleston. Tanning. (181,067.) June 21.

XVI.—SOILS; FERTILISERS.

Complete Specifications Accepted.

6434 (1921). Lo Monaco. Fertilisers. 159,481. June 21.

18,582 (1921). Niedenzu. Manufacture of artificial nitrogenous fertilisers. (166,887.) June 28.

XVII.—SUGARS; STARCHES; GUMS.

Complete Specifications Accepted.

11,767 (1921). Courtaulds, Ltd., and Stokes. Manufacture of compounds or mixtures of starch and starchy matter and sulphuric acid. (181,197.) June 21.

11,772 (1921). Courtaulds, Ltd., and Lloyd. Manufacture of compounds or mixtures of starch and sulphuric acid. (181,198.) June 21.

XVIII.—FERMENTATION INDUSTRIES.

Complete Specifications Accepted.

6636 and 28,355 (1921). Jensen (Corby). Treating and preparing yeast. (181,076 and 181,293.) June 21.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Brettell (Lepetit). Manufacture of pectin substances for food preparations. 16,515 and 17,076. June 14 and 21.

Glabau and Travis. Baking compounds. 17,370. June 23. (U.S., 24.3.22.)

Glabau and Travis. Vitamin-bearing products. 17,371. June 23. (U.S., 25.3.22.)

Hepburn. Softening water. 17,057. June 20.

Loring. Manufacture of flour. 16,960. June 20.

Martin. Food products. 16,405. June 13.

Torley. Filtering-material for water etc. 16,251. June 12.

Complete Specifications Accepted.

12,260 (1920). Watson, Jones, and Woodlands, Ltd. Manufacture of bread. (181,397.) June 28.

6474 (1921). Waite and Boldy. Apparatus for separating the solid matter from trade effluent etc. (181,071.) June 21.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Best and Collip. Preparation of extracts of pancreas. 16,360. June 13.

Blagden, and Howards and Sons. Manufacture of thymol. 16,632. June 15.

Consort. f. Elektrochem. Ind. Manufacture of esters and ethers of ethylideneglycol and vinyl alcohol. 16,898. June 19. (Ger., 23.6.21.)

Corbett and Habershon. Preparation of vaccines. 16,932. June 19.

Complete Specification Accepted.

17,799 (1921). Napp (Hoffmann-La Roche & Co.). Manufacture of CC-isopropylallylbarbituric acid. (181,247.) June 21.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Application.

Dehn (Pyrocolour Corp.). Colour photography. 16,242. June 12.

Complete Specifications Accepted.

6901 (1921). Luboshey. Sensitive plates and films for X-ray photography. (181,087. June 21.

7646 (1921). Hall. Machines for sensitising papers and other fabrics. (181,460.) June 28.

XXIII.—ANALYSIS.

Applications.

Newman. Means for detecting and indicating presence of choke-damp and fire-damp in mines etc. 17,178. June 21.

Sandy and Turquand. Apparatus for detecting presence of inflammable etc. gases. 16,231. June 12.

Turquand. Means for indicating the presence of gas or of acid or alkaline properties in air, water, etc. 17,357. June 23.

I.—GENERAL; PLANT; MACHINERY.

Membrane filters. **Jander.** *See* **XXIII.**

PATENTS.

Chemical and physical operations; Apparatus for use in connection with ——. A. T. Stuart and G. N. Middleton, Assrs. to The Toronto Power Co., Ltd. U.S.P. 1,417,585, 30.5.22. Appl., 5.7.17. Renewed 27.12.20.

An apparatus for carrying out reactions at high temperatures and pressures is constructed as a closed chamber heated by electric currents in the walls, which are of high electrical resistance and prevented from bursting by pressure-resisting means surrounding them.—B. M. V.

Dryer. F. A. Martoccio. U.S.P. 1,418,010, 30.5.22. Appl., 2.8.20.

A casing is divided by vertical partitions into a number of drying chambers to which air is delivered by a fan mounted in a chamber at one end of the casing. The partitions adjacent to the fan chamber are spaced from the top and bottom of the casing to form air-circulating passages and the drying chamber remote from the fan chamber is formed with a passage between a partition and the end wall of the casing. The upper air passage is fitted with a baffle which compels the air to pass downwards in the drying chamber remote from the fan, and the wall of this chamber is provided with exhaust ports. —H. H.

Dehydrating material; Method of and apparatus for ——. F. Maus, Assr. to S. J. Spoelstra. U.S.P. 1,418,386, 6.6.22. Appl., 3.2.21.

The apparatus consists of an air-cooling chamber, a dehydrating chamber, and connecting conduits, and means for circulating air through the system. —A. de W.

Separation of liquids from solids [drying solids]; Process and apparatus for ——. H. Terrisse and M. Lévy. G.P. 351,216, 27.4.20. Conv., 25.3.20.

The material to be dried is heated in a container by means of a stream of air or gas that has previously been heated to a temperature just sufficient to distil off the liquid without having any injurious effect on the solid. Means are provided for recovering the liquid evaporated.—A. R. P.

Fractional condensation; Process of ——. J. F. W. Schulze, Assr. to The Barrett Co. U.S.P. 1,418,885, 6.6.22. Appl., 21.6.19.

A fraction of a mixed vapour is condensed and is concentrated by heat interchange and dephlegmation with the vapours generated from the fraction by reheating it to a higher temperature than that at which it was in equilibrium with the mixed vapour. The heat is transferred from the mixed vapour to the fraction without contact between the two.—H. H.

Gas-fired shaft furnace. F. and K. Meiser. G.P. (A) 351,195, 8.2.21, and (B) 351,196, 22.2.21.

(A) The furnace is provided with hot air flues leading from the cooling shaft to the burners. Hot air is sucked from the shaft by injecting compressed air, that has previously been heated by the waste gases from the furnace, into these flues, and this air is used for the combustion of the gas used in firing the furnace. The gas also may be preheated by the waste furnace gases, and by preheating both air and gas, limestone may be calcined with low-grade producer gas. (B) The gas used in the furnace is passed through an iron recuperator built in the preheating zone of the furnace and heated by the waste gases, and the issuing hot gas is burnt by means of the hot air drawn out of the shaft as in (A). If necessary the fuel gas may be supplied under pressure, which is not possible with a masonry recuperator.—A. R. P.

Calcining furnace with indirect heating. C. Roschmann. G.P. 351,314, 10.5.21. Addn. to 344,363 (J., 1922, 164 A).

The combustion chambers and air-circulating flues of the furnace are constructed of a series of ribbed plates one above the other, the edges of which are provided with raised ribs to keep them apart. To increase further the working surface the combustion chambers and flues are filled with hollow permeable bodies through which the heating gases and air pass.—A. R. P.

Liquids; Non-corroding and non-freezing ——. Miller Reese Hutchison, Inc., Assees. of A. Z. Pedersen. E.P. 170,274, 23.8.21. Conv., 13.10.20

See U.S.P. 1,405,320 of 1922; J., 1922, 206 A

Drying materials; Process of and apparatus for ——. E. M. Bassler. E.P. 180,394, 11.2.21.

See U.S.P. 1,374,874 of 1921; J., 1921, 376 A.

Separating aqueous and other vapours from fluids and solids; Process for —— *and for preparing dilute sulphuric acid.* O. Maass. U.S.P. 1,417,618, 30.5.22. Appl., 15.4.18.

See E.P. 159,054 of 1919; J., 1921, 248 A.

Liquids; Process for evaporating ——. E. Morterud. U.S.P. 1,418,197, 30.5.22. Appl., 15.10.18.

See E.P. 120,205 of 1918; J., 1919, 853 A.

Heat-exchanging apparatus. Allgem. Elektrizitäts-Ges., and F. Münzinger. E.P. 180,025, 14.2.21.

Furnaces; Oil-fired ——. L. Krause. E.P. 180,176, 23.4.21.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Separation of the constituents of banded bituminous ——. A. E. Findley and R. Wigginton. Fuel, 1922, 1, 106—107.

By employing a combined method of sifting and classification according to density, a sample of coal from the Kirkby Top Hards seam was separated into three main fractions, *viz.*, (1) coal with density less than 1·3, passing through a 30-mesh sieve but being caught on a 60-mesh sieve, and containing 1·55% of ash; (2) coal of density greater than 1·4, passing through a sieve of 30-mesh and being caught on a 60-mesh sieve, and having an ash content of 30·0%; and (3) coal of density greater than 1·4 and passing through a 90-mesh sieve, and containing 15·3% of ash. Fraction 1 seemed to be a mixture of clarain and vitrain, fraction 2 seemed to be durain, whilst fraction 3 apparently consisted of a sort of cannel, known locally as "Jacks." Fraction 1 exhibited the phenomenon of attraction under the influence of an electric charge, whilst the particles of fraction 2 exhibited mutual repulsion. A partial separation of the two fractions from a mixture could be brought about by such means. The phenomenon seems to be connected with the tendency of the bright coal to adhere to a polished surface. Thus, when a mixture of fractions 1 and 2 was sprinkled over a glazed tile and the tile was tilted and tapped, the "adhering portion" contained 14·21% of ash, whilst the "scattered portion" contained 18·57%

of ash. Repulsion of the particles is dependent on their acquiring a like charge to that of the support or conductor, and if the particles be non-conducting, the acquirement of a charge depends on the presence of a surface film of moisture.—A. G.

Coal; Froth flotation tests on bituminous coking ——. O. C. Ralston and G. Yamada. Chem. and Met. Eng., 1922, **26**, 1081—1086.

Tests carried out on a coking coal from the Wilkeson mine (Wash., U.S.A.), No. 3 bed, showed that selective flotation could be successfully accomplished, the clean coal being first removed, followed by the "bone" portion, and finally by the ash. The fine coal will float to a certain extent without the addition of a frothing agent, and in any case this fine portion is most easily floated, very "thin" oils or soluble frothing agents giving the best results. If sufficient oil be added to float the larger sizes of coal, the fine concentrate tends to be dirty, since the fines, which are easily floated, consist of a mixture of fine coal and fine ash. It is therefore necessary to carry out a rough separation, the tailings and the concentrates from this process both being treated separately, and the tailings from this second flotation being rejected. In the cleaning of the concentrate portion, the middlings are retreated with the original feed, and the final middlings product consists almost entirely of "bone" coal which may find a market as a separate product. The "float-and-sink" method of analysis cannot be used for control of the process as regards the fine portion of the coal.—A. G.

Carbonisation [*of coal*]; *Increasing the rate of* ——. G. Weyman. Inst. Gas Eng., June, 1922. Gas J., 1922, **158**, 864—868.

In continuation of previous work (J., 1920, 168 T; 1921, 300 T), an investigation has been made of the relation between the properties of various coals and the rate of carbonisation, the experiments being conducted in a nickel-chrome-steel crucible holding 0·001 ton. The principal conclusions reached include the following: An increase in the rate of carbonisation caused by the alteration of chemical and physical conditions is accompanied by improvement in the calorific value of the gas, and of the thermal and volume yields per ton of coal. The rate of carbonisation can be very considerably increased by selection of suitable coals. When an increase in the rate of carbonisation is effected by increasing the carbonising temperature, for a certain time, the calorific value of the gas obtained at higher temperature is smaller than that of the gas obtained at lower temperature, but volume for volume, there is a slight balance in favour of the former. Volume for volume the calorific value of the gas obtained at higher temperatures falls off at a slightly greater rate than that of the gas obtained at lower temperatures.—J. S. G. T.

Coking processes; Chemistry of ——. *Production of bituminous substances of high melting point and their application to the production of metallurgical coke from non-caking coal.* F. Lierg. Z. angew. Chem., 1922, **35**, 264—268.

Coal tar pitch coked by itself gives hard, smooth coke. Non-coking coal ("sinter coal") requires 20%—30% of pitch admixed to make a good coke, but if the pitch be dissolved in tar oil, 7%—8% suffices. This coking effect observed in small-scale tests is not obtained in large-scale working owing to the long time required for coking and the low melting point of the pitch. The coking effect is best attained on the large scale by the use of bitumen of high melting point, say, 400° C. By extracting finely powdered coking coal with hot pyridine in a Soxhlet apparatus, and mixing the solution with water, a precipitate which dried to a dark-brown powder was obtained, amounting to 20·9% of the coal used. This substance did not melt when heated in carbon dioxide, but gave a swollen coke. The extraction residue had lost its coking properties, and re-addition of the extract to it did not restore them, but when the extract was dissolved in a solvent and added, the coking property was restored. A residue coking at 300° C. was made from coal-tar pitch by extracting with benzol and xylol. Further treatment with light coal tar oil gave a residue (pitch carbon) which was unaffected by heating to redness in a sealed tube, but gave off gas and coked when heated in a crucible, showing it to be a mixture of organic compounds of high molecular weight. The extracts of high melting point prepared as described above by means of pyridine still melted at the same temperature, after being mixed with an inert substance (soot), but showed reduced degrees of swelling. The pitch-carbon was somewhat soluble in hot pyridine, but the dissolved portion was mostly deposited again on cooling. Anthracene oil and heavier oils dissolved the pitch-carbon almost entirely and retained it in solution on cooling. The addition of such solutions enables a hard coke to be made from non-caking coals and even from lignite.—H. M.

Nitrogen; Liberation of —— *from coal and coke as ammonia.* A. C. Monkhouse and J. W. Cobb. Inst. of Gas Eng., June, 1922. Gas. J., 1922, **158**, 828—833. (*Cf.* J., 1921, 760 A.)

When a coke prepared at 500° C. is heated in hydrogen the proportion of nitrogen liberated uncombined is less than in an inert atmosphere. Hydrogen thus may both retard dissociation of ammonia and promote its formation from the coke. This coke, after being heated in hydrogen in stages to 1000° C., contained only 11·2% of the original nitrogen, while 68·2% had been recovered as ammonia. When heated in steam, the coke was completely gasified, the whole of the nitrogen being recovered as ammonia, and above 600° C. more rapidly than in hydrogen. A coke prepared at 1100° C. behaved similarly in steam, but the liberation of nitrogen was slower. Up to 1000° C. the cokes, heated in nitrogen evolved but little sulphur, though in hydrogen nearly all was set free as hydrogen sulphide. The coke prepared at 500° C. gave up 63·4% of its sulphur up to 800° C. and 93·8% up to 1000° C. No dissociation of hydrogen sulphide was observed. The liberation of sulphur by steam at 800° C., if not more rapid was more far-reaching than that by hydrogen at the same temperature. The effect of steam was evident from its action on the coke prepared at 1100° C., sulphur being liberated at 800° C., at which temperatures the nitrogen and carbon were but little attacked.
—H. J. H.

Carburetted water-gas plant with waste heat boiler; Thermal efficiency of a ——. Seventh Report of Research Sub-Committee of Gas Investigation Committee of Institution of Gas Engineers. Gas J., 1922, **158**, 800—823. (*Cf.* J., 1921, 649 A.)

The tests reported were made on two carburetted water-gas sets, installed at the Windsor Street Gas Works, Birmingham, each set having a rated daily capacity of 1,500,000 cub. ft. The sets were working under normal conditions for the production of a gas of calorific value 485 B.Th.U. per cub. ft., and three tests were made, two being over 5-day periods of continuous operation. The results obtained are detailed in 22 tables which include weight and thermal balances. The overall thermal efficiency of the plant, taking into account the steam raised from the "blow gases" by the boiler and that expended on auxiliary machines, averaged 68%. If the necessary steam had been independently generated with an efficiency of 70%, the efficiency would have been only 59·5%. The efficiency of the blue water-gas generator alone, without taking account of the steam required or raised, was only 53% (*cf.* the corresponding figure 56% of the Sixth Report, *loc. cit.*). The increased thermal efficiency of the carburetted water-gas process is due to the high efficiency of the oil-gas production, in these tests reaching 90%. The efficiency, therefore, increases with the amount of oil gasified per 1000 cub. ft.—in this case about 1·8 galls. The coke consumption was about 35·5 lb. per 1000 cub. ft. of carburetted water-gas. The waste-heat boiler generated about 64 lb. of steam per 1000 cub. ft. of carburetted water-gas, with a thermal efficiency of about 45%. Though this was sufficient to operate the plant, more might probably be obtained from the "blow" gases by modification in design. The intermittent operation of the plant involves difficulty in the sampling and measurement of temperature of the gases. A sampling device was constructed, and automatically operated by the valve gear, so that either "blow" or "run" gas could be separately collected over long periods. Special attention was given to the measurement of the temperature of "blow" gases entering the waste heat boiler and the elimination of errors due to lag in the pyrometers. The accumulation of silicious dust noted in the Sixth Report on a blue water-gas plant was not observed, presumably because the dust was removed in the tar.—H. J. H.

Gas meters; Life of ——. Report of Joint Committee of Institution of Gas Engineers and Society of British Gas Industries. Gas J., 1922, 158, 834—836. (*Cf.* J., 1921, 616 a.)

The changes in modern gas practice which have conduced to an increase in the corrosion of distributory systems are discussed. Substitution of oxide for lime purification has brought an increase in the content of carbon dioxide, hydrocyanic acid, and carbon bisulphide; these are all agents of corrosion in presence of moisture, and carbon bisulphide is active also in presence of ammonia. Higher carbonising temperatures cause an increased production of corrosive agents and destruction of the hydrocarbons which produce the protective oily film inside mains etc. This latter, however, can be restored by the use of carburetted water-gas. Deposition of water in mains favours corrosion and is best avoided by a preliminary over-compression, and, after separation of precipitated water, rarefaction to the normal distributing pressure. Increase in the proportion of oxygen in the gas has followed excessive "pull" on the retorts and additions of air at the purifier boxes. Sulphur dioxide is sometimes present in blue water-gas. Scrubbing the gas with solid chalk or washing with a cream of chalk (Taplay's process) is recommended to remove hydrocyanic acid as ammonium thiocyanate. To protect meters from corrosion, the vaporisation into the gas of petroleum oils has been practised. Some oils exert a solvent action on the grease of stuffing-boxes.—H. J. H.

Gas calorimeter; A recording and integrating ——. C. V. Boys. Inst. Gas. Eng., June, 1922. Gas J., 1922, 158, 882—887.

The author describes the construction and operation of a gas calorimeter designed more especially to meet the requirements of the Gas Regulation Act, 1920, in the matter of continuously recording the calorific value of town's gas, but immediately applicable to any gas. The calorimeter (see E.P. 180,080, page 569 a) is of the water-flow type, the water employed being continuously circulated through the apparatus and cooled to atmospheric temperature by a hot-air engine and cooling coil respectively. Water and gas are supplied at the correct respective rates, and the correction of the gas volume as affected by temperature, pressure, and humidity is also effected by a positive operation. The rate of water flow in the calorimeter is determined by the tipping, emptying, and draining at half-minute intervals of a celluloid bucket, the quantity of water discharged being adjusted so that if the gas is of the "declared" calorific value, the rise of temperature of the water in the calorimeter is exactly 10° C. The water supply likewise drives a small overshot celluloid water wheel which drives through an elastic connexion the escapement of a pendulum clock, and through an intervening mechanism—termed the "thinking" machine—the axle of the gas meter. The gas meter drum is of celluloid and is of such construction that the volume trapped is dependent only to a very slight degree upon the water level, which can be maintained nearly exactly constant. The meter drum rests loosely on a screwed axle. Correction of gas volume for temperature and pressure is effected by the intervention of the "thinking" machine consisting of a ball-disc-cylinder integrator, in which the position of the ball is determined by the volume of the air contained in a bell over mercury and water. Rotation of the ball is accompanied by rotation of the cylinder, resulting in endlong motion of the meter drum, whereby the gas inlet to the meter drum is closed or opened as required. The corrections effected are automatically recorded. The occurrence of accidents should the gas supply be temporarily cut off and resumed, or should the water supply cease, is prevented. The calorimeter proper comprises a lead heat interchanger and hot and cold water chambers. The burner is of silica and is surmounted by a silica dome. The operative thermometers are of brass and are sealed full of amyl alcohol. A lever system magnifies the nett deformation of the corrugated covers of the thermometers and the difference of temperature of the thermometers is recorded on a roll of paper kept in motion by a clock. Parallel lines are ruled on the paper to indicate definite percentage departures of the actual measured calorific value from the declared calorific value. An integrating device, operating after the manner of Amsler's planimeter, averages the departures of the calorific value of the gas from the declared calorific value since the indicator was last set.—J. S. G. T.

Paraffin hydrocarbons; Analysis of mixtures of hydrogen with the ——. J. G. King. Fuel, 1922, 1, 103—106.

The gases evolved in the low-temperature carbonisation of coal contain a large percentage of paraffins, varying considerably in composition and containing the higher members of the series. After determination of oxygen and carbon dioxide by absorption with caustic potash and alkaline pyrogallol solutions in the usual way, the gas is introduced into a special silica tube, containing copper oxide and heated to 280° C. The hydrogen and carbon monoxide are burnt to water and carbon dioxide respectively, and the gas is then returned to the main apparatus (that of Bone and Wheeler). The carbon dioxide is absorbed by caustic potash, and from this the percentage of carbon monoxide in the original gas can be calculated, whilst the paraffins are then exploded with excess air. The reductions in pressure after explosion, after absorption by potash, and after absorption by alkaline pyrogallol are noted. From the first of these two figures, the amount of hydrocarbons present can be calculated, and also the value for n in the expression C_nH_{2n+2} which gives the mean composition of the hydrocarbons present. From the third observation, the amount of oxygen used in the explosion can be calculated, and this should agree to within 0·3% of the amount theoretically required for the combustion of the hydrocarbons as determined from the first two observations. The silica tube may be heated by gas or may be wound with nichrome wire of 26 S.W.G., a consumption of 50 watts giving a temperature of about 300° C. This can be reduced to 280° C. by the inclusion of a suitable external resistance.—A. G.

Shale; Recent processes for treatment of oil ——. A. E. von Groeling. Petroleum, 1922, **18**, 487—493, 539—545.

After a critical review of the Scottish method of shale distillation and of other retort processes, the author describes the American "digesting process." The shale passes through a series of pulverisers and is mixed with a stream of preheated heavy oil, passes through a mixing cylinder, and into a still, or digester, where the shale undergoes the first part of the distillation in a series of four horizontal cylindrical or rectangular chambers, from the lowest of which it is transferred to the upper chambers *seriatim* by a screw mechanism. Thence it is transferred to a separate chamber to undergo the final distillation. The apparatus is directly fired, the combustion gases circulating contrary to the movement of the shale. The products of distillation are drawn upwards through the chambers and pass to a preheater for the digestion oil. The shale from the first operation is freed from oil by centrifuging before the final destructive distillation. Colorado shale gave a yield of 87 Amer. galls. of oil per ton, in place of 51 galls. in Scottish retorts. The oils obtained by first and final distillations are respectively of 0·807 and 0·798 sp. gr. and have a content of unsaturated hydrocarbons of 24%. No permanent gas is evolved. The temperature of the first stage is 650° F. (about 340° C.) and of the final stage 1500° F. (about 820° C.). Some kinds of shale have given a yield of 30% of paraffin wax from the oil. It is suggested that still better results would be obtained by the use of superheated steam. —H. M.

Gasoline; Production of —— *by cracking heavier oils.* E. W. Dean and W. A. Jacobs. U.S. Bureau of Mines, Tech. Paper 258, 1922. 56 pages.

Cracking was conducted under varying conditions. The apparatus consisted of a drip-feed lubricator delivering oil into the upper end of an electrically heated vertical iron tube, to the lower end of which was attached condensing and receiving apparatus. The tube contained a chain filling, a considerable length of the chain being packed under its own weight on a support arranged at the middle of the height of the tube. A thermocouple pyrometer measured the temperature of the tube wall midway of its height, and temperature was regulated by a rheostat. Experiments were made using Pennsylvanian distillate of gas oil type, Mid-Continental residuum fuel oil, Pennsylvanian kerosene distillate from which the fractions boiling below 175° C. had been removed, and a kerosene distillate from which constituents boiling below 200° C. had been removed. Increase in the rate of feed produced a decrease in the degree of cracking when the temperature was kept constant. Cracking seemed to occur mainly where the oil was in contact with the surface at which heat was supplied. Other conditions being constant, the yield of cracked products decreased as the temperature increased, the loss varying from 6% to 40%. The conditions which would produce commercial yields of gasoline were accompanied by losses of over 10%. The sp. gr. of the cracked product fell with increase in temperature up to 558° C., after which increase in temperature produced increased specific gravity of the product; at high temperatures the sp. gr. of the product may be greater than that of the raw material. With increased temperature the quantity of gasoline formed increased but the loss also increased. The sp. gr. of the recovered gasoline fraction was raised with increase of temperature, probably owing to formation of aromatic hydrocarbons. At pressures of 50 lb. and over the degree of unsaturation of the gasoline fraction decreased as the temperature increased, presumably owing to the formation of aromatic compounds. The ratio of gasoline formation to recovery loss, of importance in commercial working, is tabulated. Other conditions being constant the percentage of cracked oil recovered generally decreased as the pressure increased. At a temperature of 570° C. the sp. gr. reached a minimum value when using a pressure of 50 lb. per sq. inch. The percentage of gasoline formed generally increased with increase of pressure. The sp. gr. of the gasoline fraction generally increased as pressure increased, presumably owing to the formation of aromatic hydrocarbons. The degree of unsaturation of the gasoline fraction decreased as pressure increased. The pressure favourable to minimum ratio of gasoline formation to recovery loss varied between the limits 50 and 150 lb., depending upon the temperature. Increase in the rate of feed, which is equivalent to shortening the time of reaction, increased the percentage of cracked oil recovered. The sp. gr. of the recovered oil generally decreased with increased rate of feed. The effect of change of rate of feed on the quantity of gasoline formed was irregular. Increase in the rate of feed tended to decrease the sp. gr. of the gasoline fraction when the degree of cracking was considerable. The degree of unsaturation of the gasoline tended to increase with increased rate of feed. Gasoline can be produced more economically at high furnace temperatures and at a high rate of feed than by using lower temperatures and rates. A much larger amount of carbon was formed when using a residual oil as raw material than with a distillate. A series of graphs show the difference in behaviour between Mid-Continental residual and paraffin base distillate. Comparing kerosene with gas oil as a raw material for cracking, with the kerosene the recovery was greater, the yield of gasoline less, its sp. gr. lower and degree of unsaturation less. Kerosene and gas oil are about equally suitable for cracking, the gas oil being slightly easier to transform, but giving rather heavier losses in recovery. Naphthene base oils required a higher temperature for cracking than paraffin base oils. It is not economical to crack oil containing naphtha fractions. It would be more economical to separate the naphtha in a topping plant, and treat the residue in a cracking plant, the naphtha being added to the cracked product, as by this method a greater yield of gasoline would be obtained. The residuum obtained after the removal of gasoline from a cracked product, when recracked, yields less favourable results as regards cracked oil recovery and percentage of gasoline production than a fresh oil, and yields a larger deposit of carbon. The volume of gas formed is closely related to the loss of oil during cracking.—H. M.

Paraffin wax; Effect of —— *on viscosity of petroleum oils.* E. W. Dean and M. B. Cooke. J. Ind. Eng. Chem., 1922, **14**, 410—411.

Commercial paraffin wax was added to samples of water-white kerosene, transformer oil, spindle oil, medium "auto oil," "Liberty aero oil," and distillates prepared from crude oil in the laboratory. All these products had been prepared from Pennsylvanian oils. The addition of wax to kerosene increased its viscosity. The effect on the distillates was negligible, while the other oils suffered a decrease in viscosity. The removal of wax from the distillates produced no appreciable change in their viscosities. The wax could be separated into constituents of different physical properties by dissolving in benzene and cooling. When dissolved in oil, paraffin wax behaved like an oil of low viscosity at temperatures below its melting point.—H. M.

Petroleum oils; Iodine values of ——. S. Kawai. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, **25**, 406—419.

The author has studied the influence of concentration, temperature, and time of absorption on the iodine value of some petroleum oils, using three iodine solutions, viz., those of Wijs, Hübl, and Hanus. The iodine value decreases with increase in the concentration, and increases with increase of temperature and time of absorption. The three different solutions, Wijs, Hanus, and Hübl, give iodine values in descending order.—K. K.

Transformer and turbine oils; Determination of sludge values of ——. F. Schwarz and J. Marcusson. Petroleum, 1922, **18**, 741—742.

50 g. of oil is heated to 120° C. for 50 hrs. in a 200 c.c. Erlenmeyer flask. The oil is then heated for 15 mins. to 80° C. under a dephlegmator with a mixture of 50 c.c. each of 50% (by weight) alcohol and a 4% solution of caustic soda, and afterwards strongly agitated for 5 min. The mixture is then allowed to stand over-night in a separating funnel. As much as possible of the mixture is filtered into a measuring cylinder and extracted with 30 c.c. of light petroleum spirit. The resulting extract is treated with 10 c.c. of 50% alcohol with the addition of a few drops of caustic soda. The alcoholic layer is mixed with the tar soap solution, and acidified with dilute hydrochloric acid. After shaking up two or three times successively with 50 c.c. of benzene, the benzene extract is washed with distilled water till free from mineral acid, evaporated, and dried at 105° C. The amount of tarry matter obtained from the amount of fluid mixture taken gives, by calculation, the proportionate amount for the oil taken.—H. M.

Iodine value. Holde and others. *See* XII.

Patents.

Fuel [*coal*]*; Method of burning* —— *in furnaces.* W. H. Nield and W. Melland. E.P. 180,401, 16.2.21.

Coal is caused to travel along a horizontal tube in the upper part of the furnace, so that it becomes coked on its passage, and the coke falls from the open end of the retort-tube on to grate bars and is burnt. The coal gas etc. is drawn out by a fan backwards from the retort and passed through condensers where by-products are collected, and the residual gas is burnt in the furnace at a point below the retort but above the fire-bars.—B. M. V.

Gas-heated ovens and retorts. Stettiner Chamotte-Fabr. A.-G. vorm. Didier. E.P. 174,039, 4.11.21. Conv., 12.1.21.

In an installation comprising a number of oven units heated independently, each unit is provided with an auxiliary gas producer which is not used for normal working, but, as a rule, serves only for heating the unit up to working temperature. Normally, a main gas producer serves to supply the necessary heat for working all the units. The auxiliary producers can be cut off from their respective oven units, and communicate with each other by means of conduits provided with valves. Above the auxiliary producer, which is directly connected with the oven, there is a recuperator which is heated by the waste gases from the oven and through which the gas from the main gas producer passes.
—A. R. M.

Retort for gas-producing apparatus. S. F. Sworski and F. F. Ratajezak. U.S.P. 1,418,745, 6.6.22. Appl., 18.7.21.

A gas-generating receptacle, the walls of which at the bottom and lower part are thicker than at the upper part, is suspended in the upper part of a furnace. A bucket fits snugly into the lower part of the receptacle.—A. R. M.

Chamber oven for the manufacture of gas and coke. H. Koppers. G.P. 350,483, 3.6.14.

In chamber ovens utilising rich gas and low-grade gas, it is the practice to dilute the rich gas with flue gas to the same calorific value as the low-grade gas. On the other hand, in plants using the rich gas alone, the regenerator is combined with collecting mains running on either side of the battery which serve as reversal mains, conveying alternately air for combustion and flue gases. By the invention it will be possible in an installation of the latter type to heat one part with rich gas diluted with flue gas, and another part with low-grade gas. The collecting reversing mains serve as flue gas mains and as conduits for air diluted with flue gas, and are combined with connecting pieces which have connexions with these mains, with the conduit for low-grade gas and with the open air, and can be closed as desired.—A. G.

Furnace for the continuous production of gas and coke. E. Riepe. G.P. 350,509, 31.5.21.

The furnace contains two vertical retorts which are connected at their lower open ends by a square main, through which the coke is discharged. If it is desired to produce a specially good gas, lignite and coal may be carbonised simultaneously in the two retorts. The upper end of the retort filled with lignite is closed and the gases from the lignite are withdrawn and passed through the charge of coal, acting as an internal heating medium. The poor gas reacts with the coal yielding a richer gas which is mixed with the gas evolved by carbonisation of the coal.—A. G.

[*Oil*] *gas; Process and apparatus for making* ——. General Oil Gas Corp., Assees. of W. C. Dayton. E.P. 167,736, 19.1.21. Conv., 9.8.20.

Gas of constant composition and of a calorific value of 200—600 B.Th.U. per cub. ft. or over, is made by mixing a hydrocarbon oil with a stream of preheated air, heating the mixture by means of heat interchange with hot gas leaving the generator, and passing the heated mixture into a gasifying chamber which is maintained at a temperature of 1350°—1750° F. (730°—955° C.). Heat is supplied by combustion of the oil with a quantity of air insufficient for complete combustion. In ordinary working, external heat is not applied, but a pilot burner is provided for heating the chamber when it is desired to make rich gas, or when the apparatus is first put in operation.—A. R. M.

Gas making; Using heavy oil in ——. O. B. Evans and H. G. Terziam, Assrs. to The United Gas Improvement Co. U.S.P. 1,418,782, 6.6.22. Appl., 2.7.20.

Gas oil is gasified by introducing it into a chamber containing preheated checkerbrick. A deposit of carbon is formed on the checkerbrick and is removed by blowing with preheated air.—T. A. S.

Constant heat value; Apparatus for maintaining [*gas at a*] ——. H. F. Smith, Assr. to The Gas Research Co. U.S.P. 1,417,635, 30.5.22. Appl., 11.3.18.

A portion of the gas which is to be maintained at a constant calorific value by dilution is burnt (after dilution) at a constant rate, and the heat produced is utilised to regulate an electrical device which in turn regulates a valve for a fluid under pressure. The latter operates the valve through which the diluent is supplied.—B. M. V.

[*Gas producers;*] ***Method of preventing wall action** [in ——].* H. F. Smith, Assr. to The Gas Research Co. U.S.P. 1,417,636, 30.5.22. Appl., 24.5.18.

In addition to the active fluid (air or steam) which is blown into a gas producer so as to pass mainly up the central zone, a comparatively inert fluid is passed up through the fuel near the walls. —B. M. V.

[*Gas producers;*] *Method of fuel agitation [in ——].* H. F. Smith, Assr. to The Gas Research Co. U.S.P. 1,417,637, 30.5.22. Appl., 1.8.18.

An explosion is caused in a vessel outside the producer, and the high-pressure gases thus produced are admitted to the under side of the ash zone of the fuel.—B. M. V.

Ammonium chloride; Method of producing —— from coal or shales. O. L. Christenson and B. A. Hedman; Hedman, Assee. of K. I. M. Gisiko. E.P. 169,948, 25.2.21. Conv., 6.10.20. Addn. to 159,817 (*cf.* U.S.P. 1,397,264; J., 1922, 4 A).

In the method for recovery of ammonium chloride by impregnating coal or shale before distillation with an alkali chloride, silica, and water, free hydrochloric acid is added as well. The proportions may be 3·2 pts. of 30% hydrochloric acid, 2·5 pts. of silica, and 4 pts. of common salt to 100 pts. of coal. The acid combines with ammonia liberated at temperatures below the decomposition temperature of the salt.—C. I.

Acetylene; Storage receptacles for ——. W. J. Mellersh-Jackson. From Air Reduction Co. E.P. 180,273, 24.1.22.

A tank or cylinder contains a solvent for the acetylene, disseminated through a body of finely-divided wood of the ochroma family, *e.g.*, *Ochroma lagopus* (balsa). The wood, which is of a light, porous, and elastic nature, is introduced into the containing vessel and compressed therein. If desired, a binder or inert porous matter may be added to the wood filling.—A. R. M.

Hydrocarbons; Cracking ——. The Kansas City Gasoline Co., Assees. of H. M. Lasher. E.P. 160,161, 22.2.21. Conv., 12.3.20.

High-boiling hydrocarbons are mixed with a relatively small quantity of carboniferous material, *e.g.*, bituminous coal, and heated with agitation in a still or retort. Arrangements are made for passing forward light distillate and the return of heavy distillate for further cracking. Fresh high-boiling hydrocarbon is added to the carboniferous material to replace that distilled off. The distillation is carried on at atmospheric pressure out of contact with the air. In an example given the cracking temperature was 600°—1000° F. (about 315°—540° C.).—T. A. S.

Petroleum oils; Process and apparatus for the distillation and cracking of ——. S. L. Gartlan and A. E. Gooderham. E.P. 179,644—5, 8.2.21.

A mixture of steam and petroleum oil is fed into a retort, and the vapours are drawn off by a compressor and condensed under pressure, which is varied according to the final product desired. The retort is heated by a step-by-step process, the liquid volatile at each temperature being drawn off at that temperature and the pressure in the retort being maintained at about that of the atmosphere. As the temperature of distillation rises, steam superheated to that temperature is admitted to the retort. It is stated that 75% of the petroleum oil can be converted into low-boiling naphtha. —T. A. S.

Petroleum; Method of refining ——. Refining oil. P. T. Sharples. U.S.P. 1,416,890—1, 23.5.22. Appl., (A) 12.3.20, (B) 6.4.22.

(A) The residue, obtained after distilling off gas, naphtha, and burning oils from crude petroleum with the avoidance of substantial cracking, is chilled to precipitate the wax. The chilled residue is submitted to centrifugal treatment under such conditions that the wax and residue free from wax are continuously discharged. (B) The residue, obtained by the removal of the lower-boiling constituents from crude petroleum without substantial cracking, is treated to cause the precipitation of the wax whilst maintaining the fluidity of the oil, so that they may be separated by centrifugal force; the wax and oil free from wax are discharged continuously.—T. A. S.

Mineral oil and carbohydrogen [hydrocarbon] gas extracting process. G. Schneiders, Assr. to A.-G. "Eos." U.S.P. 1,418,097—8, 30.5.22. Appl., (A) 2.9.19, (B) 15.8.21.

(A) A passage driven into a bituminous deposit is protected by means of an air-dam which prevents the leakage of gas and oil into the passage. The gas and oil are removed from the deposit by means arranged in the passage. The air-dam is moved along into the deposit as gas and oil are removed. (B) Oil-bearing sand is removed from a deposit and simultaneously subjected to separating treatment. The process consists in dislodging the sand by a jet of fluid so that by the action of the jet and friction of the grains the adherent bitumen is removed. —T. A. S.

Petroleum vapour; Apparatus for treating ——. D. W. Hoge, Assr. to Izash Oil and Refining Co. U.S.P. 1,418,375, 6.6.22. Appl., 14.6.17.

Petroleum vapour is converted into gasoline by passing it through a continuous conduit built up of straight sections and heated in a bath of molten metal. The conduit system is bodily removable from the bath.—T. A. S.

Cracking oils; Process of and apparatus for ——. G. L. Hoxie. U.S.P. 1,418,713, 6.6.22. Appl., 9.8.18.

The process consists in heating a small portion of the oil to cracking temperature and immediately mixing it with a large volume of oil at a substantially lower temperature, the low-boiling products being distilled off from the large volume of oil. Several forms of apparatus are proposed for working the process.—T. A. S.

Emulsion; Process of making ——. Process of making waterproof composition. Coloured bituminous compositions and process of making same. Waterproof product. Process of treating saturated fibrous compositions. Process of saturating felt. L. Kirschbraun. U.S.P. 1,417,835 and 1,417,837—41, 30.5.22. Appl., (A) (D) 1.2.19, (B) 15.7.20, (C) 16.3.18, (E) 10.9.19, (F) 21.11.19. Renewed (C, D, E) 28.10.21, (F) 7.11.21.

(A) A bulk supply of emulsion is formed by making a mixture of water and colloidal clay, adding a waterproof adhesive binder, and thoroughly mixing into an emulsion in which the binder forms the internal phase and the water and emulsifying agent the external phase. Further quantities of water and colloidal clay and of binder are separately fed into the bulk supply, the latter being agitated whilst forming the emulsion. (B) A stock is made consisting of bitumen in a discrete form in an aqueous vehicle and containing an oxidising agent.

(c) A bituminous product consists essentially of solid residue remaining after steam distillation of wax tailings. The product is yellowish brown and pitchy, and has a conchoidal fracture when cold. (D) Mottled waterproof sheet is prepared by making a coloured, emulsified, bituminous matrix and mixing this with a fibre of different colour from the matrix. The mixture is formed into a sheet so that an uneven surface distribution of the binder is caused, thus producing a mottled appearance. (E) The fibrous and bituminous constituents of waste saturated felt are recovered for re-use by mechanically disintegrating the fibres with their contained bitumen in the presence of a heated emulsifying agent. (F) A hot bituminous liquid is applied to one face of hot dry felt, at or adjacent to the point where it is being wound up.—T. A. S.

Petroleum oil sludges; Separation of ——. S. H. Diggs, Assr. to Standard Oil Co. U.S.P. 1,418,781, 6.6.22. Appl., 23.12.18.

The acid sludge obtained in the treatment of petroleum oils with sulphuric acid is mixed with sludge obtained by treating oils with fuming acid and with gas oil. The whole is mixed with water and steamed, when separation of the acid takes place. The operations are repeated until practically all the acid is removed. The residues are suitable for the manufacture of commercial asphalt. —T. A. S.

Gas generator. S. Moore. U.S.P. 1,418,158, 30.5.22. Appl., 7.12.21.

See E.P. 168,951 of 1920; J., 1921, 762 A.

Ammonium chloride; Process of producing —— *in coking or distilling coal in coking plants and gasworks.* O. L. Christenson and B. A. Hedman; Hedman Assee. of K. I. M. Gisiko. E.P. 159,817, 24.2.21. Conv., 3.3.20.

See U.S.P. 1,397,264 of 1921; J., 1922, 4 A.

Ammonium chloride; Method of producing —— *in combusting or distilling alum slate or similar bituminous shales.* O. L. Christenson and B. A. Hedman; Hedman Assec. of K. I. M. Gisiko. E.P. 161,161, 25.2.21. Conv., 27.3.20. Addn. to 159,817.

See U.S.P. 1,397,264 of 1921; J., 1922, 4 A.

Liquid fuel; Method of raising the specific gravity and flash points of ——. L. W. Bates. E.P. 153,591, 9.11.20. Conv., 10.11.19.

See U.S.P. 1,390,229 of 1921; J., 1921, 761 A. (Reference is directed, in pursuance of Sect. 8. Subsect. 2, of the Patents and Designs Acts, 1907 and 1919, to E.P. 149,306; J., 1921, 571 A.)

Liquid fuel and method of manufacturing it. L. W. Bates. E.P. 161,929, 24.12.20. Conv., 12.4.20. Addn. to 149,306.

See U.S.P. 1,390,232 of 1921; J., 1921, 761 A.

Motor fuels containing alcohol; Process for preparing ——. Chemical Fuel Co. of America, Assees. of E. W. Stevens. E.P. 159,880, 3.3.21. Conv., 9.3.20.

See U.S.P. 1,372,465 of 1921; J., 1921, 338 A.

Oil-bearing solids; Process and apparatus for treating ——. J. T. Fenton. E.P. 180,157, 12.4.21.

See U.S.P. 1,396,173 of 1921; J., 1922, 5 A.

Oil heater for topping stills. J. E. Bell, Assr. to Power Specialty Co. U.S.P. 1,418,272, 6.6.22. Appl., 10.6.20.

See E.P. 176,099 of 1920; J., 1922, 284 A.

Coke oven doors and doorways. L. Wilputte. E.P. 180,373, 19.1.21.

Gas retorts; Apparatus for discharging ——. J. Y. Johnson. From Soc. "Entreprises et Matériel." E.P. 180,856, 20.4.21.

Gas producers; Grates for ——. K. Koller. E.P. 165,047, 17.6.21. Conv., 24.4.20.

Gas purifiers, scrubbers and the like; Grids for ——. H. S. Sadler. E.P. 180,731, 23.2.21.

See also pages (A) 538, *Distillation of oils* (E.P. 180,347). 539, *Lubricating oils* (G.P. 350,801 and 351,201); *Condenser for vacuum distillation of petroleum* (G.P. 351,004). 546, *Purifying gases* (E.P. 180,024); *Removing hydrogen sulphide from gases* (G.P. 350,591). 555, *Reducing gases* (G.P. 350,647). 566, *Formaldehyde* (E.P. 180,016). 567, *Oxidising olefines* (U.S.P. 1,418,368). 569, *Gas calorimeters* (E.P. 180,080).

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Burners; Some gas —— *and a moral.* C. Carpenter. Inst. Gas Eng., June, 1922. Gas J., 1922, **158**, 853—861.

The development of modern gas lighting burners is briefly reviewed, and it is pointed out that conditions governing the manufacture of these appliances are nowadays such as to facilitate the manufacture and use of shoddy burners—faulty in construction and inefficient in use. Curves are given comparing the lighting efficiencies of samples of such burners with that of the "Metro" burner introduced by the author. Thus, while the lighting efficiency of the "Metro" burner is 3930 mean radial candle-hours per therm, the efficiencies of various shoddy burners range from 920 to 2940 mean radial candle-hours per therm. A plea is urged that gas supply undertakings should formulate certain standards to which gas fittings, burners, glassware, mantles, etc., should conform. Reference is made to certain scientific principles concerning gas burner design, more especially to the deposition of dust upon the injector orifices, and to the phenomena of air-entrainment by the issuing jet as conditioned by the size and disposition of the orifices. The orifice dimensions, and their disposition in the case of multiple-hole injectors, may be such as to produce inherent instability and unsteadiness of the flame of the burner.—J. S. G. T.

Methane; Purification of gases [for incandescence lamps] from ——. G. R. Fouda and H. N. van Aernem. J. Ind. Eng. Chem., 1922, 14, 539—540.

In the usual method for the removal of methane from nitrogen or argon for gas-filled lamps, by the action of heated copper oxide, an inconveniently high temperature is necessary. The decomposition of methane, $CH_4=C+2H_2$, with a nickel catalyst, for which Mayer and Altmayer (Ber., 1907, **40**, 2134) have determined the equilibrium constant, is facilitated by a low partial pressure of methane, and is therefore suitable. Investigations with a mixture of nitrogen with about 2% of methane have substantially confirmed Mayer and Altmayer's figure. A series of equilibrium curves for different temperatures is given, showing for example that at 500° C. this treatment reduced the methane content of a gas from 1·5% to 0·24%. The gas must afterwards be passed over copper oxide to remove the hydrogen liberated.—C. I.

Patents.

Retorts for the distillation of oil-bearing shales or other like materials. J. S. Black. E.P. 179,964, 29.7.21.

The contents of the vertical retort are supported on a platform, above which is a member which oscillates angularly so as to break up and discharge the spent shale. The products of distillation are drawn off at various heights from the sides of the retort, with a view of effecting a separation of the distillates.—T. A. S.

Peat and like substances; Method of distilling and gasifying —— [and production of cement]. A. A. F. M. Seigle. E.P. 180,081, 24.2.21.

Agglomerates are prepared by mixing peat or the like with calcium carbonate, calcium chloride, and silicious matter or cement, and are hardened by treatment with saturated steam under pressure in a digester so as to cause formation of calcium hydrosilicate. The agglomerates are distilled at a comparatively low temperature, say 550°—580° C., in order to obtain condensable hydrocarbons, ammonia, methyl alcohol, aliphatic compounds, etc., and afterwards heated to a higher temperature, whereby complete gasification of the fixed carbon is effected with the formation of, mainly, carbon monoxide and other permanent gases. A residue of hydraulic lime is obtained by heating to a temperature of 1100°—1200° C., while if the temperature is raised to 1500° C. the residue consists of hydraulic cement.—A. R. M.

Retorts for destructive distillation; Vertical ——. E. Burnet. E.P. 180,161, 13.4.21.

Vertical retorts of narrow rectangular cross-section, particularly adapted for the distillation of shale, are provided at various heights in their side walls with horizontal slots of such dimensions and having their lower surfaces so inclined that the column of descending material can spread out at these positions without coming to rest. Distillation products are withdrawn through these openings and hence do not have to pass through the whole column of material in the retort. The retorts may be made with special sections formed as described above, interposed between the sections of the usual shape, and the heating flues are also divided into sections so that the temperature of the special sections of the retort can be maintained at a temperature independent of that of the ordinary sections.
—A. R. M.

Carbonisation; Apparatus for —— with endless belt for the material to be carbonised and internal heating. F. Caspari. G.P. 351,279, 31.12.20.

The gas offtake is situated immediately below the trough of the perforated endless belt, which is loaded with the raw material. The gases evolved are therefore immediately removed from the hot zone of the furnace and are not subjected to overheating. Decomposition of the tar is also prevented.—A. G.

Charcoal; Vegetable ——. Wilson Bros. Bobbin Co., Ltd., and S. C. Bone. E.P. 180,611, 22.10.21.

Vegetable charcoal which is free from liability to spontaneous ignition, is prepared by passing ordinary vegetable charcoal, preferably direct from the retort in which it has been made, through chambers containing an inert gas, preferably a gas containing free nitrogen, whereby the charcoal becomes impregnated with the gas.—A. R. M.

Thermionic cathodes [for vacuum tubes] and method of making the same. Western Electric Co., Ltd. From Western Electric Co., Inc. E.P. 180,090, 28.2.21.

An electron-emitting cathode consists of a core, formed of an alloy of Pt 95% and Ni 5%, coated with a thermionically active material. The latter is prepared by coating the core with alkaline-earth carbonate, *e.g.*, barium or strontium carbonate, and heating for 5—20 mins. in an atmosphere of oxygen at 1200° C., and subsequently *in vacuo* or in a non-oxidising atmosphere for several minutes at 1000° C. Palladium, osmium, rhodium, iridium, or ruthenium may replace the platinum in the core, and the nickel may be replaced by cobalt.
—J. S. G. T.

III.—TAR AND TAR PRODUCTS.

Coal tar; Stoppage of condenser in distillation of ——. W. Spalteholz. Chem.-Zeit., 1922, **46**, 544.

In distilling a tar with a high content of water, after driving off the water, light oil, and part of the creosote oil and naphthalene, crust-like formations were noticed at the condenser outlet, and the flow of oil almost ceased. There followed an explosive ejection of oil mixed with crystalline masses of ammonium chloride, which was formed to the amount of about 5—10 kg. per 15,000 kg. of tar. The large quantity of ammonium chloride is attributed to the use of coal which had been in contact with sea water during transport.—H. M.

Benzene, toluene, and m-xylene; Distillation of a mixture of ——. L. Gay. Chim. et Ind., 1922, **7**, 851—854.

The distillation takes place in two successive dephlegmating columns. The process may be conducted so as (1) to separate practically pure *m*-xylene at the base of the first column, and to separate the mixed benzene and toluene in the second column, or (2) to extract benzene from the top of the first column, and to separate the liquid mixture of toluene and *m*-xylene by further distillation. A series of triangular graphs show the rate of exchange of heat units, and under what circumstances the first, and when the second process is preferable. If the triangular diagram be divided into two portions by a line extending from the toluene corner to a point on the benzene-*m*-xylene side corresponding to 72% of benzene, for liquid mixtures, or by a line extending from a point on the benzene-toluene side corresponding to 85% of benzene to a point on the benzene-*m*-xylene side corresponding to 51% of benzene, for gaseous mixtures, then those mixtures falling in the lower portion of the triangle are best separated by method (1) and those falling in the upper portion by method (2).
—H. M.

Tetralin (tetrahydronaphthalene) and dekalin (decahydronaphthalene); Physico-chemical investigation of ——. W. Herz and P. Schuftan. Z. physik. Chem., 1922, **101**, 269—285.

Tetralin and dekalin are useful solvents, and have possibilities as combustibles and sources of power, and are also of value for lubrication. They have the following physical constants—b.p., 207·3° C. and 191·7° C.; heat of vaporisation, 79·32 cals./g., 71·01 cals./g.; m.p., $-35·0° \pm 0·5°$ C., $-124° \pm 2°$ C.; sp. gr. at temperature *t*, $0·9843(1-763\times10^{-6}t)$, $0·8975(1-818\times10^{-6}t)$; surface tension at the boiling point, 17·46 dynes/cm., 15·71 dynes/cm. respectively. (*Cf.* J.C.S., July.)—J. F. S.

Patents.

Distillation of liquids, such, for example, as tar and oils. J. L. Wilson. E.P. 180,347, 17.11.20.

The oil is distilled in a continuous still, inert gas being passed through the distilling liquid. Separation of the distillates is effected by fractional condensation. Heat is conserved by using the condensers and the coolers for the still residue as preheaters for the incoming oil. The arrangement of the still-head prevents the return of any condensed liquid to the still. Vapours from the preheaters and those not condensed by condensers in the preheaters are passed through water-cooled condensers.
—T. A. S.

Condenser for vacuum distillation of petroleum, tar, etc. L. Steinschneider. G.P. 351,004, 6.3.20. Conv., 13.8.18.

Between each outlet tube and the common main, serving as conduit for all vapours from the distillation units to the condenser, there is a catch-tube, provided with a waste pipe. If the contents of a still froth over they pass through the catch-tube and the waste pipe to a catch pot situated underneath, and cannot pass through the common main to the condenser. The operation of the other stills is thus not interfered with. Entrained oil can be separated from the vapour in the catch-tubes by means of baffles, and can be recovered, whilst the vapour passes on to the central condenser.—A. G.

Hydrocarbons; Processes for refining ——. J. Demant. E.P. 179,610, 4.2.21.

The acid treatment of hydrocarbons for the removal of impurities is varied so that instead of the foreign matters being lost in solution in concentrated acid they are polymerised and recovered as high-boiling oils from the hydrocarbons by subsequent distillation. To this end the hydrocarbon is treated with relatively dilute acid at suitable temperatures. The action is catalytic; the acid is unchanged, and may be used repeatedly. By treating 90% benzol with 10% of its weight of sulphuric acid of 46° B. (sp. gr. 1·468) at about 65°—70° C. for 5—6 hrs., and subsequent treatment with soda and distillation, pure benzol is recovered, and on distilling the residue with steam, oil and a varnish-like material are obtained. In the case of coal tar naphtha treatment with acid of 46°—48° B. (sp. gr. 1·468—1·498) at 110° C. for 5—6 hrs. converts the indene and coumarone into a viscous oil of high value, having a freezing point of −10° to −15° C.—T. A. S.

Naphthalene and other volatile solid organic bodies; Purification of ——. C. E. Andrews, C. Conover, K. B. John, and C. E. Ruth. E.P. 179,991, 19.1.21.

Crude naphthalene, or other volatile solid organic material, is heated to its melting point, *e.g.*, about 110°—120° C., in a vessel provided with coils through which hot oil is circulated. Heavy impurities in the naphthalene sink into a space below the coils, while an outlet pipe attached to the end of the vessel at a point above the bottom conveys the liquid material to the middle of a series of three vaporisers arranged in steps. Each vaporiser is heated by coils containing hot oil, the lowest of the series to 140°—150° C., the middle one to 120°—130° C., and the uppermost to 110°—120° C. Vapour from the middle vessel passes into the uppermost vessel, in which a portion condenses and returns as liquid to the middle vessel, while the remainder passes to a series of condensing chambers. Liquid from the middle vessel flows into the lowest vessel, whence the vapour returns to the middle vessel, and the residual liquid is withdrawn. Air or other gas is blown through the liquid in the bottom vessel, and each vessel is provided with baffles alternately attached to and clear of the lid. A quantity of sodium hydroxide or the like, amounting to 0·5 to 5% of the weight of the naphthalene charged into the apparatus, is added, *e.g.*, as a 5% aqueous solution, to one or more of the vaporisers.—L. A. C.

Lubricating oils; Process for the production of —— of high viscosity from coal tar oils. Chem. Fabr. Worms A.-G. G.P. 350,801, 13.9.17.

The oils are treated at ordinary, or higher, temperatures with an acid condensing agent other than sulphuric or waste acid. Suitable condensing agents are sulphuryl and thionyl chlorides, phosphorus chlorides, phosphorus oxychloride, aluminium chloride, phosphorus pentoxide, and sulphur dichloride. Anthracene oil, with a flash-point of 140° C. and a viscosity of 4·6° Engler at 40° C., gives, on treatment with sulphuryl chloride and removal of the hydrochloric acid produced, a lubricating oil with a flash-point of 172° C. and a viscosity of 40° Engler at 40° C.—A. G.

Lubricating oil substitute. G. Schultz. G.P. 351,201, 15.5.17.

The residue from the preparation of anthracene from anthracene oil, which is rich in phenanthrene, is dissolved in petroleum or solvent naphtha and is treated with sodium. Alcohol is then added gradually until all the sodium has been combined, the liquid is diluted with water, the aqueous solution separated, and the oil distilled. The lubricating oil is produced from the fraction boiling above 300° C. Instead of nascent hydrogen (sodium and alcohol) molecular hydrogen may be used in the presence of a catalyst.—A. G.

[Tar] distillation process and product thereof. J. M. Weiss, Assr. to The Barrett Co. U.S.P. 1,418,893, 6.6.22. Appl., 7.2.20.

See E.P. 158,852 of 1920; J., 1921, 575 a.

IV.—COLOURING MATTERS AND DYES.

Electrochemical study of the reversible reduction of organic compounds. J. B. Conant, H. M. Kahn, L. F. Fieser, and S. S. Kurtz, jun. J. Amer. Chem. Soc., 1922, **44**, 1382—1396.

The reduction-oxidation potentials of six anthraquinonesulphonic acids have been measured by a titration method, using titanous chloride and sodium hydrosulphite, and the results obtained over a wide range of hydrogen-ion concentration have been found to be in accord with a general equation established for expressing the reduction-oxidation potentials of compounds of the type of quinone, *e.g.*, vat dyestuffs, in both acid and alkaline solutions. The validity of the method is shown by determinations of the potentials of mixtures of the reduced and oxidised compounds.—W. G.

Patent.

Mordant dyeing dyestuffs and chromium compounds thereof; Manufacture of ——. O. Imray. From Soc. of Chem. Ind. in Basle. E.P. 180,433, 22.2.21.

See U.S.P. 1,402,350 of 1922; J., 1922, 137 a.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cotton; Effect of fireproofing solutions on ——. G. Durst. Textilber., 1922, **3**, 228—229.

The work of Sibley (J., 1921, 806 a) is adversely criticised, mainly on the ground that the tests were not carried out under conditions which would apply to the large-scale fireproofing of cotton fabrics.—A. J. H.

Silk-fibroin; Composition of —— and its structure. E. Abderhalden. Z. physiol. Chem., 1922, **120**, 207—213.

100 g. of silk-fibroin (free from ash) yielded 25 g. of *d*-alanine, 2·5 g. of *l*-leucine, 1·5 g. of phenylalanine, 1·8 g. of *l*-serine, and 1 g. of *l*-proline. Altogether 86·4% of the amino-acids were accounted for. The examination of the products of hydrolysis in the intermediate stages of hydrolysis showed the presence of considerable quantities of *d*-alanylglycine-anhydride, m.p 240°—247° C., $[\alpha]_D = -5{\cdot}02°$, small quantities of glycyl-*l*-tyrosine-anhydride, and a compound containing serine, *d*-alanine, and glycine.—S. S. Z.

Wood and other raw materials; Determination of cellulose in —— by the action of chlorine dissolved in carbon tetrachloride. E. Heuser and H. Casseus. Papierfabr., 1922, **20**, Fest- u. Auslandsheft, 80—93.

The determination of cellulose in wood by Cross and Bevan's chlorination method is simplified and brought more under control by treating the ground material with a solution of chlorine in carbon tetrachloride. A solution saturated by passing chlorine gas through carbon tetrachloride at the ordinary temperature contained 8·10 g. of chlorine per 100 g. of solvent and was practically stable for several weeks. The wood should be ground to a meal of medium fineness; too coarse particles are attacked unevenly and too fine particles present some difficulty in the subsequent filtrations. It is not necessary to remove the fat and resin by preliminary extraction. The chlorination proceeds too slowly if the wood is treated in the dry state and the best procedure, in the case of wood meal of medium fineness, is to moisten the material in a Gooch crucible and allow it to drain without suction before proceeding to the first chlorination. For the second and third chlorinations the quantity of moisture must be greatly reduced and a current of air is sucked through the cake of material in the Gooch crucible for a considerable time. A special apparatus used by the authors for the treatment of the wood with chlorine consists of a short wide cylindrical shaking-funnel fitted with a ground stopper and a tap at the lower end. The lower part of this funnel is ground to fit into the upper part of the Gooch crucible, which is detached for the shaking treatment and attached for the filtration and extraction treatments. About 1·5 g. of wood meal is treated in the funnel with 50 g. of the chlorine solution, the stopper is tied down, and the mixture is shaken in a shaking machine. With the right degrees of moisture, the times of chlorination may be reduced to 30 mins. for the first, 20 mins. for the second, and 15 for the third. After each treatment the funnel is fitted to the Gooch crucible, the tap is opened, and the contents are transferred to the filter chamber. The carbon tetrachloride is filtered off and the cake is washed first with alcohol and then with water. Treatment with hot 2% sodium sulphite solution in the Gooch crucible then follows, and the purified residue is transferred again to the funnel for the next chlorination. The consumption of chlorine may be determined by shaking the carbon tetrachloride filtrate with potassium iodide solution and titrating; a train of gas-washing vessels containing potassium iodide should be inserted between the filter flask and the pump. The results are extremely concordant, showing 59·7% of cellulose, containing pentosan, in wood meal; the cellulose is free from lignin and the absence of destructive oxidation is shown by the low "copper value" of the final product, *i.e.*, 0·8—0·9, as compared with 3·2 for the cellulose prepared by the chlorine gas method.—J. F. B.

Sulphite pulps; Determination of the chlorine consumption value of ——. R. Sieber. Zellstoff u. Papier, 1921, **1**, 181—184. Pulp and Paper Mag., 1922, **20**, 425—427. (*Cf.* J., 1921, 382 A; 1922, 409 A.)

The results of the test originally described are greatly influenced by the degree of alkalinity of the bleach liquor and the temperature at which it acts. The prescription, therefore, is modified by specifying an alkalinity equivalent to 10 c.c. of $N/10$ caustic soda in the quantity of bleach liquor taken, and a standard temperature of 20° C. The quantity of active chlorine taken for 5 g. of dry pulp is 0·3 g. and the necessary conditions are best established by mixing calculated quantities of two bleaching powder solutions of different known strengths and alkalinities. The following formula is useful for calculating the necessary quantities of the two solutions: $x=(422w-220q)/(wp-vq)$ and $y=(250p-422w)/(wp-vq)$, in which p and q are c.c. of $N/10$ As_2O_3, required for 5 c.c. of the stronger and weaker solutions respectively, and v and w are c.c. of $N/10$ acid equivalent to 25 c.c. of the respective solutions. Then $x+y$ c.c. of the mixed solutions contains 0·3 g. of active chlorine and an alkalinity equivalent to 10 c.c. of $N/10$ caustic soda. One solution is made up with 30 g. of bleaching powder per litre and the other with 80—90 g. Both are filtered and preserved in brown glass bottles under a layer of paraffin oil. The two solutions are standardised every time before mixing, and sufficient of the mixed solution may be prepared to last a week; this is also kept in a brown bottle under paraffin, the bottle being connected with the burette for the test.—J. F. B.

Artificial silk industry; Progress in the ——. E. Bronnert. J. Soc. Dyers and Col., 1922, **38**, 153—162.

In the manufacture of collodion silks the recovery of the organic solvent is one of the major economic problems. When spinning into aqueous baths, the author succeeded in eliminating the use of ether by dissolving the dinitrocellulose in a mixture of alcohol and calcium chloride. Cuprammonium solutions of cellulose are obtained economically in a sufficiently concentrated form by suitable pre-treatment of the cellulose and the judicious use of low temperatures. Fine silk of good quality is obtained by spinning with dilute acid, but the caustic soda coagulating baths are more generally employed and are moreover essential for spinning thick filaments (horsehair). Temperatures up to 60°—70° C. are employed. The addition of sugar to the caustic soda bath is necessary in order to preserve the lustre; the sugar prevents the formation of coarse precipitates of cupric hydroxide in the thread and holds it in the form of a clear solid solution. The recovery of the copper and ammonia from the spent baths presents no serious difficulty. The resistance to water of cuprammonium silk is stated to be superior to that of other artificial silks, and this is one of the reasons which justify the survival of the process. By the so-called "stretch spinning" of Thiele-Bemberg, filaments of a fineness down to 2 deniers are obtainable with cuprammonium solutions from relatively large orifices. Such fine counts had not, up to now, been possible with viscose. The influence of the composition of the coagulating bath on the shape of the cross-sections of viscose silk has been studied, and the author showed in 1913 that when spinning filaments of about 8 deniers the quantity of sodium sulphate in the bath must be definitely in excess of the equivalent required to produce sodium bisulphate with the acid. A study of the effect of varying the concentration of the acid in the coagulating bath has now revealed the fact that the fineness of the filaments which can be spun is a function of the concentration of the acid. With a given viscose and a given size of jet orifice the minimum concentration of acid which must be present in the bath increases inversely as the square root of the denier required. More concentrated viscose solutions require either smaller orifices or higher concentrations of acid to give filaments of the same degree of fineness, and with the same viscose smaller orifices require lower minimum concentrations of acid than larger orifices. Hence a series of inter-related spinning conditions has been established which enable filaments of any degree of fineness down to 0·75 denier to be spun with accuracy.—J. F. B.

Cellulose complexes; Transformations of —— during the manufacture of artificial silk. W. Vieweg. Zellstoff und Papier, 1922, 2, 18—19.

The insoluble residue obtained by grinding cellulose with sodium hydroxide solution is the sodium alkyloxide of α-cellulose, and reacts as such with carbon bisulphide, benzoyl chloride, and the like. Alkali-cellulose having the formula, $(C_6H_{10}O_5)_3$,NaOH, is prepared by steeping cellulose in 18% sodium hydroxide solution and pressing the product; this product is unaffected by air or other oxidising agents. The cellulose xanthates capable of spinning contain the complexes $(C_6H_{10}O_5)_3$ and $(C_6H_{10}O_5)_4$. —L. A. C.

Cellulose acetates; Detection and determination of free sulphuric acid and sulphoacetates in ——. M. Entat and E. Vulquin. Ann. Chim. Analyt., 1922, 4, 131—135.

Free sulphuric acid is determined by digesting 10 g. of the cellulose acetate with 200 c.c. of water at 15° C. for 30 mins., filtering the mixture, and titrating the filtrate with standardised barium hydroxide solution, the end-point being determined electrometrically; the titration curve shows a sharp break when the free sulphuric acid is neutralised. Samples of normal cellulose acetate examined did not contain free sulphuric acid, and alkali and alkaline-earth sulphates have been mistaken for sulphuric acid by other observers. To determine sulphoacetates, 5 g. of the sample is heated with 50 c.c. of water for 5 hrs. in an autoclave at 125° C., and the sulphuric acid resulting from the hydrolysis of the sulphoacetate is then titrated as described above. All cellulose acetates prepared by methods in which sulphuric acid or its derivatives are used as catalysts contain sulphoacetic acid combined with the cellulose ester; the quantity of sulphuric acid present as sulphoacetic acid does not exceed 0·03% in the case of cellulose acetates of good manufacture.—W. P. S.

Patents.

Textile materials; Method of and apparatus for drying ——. H. Krantz. E.P. 179,409, 18.4.21. Addn. to 157,425 (J., 1922, 459 A).

The process described in the original patent is modified in that the final drying operation is effected by blowing warm air through the material after partially drying with steam. Suitable alterations are made in the various forms of apparatus previously described.—D. J. N.

Textile fibres; Manufacture of —— from stems of plants, especially nettles. J. Elster. G.P. 309,234, 22.2.18. Addn. to 305,409 (J., 1921, 689 A).

The fibres obtained as described in the chief patent are boiled with dilute caustic soda solution for about 2 hrs. in an open vessel or for a short time in a closed vessel under pressure, then washed with warm water, treated with soap solution to remove vegetable glue and other impurities which would interfere with the spinning of the fibres, washed successively with hot water and cold water, and dried.

Wool, fur, hair, and other materials; Process for protecting —— from moths. Farbenfabr. vorm. F. Bayer und Co. G.P. (A) 347,723, 25.9.19, and (B) 347,849, 13.7.20. Addns. to G.P. 346,598.

(A) Wool and other materials which have been made resistant to moth by treatment with hydrogen silicofluoride, other complex acids or their salts (*cf.* E.P. 173,536; J., 1922, 138 A), are after-treated with metallic salts capable of forming insoluble compounds with these complex inorganic acids, so that the treated material retains its moth-resisting properties even after the usual processes of washing, fulling, hot pressing, treatment with acids, etc. (B) Wool, fur, hair, and the like are rendered resistant to moths by treatment even with a cold liquor containing a complex inorganic acid, such as hydrogen silicofluoride, phosphotungstic acid, titanium-hydrofluoric acid, or hydrofluoric acid or one of its salts or double salts, if to the liquor is also added an assistant such as sodium sulphate, sodium chloride, an acid such as sulphuric or formic acid, or a metallic mordant such as a salt of chromium, aluminium, tin, zinc, or antimony.—A. J. H.

Wool, hair, and feathers; Process for increasing the strength and elasticity of ——. J. Korselt. G.P. 350,803, 18.4.20. Addn. to 349,179 (J., 1922, 410 A).

Neutral, alkaline, or acid solutions of decomposition products of alkaloids, *e.g.*, derivatives of pyridine, piperidine, pyrrolidine, quinoline, isoquinoline, phenanthrene, morpholine, or purine can be employed, either under normal or increased pressure, for treating wool, hair, or feathers as described in the chief patent.—L. A. C.

Carotting hairs; Process for ——. Soc. Pichard Frères. E.P. 163,297, 28.4.21. Conv., 15.5.20.

The skins "in the hair" are moistened with pure water, or water containing an antiseptic, such as formaldehyde, stacked hair against hair for several hours, and then exposed to sufficient cold by, *e.g.*, immersing them for a few seconds in liquid oxygen, nitrogen, or air, to freeze the water which has penetrated into the medullary ducts of the hairs. This causes the hairs to burst, and thereby improves their felting qualities. The process may also be applied to hairs which have been removed from the skin.—D. J. N.

Fibrous materials; Process for boiling —— and a device for carrying out the process. A.-G. der Maschinenfabr. Escher, Wyss und Co. E.P. 168,304, 4.7.21. Conv., 21.8.20.

Fibrous material is treated with a hot liquor within an upright boiler, provided with a supply pipe at the top, a discharge pipe connected with an annular space at a level below the top, and a pipe at the bottom which may serve either as a supply pipe or discharge pipe. The two upper pipes are provided with non-return valves, and by means of a single cross-over device the valves can be so operated that the liquor is introduced at the top, flows downwards, and is discharged at the bottom or is introduced at the bottom, flows upwards, and is discharged through the pipe connected with the annular space. The direction of flow of the liquor in the preheater connected with the boiler remains always the same.—A. J. H.

Fibrous pulp material; Process of preparing ——. C. and J. Bache-Wiig. U.S.P. 1,418,353, 6.6.22. Appl., 21.8.20.

In the preparation of paper pulp, straw-like substances containing ligneous matter are chemically softened, subjected to treatment in a kollergang (edge-runner), digested with a liquor containing a mixture of acid and alkaline compounds, and then further subjected to a second treatment in an edge-runner.—A. J. H.

Thin bands [cellulose film] to be used in the manufacture of cigaratte mouthpieces; Manufacture of ——. Chem. Fabr. von Heyden A.-G. E.P. 157,126, 8.1.21. Conv., 5.3.14.

A mixture containing 1 pt. of cellulose acetate, 5—15 pts. of bronze powder, and 40 pts. of acetone is sprayed in a uniform thin layer over a steel cylinder, heated slightly internally, which slowly revolves so that the coagulated film can be continuously removed. Films having a thickness of less than 0·05 mm. can be obtained, and they do not easily tear when used as a substitute for metallic foil in cigarette machines.—A. J. H.

Nitrocellulose; Manufacture of compound sheet material from ——. C. Claessen. E.P. 156,096, 22.12.20. Conv., 3.9.19. Addn. to 155,778 (J., 1922, 459 A).

A NON-INFLAMMABLE nitrocellulose composition suitable for use as a binding material for balata driving belts or as a floor covering is obtained by dissolving nitrocellulose in the liquid non-volatile tricresyl esters of phosphoric or thiophosphoric acid or their halogen substitution products, and adding suitable filling materials. A satisfactory composition contains 20—25% of nitrocellulose, 28—35% of tricresyl phosphate, 15—20% of chalk or the like, 2—5% of English red, and 35—15% of finely ground sawdust.—D. J. N.

Alkali cellulose and the like; Apparatus for use in reducing ——. A. Kämpf, Assr. to Die Köln-Rottweil Akt.-Ges. E.P. 157,982, 12.1.21. Conv., 13.1.20.

A MACHINE suitable for reducing alkali-cellulose to a loose flocculent state before treatment with carbon bisulphide, for conversion into viscose, consists of a saddle-shaped trough having teeth or projections on the bottom, and within which beaters or paddles rotate. Each beater has on its periphery a continuous row of teeth which work between the teeth on the bottom of the trough, so that fibrous material placed therein is subjected to a shearing action. The shearing action is increased by the addition of grooves or channels across the toothed portion of the trough.—A. J. H.

Viscose; Removal of sulphur compounds from coagulating baths and waste gases produced in the manufacture of ——. E. Schülke. G.P. 346,829, 29.3.20.

THE liquors used for coagulation and the waste gases are treated with hydrochloric acid containing free chlorine, whereby sulphur is precipitated in a form which can be easily separated by filtration.
—A. J. H.

Cellulose acetate; Manufacture of plastic materials or articles having a basis of ——. H. Dreyfus. E.P. 179,208, 4.11.20.

CELLULOSE acetate in a dry or air-dry condition is kneaded or mixed with not more than 50% of its weight of a plastifying agent, which is not saponified by water, the temperature during the mixing operation being kept at 100°—150° C. or higher. Fillers or colouring agents may be added if desired, together with substances capable of neutralising traces of acid, *e.g.*, urea, methylurea, etc. The molten mixture is run into moulds, or worked up by any of the usual processes. Suitable plastifying agents are the xylene-alkyl-sulphonamides described in E.P. 132,283 (J., 1919, 896 A), in admixture, if desired, with triphenyl or tricresyl phosphate. This process, in which no volatile solvents are used, gives strong celluloid-like masses which require no seasoning.—D. J. N.

Artificial filaments, threads and films; Manufacture of ——. British Cellulose and Chemical Mfg. Co., Ltd., C. W. Palmer, and W. A. Dickie. E.P. 179,234, 4.1.21.

OTHER substances such as acetone, diacetone-alcohol, alcohol, acetic acid, formic acid, aqueous solutions of zinc chloride, or mixtures of these, which are soluble in water, and have a solvent action on cellulose acetate, may be used in place of thiocyanates in the coagulating bath for cellulose acetate dissolved in water-soluble organic solvents (*cf.* E.P. 177,868; J., 1922, 459 A). Suitable concentrations of these substances per 100 pts. of water are acetone 10—50 pts., alcohol 100 pts., diacetone-alcohol or acetic acid 5 pts.—D. J. N.

Cellulose ethers; Process of making ——. J. M. Donohue, Assr. to Eastman Kodak Co. U.S.P. 1,415,023, 9.5.22. Appl., 9.6.21.

CELLULOSE is soaked in caustic soda solution until mercerised, and is then mixed with powdered alkali. Excess of liquor is removed by pressure, and the cellulose in the resulting mixture etherified in the usual way.—D. J. N.

Cellulose-ether solvent and composition. W. R. Webb, Assr. to Eastman Kodak Co. U.S.P. 1,418,413, 6.6.22. Appl., 10.1.21.

A CELLULOSE ether is dissolved in a mixture of carbon tetrachloride and a monohydroxy aliphatic alcohol with less than 3 carbon atoms in the molecule, to form a fluid film-forming composition.
—W. C.

Plastic masses. Ges. für Verwertung Chem. Produkte m.b.H. G.P. 351,103, 27.11.19.

PLASTIC masses are prepared from a mixture of a cellulose ester (especially nitrocellulose) and a naphthenic acid. The properties are largely dependent on their content of naphthenic acid. Such masses are suitable for use in the preparation of films and medical bandages, etc.—A. J. H.

Friction composition and process for making same. W. Achtmeyer. U.S.P. 1,418,607, 6.6.22. Appl., 10.3.21.

A BRAKE friction composition consists of asbestos impregnated with a condensation product of phenol and methylenediphenyldiamine.—A. J. H.

Paper; Bleaching of "stuff" or fibres in the manufacture of —— *and apparatus therefor.* W. H. Salmon. E.P. 178,209, 14.1.21.

THE removal of liquor from bleached paper pulp is accelerated and pulp of a more uniform colour obtained by subjecting the underside of the partially drained "stuff" to the action of a vacuum. The drainage bins are fitted with a tiled draining floor, and means are provided for exhausting the air from the space between this draining floor and the main floor of the bin. Provision is also made for removing the drainage liquor.—D. J. N.

Paper pulp; Method for the manufacture of —— *and apparatus therefor.* V. Bernot and P. R. Fournier. E.P. 178,962, 1.2.21.

A PROCESS is described for the manufacture of paper pulp from rags and other fibrous material, in which the raw material and digestion liquor are fed continuously into a horizontal digestion cylinder, suitably heated and fitted internally with a screw conveyor, the pitch and rotation of which determine the duration of the digestion treatment; the cylinder wall is recessed to accommodate a wheel provided with teeth of such a shape that they engage with the thread of the screw conveyor and force the material under treatment to go forward as the screw rotates. The apparatus for separating the fibres consists of a cylinder adjacent to and in alinement with the digestion cylinder, and is fitted internally with a revolving knife cutter and a number of vertical partitions provided with openings decreasing in width from the first partition to the last, *e.g.*, the first partition may have openings several cm. wide, while the last has slits of such a width as to permit only of the passage of single fibres. Between these partitions and clearing them by about 2 mm. are rotating stirring members to disintegrate the fibrous material; the pulp and liquor leaving the apparatus are separated in a filter press; the pulp is washed, while the liquor passes back into the digestion cylinder.—D. J. N.

Paper and paper containers; Rendering —— greaseproof. W. L. Wright, Assr. to Seabright Co., Inc. U.S.P. 1,417,708, 30.5.22. Appl., 11.7.18.

Paper material is coated by means of a nearly saturated aqueous solution of sugar containing a soluble adhesive.—A. J. H.

Sulphite[-cellulose] liquor; Continuous process for decomposing waste ——. K. Mörch. U.S.P. 1,415,843, 9.5.22. Appl., 10.5.20.

Sulphite-cellulose waste liquor is continuously passed through a chamber in which the temperature and pressure are so regulated as to cause the liquor to decompose.—D. J. N.

Sulphite-cellulose waste liquor; Utilisation of the free sulphurous acid and that combined with lignin present in ——. E. Mürbe. G.P. 347,658, 21.4.14. Addn. to 344,955 (J., 1922, 290 A).

On entering the separator, as described in the chief patent, the sulphite-cellulose waste liquor is mixed with a substance such as sodium bisulphate, in a finely divided form, which assists the liberation of sulphur dioxide. Suction is applied to the condenser attached to the separator so as to avoid back pressure. Nearly 30% of the sulphur present in the original sulphite liquor can thus be recovered in a useful form. Almost perfect separation is obtained of free and loosely combined sulphur dioxide and also of that combined with lime. All the calcium present is recovered as calcium sulphate in a finely divided state.—A. J. H.

Viscose solutions; Manufacture of ——. W. P. Dreaper. U.S.P. 1,418,135, 30.5.22. Appl., 14.11.21.

See E.P. 178,152 of 1920; J., 1922, 459 A.

Threads or filaments; Manufacture of artificial ——. W. P. Dreaper. U.S.P. 1,418,136, 30.5.22. Appl., 15.11.21.

See E.P. 171,719 of 1920; J., 1922, 52 A.

Expressing liquid from fibrous substances, such as mechanical pulp or cellulose; Rotary apparatus for ——. Aktiebolaget Karlstads Mekaniska Verkstad. E.P. 159,204, 19.2.21. Conv., 25.2.20.

Paper-pulp; [Mechanical] process for manufacture of ——. H. Steinhilber. E.P. 180,097, 3.3.21.

Paper making machines; Fourdrinier ——. S. Milne. E.P. 180,504, 7.4.21. Addn. to 128,425.

Paper; Process of [and means for feeding the pulp to the forming wire in] apparatus for manufacturing ——. H. Wade. From International Paper Co. E.P. 180,766, 4.3.21.

See also pages (A) 536, *Bituminous products, felt, etc.* (U.S.P. 1,417,835 and 1,417,837—41). 543, *Dyeing fabrics containing cellulose acetate* (E.P. 178,946); *Dyeing cellulose acetate* (E.P. 179,384). 546, *Aluminium compounds for sizing paper etc.* (G.P. 345,315). 548, *Protectively treating materials* (U.S.P. 1,418,609—10).

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Hypochlorite bleaching solutions. Royer. *See* VII.

Patents.

Dyeing [union fabrics containing cellulose acetate fibres]; Process of ——. British Cellulose and Chemical Mfg. Co., Ltd., J. F. Briggs, and L. G. Richardson. E.P. 178,946, 27.1.21.

The superficial saponification of cellulose acetate silk previous to or during the dyeing operation (E.P. 169,741, 175,485, and 175,486; J., 1921, 808 A; 1922, 289 A) is applied in the production of level shades of colour on textile fabrics containing mixtures of cellulose acetate silk with cotton or other cellulose fibres, natural or artificial. The union fabric is worked in a dye-bath, preferably containing small quantities of soap and/or soda ash, at a temperature not exceeding 50° C. until the cotton or other cellulose fibre has become fully dyed, leaving the cellulose acetate threads but slightly coloured. The temperature of the bath is then raised to 75°—80° C. and a quantity of alkali, *e.g.*, up to 10% NaOH on the weight of the cellulose acetate, added. As saponification of the cellulose acetate proceeds, the colour bleeds from the cotton on to the cellulose acetate threads, and, by controlling the reaction, level shades of colour may be obtained, or any desired difference in shade on the cellulose acetate and cotton. Any of the saponifying agents described in the above patents may be employed.—D. J. N.

Acetyl cellulose [cellulose acetate]; Process for dyeing ——. Burgess, Ledward, and Co., Ltd., and W. Harrison. E.P. 179,384, 21.3.21.

Cellulose acetate may be dyed with dyestuffs, for which, in the ordinary way, it has little or no affinity, by employing them in colloidal solution, obtained by adding a colloid, *e.g.*, gelatin, casein, saponin, or their hydrolytic products, to the dye-bath, followed by a precipitant (other than a metallic chloride), preferably one which is itself absorbed by cellulose acetate. Suitable precipitants for basic colours are molybdates, tungstates, stannates, tannic acid, salts of phenols, etc., and for acid colours, direct cotton colours, sulphur and vat colours, an organic compound containing basic groups, *e.g.*, a salt of aniline, benzidine, dianisidine, etc. The method of procedure is, for example, as follows: 100 g. of cellulose acetate silk is worked for 5 mins. in a bath containing 2 g. of indigo, 8 g. of caustic soda, 5 g. of sodium hydrosulphite, 2 g. of glue, 2000 c.c. of water at 60°—70° C.; a solution of 0·5 g. of dianisidine in 4 c.c. of glacial acetic acid and 200 c.c. of water is then added in successive small quantities. The dyed silk is taken out of the bath, allowed to oxidise in the air, and is then washed and dried. This process is particularly useful for sulphur and vat colours, but is less satisfactory with direct cotton colours, as the dyeings with this latter group of colours are not fast to soap or alkaline liquors.—D. J. N.

Dyeing skins, hairs, and the like; Process for ——. O. Kaltwasser and H. Oehrn, Assrs. to A.-G. für Anilin-Fabr. U.S.P. 1,416,646, 16.5.22. Appl., 7.12.21.

The material is treated in the presence of a suitable oxidising agent with a solution containing a 5-nitro-2-amino-1-hydroxy derivative of the benzene series. —D. J. N.

Dyeing machine. E. S. Halter. U.S.P. 1,417,825, 30.5.22. Appl., 5.2.21.

A machine suitable for dyeing material in the form of skeins consists of a vat over which are arranged skein carriers which also oscillate between limits of movement approximately equidistant from the surface of the liquor contained in the vat. The skeins are suspended on reels which revolve on the carriers.—A. J. H.

Dyeing; Process of ——. H. Toepfer, Assr. to The Grasselli Chemical Co. U.S.P. 1,417,869, 30.5.22. Appl., 4.8.21.

ANIMAL fibres are dyed by means of cobalt salts in conjunction with azo dyestuffs derived from nitro-*o*-aminophenols.—A. J. H.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitric oxide; Peroxidation of —— and the recovery of oxides of nitrogen from mixtures with air. E. Briner, S. Niewiazski, and J. Wiswald. J. Chim. Phys., 1922, **19**, 290—309.

THE authors' experiments confirm the views of Raschig and of Le Blanc (J., 1905, 923; 1906, 869) that the formation of nitrite from a mixture of gases containing nitric oxide and nitrogen peroxide by alkali occurs through nitrous anhydride. The oxidation of nitric oxide at low temperatures takes place directly to nitrogen peroxide without the intermediate formation of nitrous anhydride. The best means of effecting a complete recovery of oxides of nitrogen from dilute gaseous mixtures such as are obtained in the electric arc process of nitrogen fixation, consists in submitting the gas to a very low temperature, provided that the technical difficulties can be overcome; without such a low temperature very large oxidation chambers will be necessary. (*Cf.* J.C.S., Aug.)—J. F. S.

Phosphoric acid; [Determination of] composition of commercial ——. W. H. Ross, C. B. Durgin, and R. M. Jones. J. Ind. Eng. Chem., 1922, **14**, 533—535.

THE methods of analysis suitable for the determination of impurities in phosphate rock are not satisfactory in the case of phosphoric acid. A series of tests have therefore been devised which are applied after the impurity has been concentrated by the removal of the free acid by volatilisation or precipitation of the impurity, which may be Ca, Fe, Al, Mn, Pb, As, S, Cl, F. For the determination of the alkali metals it is, however, necessary to precipitate the phosphoric acid. Calcium is precipitated as sulphate by excess of 95% ethyl alcohol and converted into oxalate. Aluminium is weighed as phosphate, being precipitated by a slight excess of calcium chloride over that required to form the soluble calcium diphosphate. Colorimetric tests are given for manganese and lead. The results of a series of analyses by these methods are tabulated. —C. I.

Ammonia; Production of —— by the sodium cyanide method. F. E. Bartell. J. Ind. Eng. Chem., 1922, **14**, 516—521.

THE briquettes prepared by the Bucher process, in which nitrogen is passed through a heated mixture of coke, soda ash, and iron, contain sodium cyanide with some cyanate. The cyanide and cyanate are converted into ammonia by the action of steam. By hydrolysis at a low temperature (100°—200° C.) sodium formate is formed, with evolution of heat. At temperatures above 200° C. the sodium salt obtained is oxalate, and above 400° C., carbonate. It is best to effect the conversion into carbonate, as the briquettes, after steaming, can then be returned to the cyanising apparatus. In order to avoid the formation of ferrocyanide, superheated steam must be used. The temperature at the beginning of steaming should be 260° C. About 50% excess steam over the theoretical should be used. If the steam is admitted too slowly ferrocyanide will be formed, if too rapidly, ammonium carbonate. The temperature should not reach 650° C., at which point ammonia begins to decompose. (Sodium ferrocyanide is decomposed at 475° C.) Trials with retorts holding from 190 lb. up to 640 lb. of briquettes showed that with proper temperature regulation on these lines 85—100% ammonia recovery could be obtained. A horizontal continuous steamer with screw conveyor gave promise of satisfactory results.—C. I.

Ammonium nitrate; Preparation of ——. Wurmser. Comptes rend., 1922, **174**, 1466—1468.

LE CHATELIER (J., 1921, 214 A) has previously given a square diagram showing the states of equilibrium between the four salts, ammonium chloride, sodium nitrate, ammonium nitrate, and sodium chloride in solution and the solid salts at 16° C. A similar diagram is now given for a temperature of 100° C., the curves being of similar shape. From them it is possible to determine the best experimental conditions for obtaining the maximum yield of ammonium nitrate from a solution of the four salts.—W. G.

Hypochlorite bleaching solutions; Determination of the available chlorine in ——. J. Royer. Ann. Falsif., 1922, **15**, 146—148.

FOR the estimation of available chlorine in bleaching solutions the method of Poncius is recommended as being rapid and exact. It consists in titration with a solution of potassium iodide after the addition of sodium bicarbonate. At first the iodide is oxidised to iodate by the free chlorine, but as soon as this reaction is completed the next drop of iodide solution reacts with the iodate, and iodine is liberated and detected by means of starch paste.—W. G.

[Sodium] bisulphite; Method for the determination of ——. F. Kühl. J. Soc. Leather Trades Chem., 1922, **6**, 199—200.

Two grams of the bisulphite is dissolved in water and titrated with $N/1$ sodium hydroxide (a c.c.). 10 c.c. of neutral 40% formaldehyde solution is added and the sodium hydroxide liberated is titrated with $N/1$ hydrochloric acid (b c.c.). If $a=b$ the impurities are neutral. If $a>b$ the difference is calculated as $NaHSO_4$ and when $b>a$, $b-a$ is calculated as Na_2SO_3. —D. W.

Calcium carbide; Calculation of power consumption in the manufacture of ——. H. Furusaki. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, **25**, 24—36.

IN commercial operation the quantities of raw materials used per metric ton of carbide of 71·4% purity are 510 kg. of charcoal, 200 kg. of anthracite, 980 kg. of quicklime, and 70 kg. of electrode carbon. There is a loss of 450 kg., and the quantity of heat to be supplied by the electric power is 2,350,000 kg.-cals., corresponding to 2733 kw.h. Of a total 1054 kw. supplied to the furnace 336·5 kw. was used to cover losses by radiation, conduction, etc., of the furnace, by the resistance in the conductors and electrodes, etc., and 717·5 kw. was consumed for the production of carbide. The heat efficiency of the electric power supplied to the furnace is, therefore, 68·1%, and the power necessary for the production of a metric ton of 71·4% commercial carbide is 4013 kw.h. A further consumption of 825·1 kw. occurs at the upper surface of the charge, and the actual heat efficiency of the furnace is therefore 40·5% —K. K.

Carbon dioxide; Velocity of absorption of —— by alkaline solutions. P. Riou. Comptes rend., 1922, **174**, 1463—1466.

The velocity of absorption of carbon dioxide from air by solutions of potassium carbonate increases with the concentration of the solution at first very rapidly to a maximum and then slowly decreases. The presence of potassium bicarbonate causes a very marked diminution in the velocity of absorption, but the effect of potassium chloride is less marked. In every case rise in temperature is accompanied by an increase in the velocity of absorption. Other factors being equal, the velocity of absorption is practically proportional to the concentration of the carbon dioxide in the air mixture.—W. G.

Calcium carbonate; Inadequacy of "A.R." test for alkalis in ——. W. Singleton and H. Williams. Analyst, 1922, **47**, 252—254.

Only about 50% of the total extractable sodium carbonate is washed out on boiling 5 g. of calcium carbonate with 50 c.c. of water for 10 mins. The alkalis present in 5 g. of "A.R." calcium carbonate were therefore determined by the Lawrence Smith method (Amer. J. Sci., 1871, **50**, 269), and the amount of sodium carbonate obtained was over ten times that obtained by the "A.R." method. The method was checked by decomposing 5 g. of the calcium carbonate with hydrochloric acid and precipitating the calcium twice with ammonium carbonate and ammonium oxalate. Substantially the same result was obtained. It therefore appears that only about 10% of the alkali carbonates present in the calcium carbonate is removed by one extraction with water.—H. C. R.

Aluminium salts; Reactions of sodium hydroxide with ——. E. Grobet. J. Chim. Phys., 1922, **19**, 331—335.

On addition of sodium hydroxide to dilute solutions of aluminium nitrate, aluminium hydroxide, sodium metaluminate, and sodium ortho-aluminate are successively formed. When dilute solutions of aluminium sulphate or chloride or potash alum are used, aluminium hydroxide, basic sodium aluminate, $Al(ONa)_3,Al(OH)_3$, and sodium ortho-aluminate are formed successively. Concentrated solutions of aluminium chloride, nitrate, or sulphate produce under the same treatment a basic salt of the type, $AlX_3,Al(OH)_3$, which is followed by the hydroxide, metaluminate, and ortho-aluminate. Concentrated solutions of potash alum yield a basic salt, $Al_2(SO_4)_3,2Al(OH)_3$, aluminium hydroxide, a basic aluminate, $Al(ONa)_3,Al(OH)_3$, and the ortho-aluminate.—J. F. S.

[*Commercial copper sulphate;*] *Determination of copper and iron* [*in* ——] *iodometrically.* A. Wöber. Z. angew. Chem., 1922, **35**, 336—337.

Five g. of the sample is dissolved in water and the solution is diluted to 100 c.c. in a graduated flask. Ten c.c. is pipetted into a stoppered conical flask, diluted to 50 c.c., heated to 70° C., and treated with 3—5 c.c. of ammonia (sp. gr. 0·944). A current of air is passed through the solution for 15 mins. to oxidise the iron and copper to the cupric and ferric states, the ammonia is boiled off, and the solution treated with hydrochloric acid and potassium iodide in an atmosphere of carbon dioxide. After standing for 20 mins., the liberated iodine is titrated with thiosulphate to obtain the sum of the copper and iron. Copper alone is determined in a second portion which is treated as above except that the iron is removed by filtration, before acidifying the solution after the air treatment. Re-precipitation of the iron is necessary to obtain all the copper in the filtrate.—A. R. P.

Lead acetate; Solubility of —— by the floating equilibrium method. M. L. Dundon and W. E. Henderson. J. Amer. Chem. Soc., 1922, **44**, 1196—1203.

A new method of determining solubility is described, which consists in placing a float, calibrated so that it will just sink in a solution of known composition of the substance under investigation, into a weighed quantity of the saturated solution and adding the solvent until the float just sinks. The quantity of solvent added is noted, and from this the weight of solution taken, and the calibration constant of the float the solubility is readily calculated. This method has been applied to the determination of the solubility of lead acetate in water at temperatures from 0° C. to 50° C. The following values in g. of lead acetate per 100 g. of water are recorded: 0° C., 19·7; 5° C., 23·7; 10° C., 29·3; 15° C., 35·6; 20° C., 44·3; 25° C., 55·2; 30° C., 69·7; 35° C., 88·9; 40° C., 116·0; 45° C., 153·0; 50° C., 221·0. The method is capable of considerable speed and of great accuracy.—J. F. S.

Carbon; Preparation of —— from carbon monoxide by means of a catalyst. J. P. Wibaut. Rec. Trav. Chim., 1922, **41**, 400—401.

Carbon prepared by passing carbon monoxide over iron oxide in a porcelain tube heated to 450°—470° C., gave about half its weight of iron oxide on ignition. During the reaction, the catalyst appears to distribute itself fairly uniformly throughout the carbon which is formed, and all attempts to free the product from metallic oxide were unsuccessful.
—H. J. E.

Liberation of nitrogen from coal and coke as ammonia. Monkhouse and Cobb. *See* IIa.

New method of volumetric analysis. Dutoit and Grobet. *See* XXIII.

Suspended impurities in gases. Scott. *See* XXIII

Patents.

Nitric acid; Process for production of concentrated ——. Norsk Hydro-Elektrisk Kvaelstofaktieselskab. E.P. 170,840, 13.10.21. Conv., 27.10.20.

In the usual process for the production of concentrated nitric acid from liquid oxides of nitrogen with oxygen and water, the first-named being in excess, two layers of liquid are formed, the upper non-aqueous layer containing nitric acid and excess of oxides of nitrogen and the lower layer being 80—90% nitric acid. Whilst hitherto the former has been used for the production of acid, and the latter returned to the process, the reverse procedure is now claimed to be preferable, the cost of concentrating the aqueous acid being more than offset by the nitrogen loss involved in the former practice. A little of the aqueous layer may be returned to the reaction tower along with the upper layer.—C. I.

Barium hydrate [*hydroxide*]; *Continuous process for the manufacture of ——.* C. Deguide. E.P. 174,052, 20.12.21. Conv., 13.1.21.

In the production of barium hydroxide by the process described in E.P. 110,537 (J., 1918, **30** a) a better yield of the hydroxide is obtained by alternately forming and decomposing tribarium silicate, $SiO_2,3BaO$ or silicate intermediate between the tri- and di-barium compounds than by the use of the dibarium silicate as described earlier (*loc. cit.*).
—H. R. D.

Sodium ferrocyanide; Manufacture of ——. F. F. Delarozière. E.P. 179,982, 17.1.21.

In the manufacture of the sodium salt from calcium ferrocyanide by double decomposition, sodium sulphate is substituted for sodium carbonate. The resulting precipitate is more easily washed. Slightly less sulphate than the equivalent of the calcium ferrocyanide is used, and, after filtration, the decomposition is completed with sodium carbonate in order to render the liquor alkaline. Salt may be added to the liquor to reduce the solubility of the sodium ferrocyanide, or impure salt-cake may be used for the decomposition.—C. I.

Gases [e.g., hydrogen]; Process for purifying ——. J. Y. Johnson. From Badische Anilin und Soda Fabrik. E.P. 180,024, 14.2.21.

To remove carbon oxysulphide and allied substances from gas which has already been freed from hydrogen sulphide, the gas is treated with activated charcoal made alkaline with, for example, ammonia. Oxygen may be introduced into the gas stream in order to assist in the oxidation of the sulphur compounds. The process is specially applicable to the purification of hydrogen to be used in the synthesis of ammonia.—A. R. P.

Hydrogen and nitrogen; Process to produce mixtures of ——. E. Szarvasy. U.S.P. 1,417,952, 30.5.22. Appl., 12.2.15.

A mixture of nitrogen and methane is heated in a decomposing chamber containing glowing carbon from a previous decomposition. The gases are so proportioned that the mixture produced contains hydrogen and nitrogen in the ratio necessary for ammonia synthesis.—C. I.

Ammonium sulphate; Process of obtaining —— by the interaction of ammonium carbonate and calcium sulphate. Soc. Ind. de Prod. Chim. G.P. 345,256, 29.12.20. Conv., 22.7.20.

Calcium sulphate is added to ammonium carbonate solution which has been previously warmed to a temperature above 30° C., and the mixture is kept at about 70° C. until the reaction is complete.

Sodium pentaborate; Process for production of —— direct from boron ores. A. A. Kelly and B. D. Jones. E.P. 180,110, 12.3 and 25.10.21.

Sulphur dioxide is introduced into a mixture of 100 pts. of boronatrocalcite (40% B_2O_3), and 400 pts. of water. When the separation of boric acid according to the equation, $Na_2O+2CaO+5B_2O_3+3SO_2=2CaSO_3+Na_2SO_3+5B_2O_3$, is complete, the supply of sulphur dioxide is stopped, the calculated amount of boronatrocalcite is added to the reaction mixture, and the latter heated to boiling, whereby sodium pentaborate is formed according to the equation,

$$2(Na_2SO_3+5B_2O_3)+Na_2O+2CaO+5B_2O_3= 2CaSO_3+3(Na_2O+5B_2O_3),$$

and may be recovered by crystallisation.—H. R. D.

Carbon bisulphide; Manufacture of ——. Courtaulds, Ltd., and A. E. Delph. E.P. 180,175, 23.4.21.

Retorts and other parts of the plant made of iron, or steel, are protected against the action of sulphur or sulphur compounds by a thin coating of aluminium.—H. R. D.

Cyanides; Process of producing ——. F. von Bichowsky and J. Harthan. U.S.P. 1,417,702, 30.5.22. Appl., 25.10.20.

Titanium nitrides are heated with an alkali salt in presence of a carbide of iron, but without free carbon.—C. I.

Potassium salts; Process for obtaining —— from natural potassium compounds. D. D. Jackson. U.S.P. 1,417,919, 30.5.22. Appl., 29.6.20.

The material is mixed with lime and a haloid salt, and heated at a temperature below the clinkering temperature of the mixture, but high enough to cause rapid volatilisation of the potassium halide formed.—H. R. D.

Beryllium [glucinum] compounds; Production of ——. Process for production of zirconium compounds. L. Burgess. U.S.P. (A) 1,418,527 and (B) 1,418,528, 6.6.22. Appl., 16.8.21.

An oxidised ore of (A) glucinum or (B) zirconium is heated with carbon and the compound produced is then treated with gaseous hydrochloric acid to obtain glucinum or zirconium chloride.—H. R. D.

Aluminium compounds for sizing paper and other purposes; Preparation of ——. G. Muth. G.P. 345,315, 4.12.19. Addn. to 319,420 (J., 1920, 517 A).

The treatment of aluminium compounds as described in the chief patent is more expeditiously carried out in closed vessels under a high temperature and pressure.—A. J. H.

Hydrogen sulphide; Process for the removal of —— from gases. Ges. für Kohlentechnik m.b.H. G.P. 350,591, 26.10.19.

The gas is washed with a solution of a copper salt, and the resulting copper sulphide is treated in suspension with a gas containing oxygen, under pressure, and with the aid of heat to oxidise it to copper sulphate. Other metallic salts can be used, *e.g.*, zinc salts, the metallic sulphide being treated with copper sulphate solution, and converted into the sulphate, whilst the copper sulphide produced is converted in sulphate as outlined above.—A. G.

Sulphuric acid; Manufacture of ——. E. A. Gaillard. E.P. 180,546, 10.5.21.

See G.P. 346,121 of 1921; J., 1922, 215 A.

Sulphuric acid; Process for distilling ——. G. Baum, Assr. to Chem. Fabr. Weissenstein Ges. m.b.H. U.S.P. 1,419,008, 6.6.22. Appl., 11.6.21.

See E.P. 163,685 of 1921; J., 1922, 501 A.

Zinc oxide; Manufacture of ——. New Jersey Zinc Co., Assees. of J. A. Singmaster. E.P. 161,156, 14.1.21. Conv., 31.3.20.

See U.S.P. 1,372,462 of 1921; J., 1921, 346 A.

Alkali-metal silicates; Process for the manufacture of ——. C. Deguide. E.P. 174,581, 20.12.21. Conv., 22.1.21.

See G.P. 345,669 of 1921; J., 1922, 216 A.

Rocks; Process for obtaining in soluble state some of the constituents of complex ——. F. Jourdan. U.S.P. 1,417,831, 30.5.22. Appl., 22.12.20.

See E.P. 175,348 of 1920; J., 1922, 293 A.

Potassium sulphate and hydrochloric acid; Manufacture of ——. P. Comment, Assr. to Soc. Fabr. de Prod. Chim. de Thann et de Mulhouse. U.S.P. 1,417,887, 30.5.22. Appl., 4.11.20.

See E.P. 154,111 of 1920; J., 1921, 44 A.

Ammonium chloride from coal or shales. E.P. 169,948. *See* IIA.

VIII.—GLASS; CERAMICS.

Clays; Use of electrolytes in the purification and preparation of ——. H. G. Schurecht. U.S. Bureau of Mines, Tech. Paper 281, 1922. Pp. 47.

Slips were prepared from clay, water, and electrolytes in varying proportions and their viscosities measured by determining the time necessary for

250 c.c. of slip to pass through an orifice of $\frac{3}{32}$ in. In order to maintain minimum viscosity in clay slips in which the clay and water contents varied, but in which the water content exceeded 50%, it was much more important to keep the ratio of electrolyte to clay constant than to keep the ratio of electrolyte to water constant. When sodium hydroxide was added in small quantities to Georgia kaolin the decrease in viscosity was gradual up to a certain point, but on further addition of the electrolyte there was a sudden drop to minimum viscosity. The limits within which sodium hydroxide produced minimum viscosity were small, but the limits within which sodium silicate and sodium carbonate produced minimum viscosity were relatively large. In presence of sufficient alkali to produce minimum viscosity, slip of a given viscosity contained 50—58% more clay per unit quantity of slip than when no alkalis were added, but this result should be checked by large-scale clay washing tests. The effect of completely or partly neutralising with sulphuric acid a clay slip containing sodium hydroxide as the deflocculating agent was studied. The viscosity of Florida and N. Carolina kaolins was increased when the slip was neutralised with sulphuric acid equivalent to the sodium hydroxide first added, the increase in plasticity that sometimes has caused trouble to kaolin refiners being due to this increase in viscosity. In some cases black discoloration of the dry kaolin is caused by adding an excess of sulphuric acid. Both these defects are reduced by adding less sulphuric acid than the equivalent of the sodium hydroxide used, the amount required varying with different clays. With Florida and Georgia kaolins the sedimentation was much slower after the slips had been treated with sodium hydroxide and sulphuric acid than it was before treatment. The deflocculated kaolin could not be filtered successfully, as the fine particles either passed through or clogged the filter. Ready filtration was possible after partially neutralising the alkalinity of the kaolin by adding sulphuric acid. The rate of disintegration in water of cubes containing equivalent parts of filtered kaolin and flint was slower than when untreated kaolin was used. Care should be taken to have the proper ratio of acid to alkalis in the kaolin slip, because any variation of acid causes the kaolin to act differently towards subsequent alkali treatment, those slips which have received the larger additions of acid requiring more alkali to produce the same degree of dispersion upon again deflocculating. Electrolytes added to the clays in the plastic state increased the dry strength, the order of effectiveness being sodium hydroxide, sodium silicate, sodium carbonate, tannic acid, and calcium hydroxide. Alkalis lowered the percentage of water of plasticity of ball clays. Acids at first increased, but when in excess decreased, the water necessary to work the bodies. Calcium hydroxide increased the water of plasticity. The drying shrinkage of mixtures of equal parts of clay and flint was decreased for all the clays examined (except Georgia kaolin and Kentucky ball clay) by adding 1 or 2% of alkalis. Sulphuric acid in small percentages increased, and in larger percentages decreased the drying shrinkage. Tannic acid and calcium hydroxide increased the drying shrinkage. The shrinkage on firing to cone 01 was lowered when small percentages of caustic soda were added, and increased when larger quantities were used. The porosity after firing was decreased and the density increased when sodium hydroxide was used. The strength after firing to cone 8 was increased by adding the following electrolytes (arranged in order of decreasing effectiveness) to the bodies in the plastic state: sodium hydroxide, sodium silicate, sodium carbonate, tannic acid. The dry strength of a clay was increased by wet grinding for two hours, by adding 1% sodium hydroxide when grinding, removing the coarse material by screening through 150-mesh sieve, and by adding 1% of dextrin. The plasticity of all clays was increased by wet grinding, screening, and adding 1% of dextrin. The addition of 1% of sodium hydroxide caused the clay to become tougher in the plastic condition and somewhat more difficult to mould. No scumming was caused by the soda if 1% of dextrin was added. The drying shrinkage and water of plasticity were increased, and the density was decreased, by wet grinding. The strength of the clays after firing to cone 2 was increased considerably by these treatments.

—H. S. H.

After-contraction test [*of fire-bricks*]; *Standardisation of the* ——. D. A. Jones. Report of the Refractory Materials Research Committee of the Institution of Gas Eng., June, 1922. Gas J., 1922, 158, 840—844.

Discordant results are obtained for the after-contraction of a firebrick when the tests are made according to the standard specification method. The errors are not eliminated by using whole bricks for the test, the chief source of error being the dislocation of the surface of the brick after firing. Scratches were made on the specimen to be tested and the distance between them measured with a travelling microscope before and after heating the brick for two hours at the specified temperature. Owing to the more equal firing in the laboratory furnace small test pieces give more concordant results than the whole bricks, and are recommended for use in carrying out the test. Different bricks from the same batch exhibit differences in after-contraction due to uneven firing in the kiln during manufacture.—H. S. H.

Refractory materials; Thermal conductivity of —— *at high temperatures.* A. T. Green. Report of the Refractory Materials Research Committee of the Inst. of Gas Eng., June, 1922. Gas J., 1922, 158, 844—852.

A critical review of previous experimental work on the thermal conductivity of refractories is given. Nine bricks, placed with their lengths along the direction of the flow of heat, were built to form a wall, which was heated by a bauxitic plate heated by a carbon resistance furnace, the central brick being used as the test piece. The temperatures of the hot face and of the interior of the brick at two known depths were measured with thermocouples after the hot face had been maintained for about 9 hours at its final temperature. The diffusivity of the material was obtained from the formula

$$\frac{\theta_0-\theta}{\theta_0}=\frac{2}{\sqrt{\pi}}\int_0^{\frac{x}{2kt}} e^{-B^2}\,dB \text{ where } B=\frac{x}{2\sqrt{kt}},\ k=\text{the}$$

diffusivity, θ_0=temperature of hot face, θ=temperature after t secs. of an isothermal plane at a distance, x, from the hot face. The conductivity was obtained by multiplying the diffusivity by the product of the specific heat and the apparent specific gravity of the material. The results obtained were much lower (about one-half) than those obtained by calorimetric methods. The thermal conductivity of silica and fireclay materials increased with rise of temperature. The conductivity of magnesite was greater than that of firebricks at temperatures below 1000° C., but it decreased with rise of temperature. The variation of diffusivity with temperature is shown, and it is suggested that in the carbonising industries the diffusivity is the best guide to the thermal efficiency of the material, while thermal conductivity is the important factor where insulating properties are desired.—H. S. H.

PATENTS.

Opal glass; Composition for ——. A. L. Duval d'Adrian. U.S.P. 1,419,032, 6.6.22. Appl., 27.6.21.

A COMPOSITION to be added to the usual glass mixture comprises a complex fluoride of an amphoteric element with an alkaline-earth fluoride.—H. S. H.

Tungsten or molybdenum carbide or a mixture of their carbides; Manufacture of pieces of any desired size or shape of —— *for tools and articles of all kinds.* Lohmann-Metall, G.m.b.H. E.P. 157,749, 10.1.21. Conv., 29.1.14. Addn. to 157,747 (*cf.* G.P. 289,066; J., 1916, 423).

THE moulded articles are produced from the powdered carbides by pressing in iron matrices, and after removal from these are heated in a reducing atmosphere to very near the melting point of the carbides.—H. S. H.

Refractory material and process of making the same. C. A. French, Assr. to International Harvester Co. U.S.P. 1,418,372, 6.6.22. Appl., 14.6.20.

A REFRACTORY compound is formed essentially from zirconium oxide and steatite.—T. A. S.

Refractory material and process of making same. R. W. Hull. U.S.P. 1,418,648, 6.6.22. Appl., 9.4.21.

A REFRACTORY material for surfaces subjected to intense heat comprises waste material left after concentrating disseminated chrome ore containing a mixture of silica, serpentine, and olivine, and united by a binder.—H. S. H.

Furnace; Heat-treating —— *and method* [*for earthenware*]. C. J. Kirk. U.S.P. 1,418,446, 6.6.22. Appl., 10.2.20.

THE earthenware is fired while traversing a firing chamber heated from several separate heat-sources regulated independently and creating well defined zones of heat.—H. S. H.

Tunnel kiln. E. P. Ogden, Assr. to J. B. Owens. U.S.P. 1,418,669, 6.6.22. Appl., 5.11.20.

A TUNNEL kiln is provided with an auxiliary chimney stack or fan, in addition to the main one. Vapours which have been introduced for special purposes are removed from the kiln by means of the auxiliary stack or fan without interfering with the main draught.—A. B. S.

Kiln for burning refractory bricks, especially lime-bonded silica or Dinas bricks, and other ceramic ware. H. Koppers. G.P. (A) 347,672, 9.3.18, (B) 347,673, 20.6.18, (C) 347,674, 20.6.18, and (D) 347,675, 7.1.19.

(A) SEVERAL separate intermittent kilns are so arranged that cars carrying the goods to be burned can be passed into them from a preheating chamber, and after the firing is completed transferred to a cooling chamber. For each preheating chamber there are two cooling chambers, in order that the goods may be cooled sufficiently slowly. The firing chamber is divided into two compartments by a longitudinal partition; one compartment is heated by gas and air on the down-draught principle, and the hot gases pass through openings in the partition and then upwards through the other compartment to the regenerators. On changing the dampers in the regenerators the direction of the gases is reversed. (B) The bricks or other ware are burned on cars in a twin kiln, to which cold air and gas are first admitted direct, whilst the waste gases are passed through a regenerator. Afterwards, first the air only and then both air and gas are preheated regeneratively. The cooling is effected and controlled by shutting off the gas and admitting air through the regenerator last heated by waste gases, so that this air is strongly heated before it comes in contact with the goods, and cools them gradually. The air is then passed into the regenerator of another kiln. When one regenerator can no longer supply air at a temperature suitable for cooling the goods it is replaced by another regenerator, so that the cooling is effected at any desired rate without the goods being in contact with cold air. (C) In the plant described under (A) the regenerators are placed parallel to and alongside the burning chambers and are connected with the latter at the top. The gas to be preheated thus flows upward through the regenerator, then downward through one compartment of the burning chamber, upward through the other, and finally downwards through the regenerator on the other side. (D) The construction of the kiln is modified so as to convert it from an intermittent to a continuous tunnel kiln, and regenerators are provided in the cooling zone at each side of the kiln, so as alternately to preheat the cold air required for combustion and withdraw heat from the cooling goods. These regenerators prevent the hot goods from coming in contact with cold air, and the goods are cooled to such a degree by the time they reach the exit end of the kiln that they can pass out without risk of damage.—A. B. S.

Ceramic wares; Burning —— *and apparatus therefor. Burning ceramic wares.* T. G. McDougal, Assr. to Champion Ignition Co. U.S.P. (A) 1,416,726 and (B) 1,416,727, 23.5.22. Appl., 18 and 28.7.21.

(A) THE goods are passed continuously through a kiln having a preheating zone, a high-temperature zone, and a cooling zone, and are maintained exposed to radiation from the under surface of the roof of the kiln in the high-temperature zone sufficiently long to ensure thorough burning. The under surface of the roof is intensely heated by combustion in the space between it and the goods. (B) A continuous kiln has a thin highly refractory carrier forming the support for the ware, and supporting means on which the carrier travels through the kiln, the space between these supports and the lower side of the carrier being filled with heat-insulating material. The supporting means include a highly refractory element projecting through the floor of the kiln on which the carrier rests directly and with reference to which it is movable.—H. S. H.

Enamel; Process of removing —— *from enamelled metal articles.* W. E. Patch. U.S.P. 1,416,865, 23.5.22. Appl., 28.7.21.

THE enamel is removed by heating the ware in a closed oven to a temperature above the original baking temperature.—H. S. H.

Glass; Apparatus for feeding molten ——. F O'Neill. E.P. 179,977, 12.1 and 26.5.21.

Pug mills [*for clay mixtures*]. T. C. Fawcett, Ltd., J. W. Bottomley, and D. L. Fawcett. E.P. 180,035, 16.2.21.

IX.—BUILDING MATERIALS.

PATENTS.

Wood and the like; Protectively treating ——. *Protectively treating materials.* A. Arent, Assr. to A. Arent Laboratories, Inc. U.S.P. (A) 1,418,609 and (B) 1,418,610, 6.6.22. Appl., 14.11.19 and 9.6.20.

(A) WOODY materials are treated with a tarry solution containing a toxic and fire-retarding metal compound which is capable of hydrolysis to yield a compound of the metal insoluble in water. (B) Material is treated with a solution of antimony trichloride in benzene.—A. J. H.

Wood; Preservation of ——. *Impregnating wood* [*with oil*]. Ostpreussische Imprägnierwerke G.m.b.H. G.P. (A) 347,631, 21.5.14, and (B) 347,632, 1.9.15. Addns. to 345,704 (J., 1922, 296 A).

(A) Wood, such as pine, oak, and beech, which does not readily absorb liquid material, is subjected to a high vacuum before steeping in tar oil in the process described in the chief patent. For example, pine wood is maintained for 1 hr. under vacuum in a suitable vessel, and hot oil is admitted into the vessel while still under vacuum. After increasing the pressure to normal, the residual oil is removed, and the wood is treated with steam for ½ hr. at 2 atm. pressure, then with hot oil at 10 atm., and is finally subjected to a high vacuum for 1 hr. (B) Wood is impregnated with oil by treatment with oil vapour or atomised oil mixed with steam or air which is charged under pressure into a vessel containing the wood.—L. A. C.

[*Magnesium oxychloride*] *material; Process for manufacturing* —— *suitable for wall covering, putty, or the like.* K. Wolf, Assr. to Elektro-Osmose A.-G. U.S.P. 1,418,896, 6.6.22. Appl., 1.8.21.

See E.P. 178,320 of 1921; J., 1922, 417 A.

Gas-fired shaft furnaces. G.P. 351,195–6. *See* I.

Bituminous products, felt, etc. U.S.P. 1,417,835 and 1,417,837–41. *See* IIA.

Distilling peat and the like. E.P. 180,081. *See* IIB.

Granulating slag. E.P. 180,479. *See* X.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron ores; Sintering of ——. K. Endell. Mitt. Kaiser Wilhelm-Inst. Eisenforsch. Düsseldorf, 1921, **3**, 37—43. Chem. Zentr., 1922, **93**, II., 1164.

To determine the sintering temperature of iron ores, the physical properties of five ores were examined after grinding them to pass through a sieve of 4900 holes per sq. cm. and heating test portions for 2 hrs. at 600°, 800°, 900°, and 1100° C. Density determinations showed that only limonite that contained considerable quantities of gels underwent any appreciable shrinkage and diminution of density. Direct observation of the sintering process by means of the "heating microscope" (*cf.* J., 1921, 394 A) gave the best results with partly colloidal ores, but was useless with others, while measurements of the contraction and porosity as applied to ceramic ware, were generally applicable, as immediately sintering commenced a sharp change was noticed in these properties. The commencement of the reaction between ferric oxide, silica, and lime was determined by solubility measurements; calcium ferrite begins to form, in the absence of silica, at 600° C.; when the latter is present, however, it appears to have a greater affinity for lime than has ferric oxide.—A. R. P.

Pig iron; Comparison of shaft and open top furnaces in the manufacture of —— *electrically from iron ore.* R. C. Gosrow. Trans. Amer. Electrochem. Soc., 1922, 63—74. [Advance copy.]

The principal disadvantages of the stack type of furnace are that the stacks may freeze up; the charge is subject to "hang-ups" and slips and segregation of the constituents; the pressure at the base of a stack crushes the fuel and interferes with the conductance; the charge is subject to bridging; no direct indication of the conditions inside the furnace is obtained. The contention that reduction is accelerated by the use of stacks is not proved. In the open-top furnace there is greater freedom of working and more accurate control. The charge travels a shorter distance, and the feed is through an overhung trolley provided with a hopper and spout. Continuous small charges are properly placed and distributed and no packing occurs. The gases leave the top of the furnace at low pressure, the combustibles burning with a short flame. The rectangular shape of furnace seems better than the circular for smelting, the heat being concentrated at or near the centre. In the open-top furnace the refractories last longer, and with proper feeding of the charge the loss of carbon is small. Open-top furnaces of 7000—10,000 kw. capacity are advocated. A comparison of carbon and graphite electrodes shows several advantages in favour of the latter. The average production cost per ton of iron is estimated on 1920 conditions as $39·66 for a plant with a capacity of 20,000 tons per year.—T. H. Bu.

Cast iron; Carburisation in the manufacture of synthetic ——. C. E. Williams and C. E. Sims. Trans. Amer. Electrochem. Soc., 1922, 157—176. [Advance copy.]

The carburising action of different forms of carbon increases with the density of the carbon and decreases as the ash content increases. Graphite gave the best results of all forms tried. The presence of slag decreases the rate of carburisation, the action being more effective as the acidity of the slag increases. Lime slags counteract the deleterious effect of high ash content. Silicon carbide in the inexpensive form of firesand is an excellent medium for adding both carbon and silicon to iron, but is generally used with coke to prevent the introduction of too high a percentage of silicon. Silicon and phosphorus have no effect on the rate or degree of carburisation, but may slightly decrease the total carbon content of the pig iron. Manganese increases the rate and degree of carburisation, but the effect is small for ordinary contents of manganese in iron. Sulphur probably decreases the rate and degree of carburisation. No noticeable effect on carburisation was observed on increasing the temperature from 1350° to 1450° C. —T. H. Bu.

Carbon in metals; Diffusion of —— *and mixed crystals of iron.* G. Tammann and K. Schönert. Stahl u. Eisen, 1922, **42**, 654—659.

Curves indicating the depths of the cementitic, pearlitic, and hypo-eutectoid layers when iron is carburised for 2 hrs. at different temperatures in a mixture of hydrogen and hexane vapour were found to be continuous. The coefficient of diffusion of carbon in iron as determined by different observers varies considerably and is dependent on factors not brought out in the analysis of the iron. The author attributes the differences to the influence of thin films of material between the crystallites of iron. On dissolving iron these intercrystalline films are destroyed, but in the case of cadmium and zinc the network of intercrystalline material may be isolated. The addition to iron of molybdenum, tungsten, nickel, cobalt, and manganese first increases and afterwards diminishes the depth of penetration of carbon; vanadium and antimony have no appreciable effect, and silicon and aluminium diminish the penetration of carbon. —T. H. Bu.

[Steel] furnace practice; British Siemens ——. F. Clements. Iron and Steel Inst., May, 1922. [Advance proof.]

THE balance of the chemical operations in a 60-ton Siemens furnace hearth was investigated, a notable feature being the relatively large extent to which carbon, silicon, phosphorus, and manganese are eliminated during the melting period. The heat balance was deduced from the chemical balance. The overall thermal efficiency amounts to 16·98%. The heat losses due to radiation from bath and port ends (44·2%), from regenerators (15·5%), and from flues (4·1%), and heat lost with the gases to the chimney (36·2%), were estimated, and the heat distribution throughout the system was determined for a selected half hour during the working period of a heat. A higher average temperature in the furnace hearth is desirable and this will be best attained by reducing the quantity of air admitted. The efficiency of the system of regeneration is critically discussed. The mean temperature variation in the chequers should only be about 100° C. The deductions made are confirmed by the data obtained from detailed schedules of British Siemens furnace practice. A design for a 100-ton furnace is suggested. The usual positions of gas and air uptakes are reversed. The gas reverse valves are as near the regenerators as possible and shut off the supply to the furnace while reversal takes place. The air reverse valves are water-sealed. A strong case may be made out for automatic reversal. The fuel consumption used in the calculations was 3 cwt. per ton of steel, but if radiant heat losses were prevented as suggested it is probable that the consumption would not be greater than 2 cwt. per ton of metal.—T. H. Bu.

Martin [open-hearth steel] process; Influence of the difference in height of, and distance between, the producer and furnace in the ——. E. Maurer and R. Schrödter. Mitt. Kaiser Wilhelm-Inst. Eisenforsch. Düsseldorf, 1921, **3**, 21—36. Chem. Zentr., 1922, **93**, II., 1165.

A DECREASE in gas pressure between the producer and the furnace is avoided and the lowest pressure obtained in the producer if the gas-mains are of uniform cross-section and have no bends and the producer is only sufficiently high to avoid ground water and transport difficulties. Except for the effect of the additional friction, the length of the mains has no influence on the pressure, if they are straight, but to overcome any trouble likely to be caused by occasional pressure changes the furnace should be provided with a pressure-equalising chamber. The heat losses in the mains may be reduced by reducing the surface in contact with the gas, *e.g.*, by shortening the mains, or by covering them with a good heat-insulating material, but heat losses caused by settling of dust and soot, chiefly behind the dampers and in places where the cross-section or direction of the mains change, are unavoidable and are influenced by the nature of the coal. The energy content and significance of the physical and chemical properties of producer gas for regenerative heating are discussed.—A. R. P.

Austenitic steel; Arrangement of the iron atoms in ——. F. Wever. Mitt. Kaiser Wilhelm-Inst. Eisenforsch. Düsseldorf, 1921, **3**, 45—56. Chem. Zentr., 1922, **93**, II., 1357.

THE X-ray spectrum of α-iron shows it to possess a space-centred cubic lattice, the side of the elementary cube being $2·85 \times 10^{-8}$ cm., while the γ-iron in homogeneous austenite has a cubical face-centred lattice, the length of the edge of the elementary unit of which varies between $3·56 \times 10^{-8}$ and $3·60 \times 10^{-8}$ cm., according to the nature and quantity of the alloying elements in the steel. Cooling in liquid air causes the austenite to be transformed partially into martensite with simultaneous diminution in the grain-size of the remaining γ-iron. Martensite contains α-iron, and the cause of austenitic steel becoming magnetic on cold deformation is shown to be the partial transformation of γ-iron into α-iron, the grain-size being probably less than 10^{-6} cm. The transformation of a steel containing 1·9% C and 2·1% Mn into troostite by annealing above 300° C. is due to the alteration of the γ-lattice into the α-lattice in the very fine-grained metal.—A. R. P.

Case-carburising; Selective ——. W. P. Wood and O. W. McMullan. Chem. and Met. Eng., 1922, **26**, 1077—1080.

THE protective action against case carburisation of a large number of non-metallic coatings was tried. The protective coatings consisted chiefly of a solution of sodium silicate mixed with clay, flint, asbestos, etc. A mixture of powdered asbestos and sodium silicate was found to give the best results, and after treatment may be removed by quenching in water, or by immersion in molten sodium hydroxide. The use of non-metallic protective coatings is not so generally applicable as an electrolytic deposit of copper. A deposit of copper by simple immersion, owing to its porosity, does not afford satisfactory protection against case-hardening.—C. A .K.

Steel; Effect of sulphur on rivet ——. E. E. Thum. Chem. and Met. Eng., 1922, **26**, 1019—1024.

THE author gives a résumé of a preliminary report of a joint committee of the American Society for Testing Materials and the U.S. Bureau of Standards on the effects of phosphorus and sulphur in steel. Steels containing about 0·11% C, 0·43% Mn, 0·01% P, and from 0·028 to 0·17% S were made into rivets and the latter were subjected to the usual forge and mechanical tests. The presence of sulphur up to 0·10% did not affect the hot or cold shortness and had no appreciable influence on the hardness. The tensile strength was decreased 200 lb. per sq. in. for each additional 0·01% S up to 0·10%. The maximum sulphur content now allowed in structural steel rivets (0·045%) is at least 0·01% below the point at which sulphur will prove harmful to the strength of a well-made rivet steel.—C. A. K.

Slag; Estimation of —— *in steel.* F. Wüst and N. Kirpach. Mitt. Kaiser Wilhelm-Inst. Eisenforsch. Düsseldorf, 1920, **1**, 31—38. Chem. Zentr., 1922, **93**, II., 1070—1071.

A SOLUTION of bromine in aqueous potassium bromide was found to be the most efficient solvent for the iron in the determination of slag in steel, but the addition of oxalic acid to prevent the precipitation of basic salts caused solution of a portion of the silica, thus yielding low results. The method adopted was as follows: Steel filings (5 g.) were heated to 70°—80° C. for 4 hrs., with intermittent shaking, with 200 c.c. of a solution of 200 g. of bromine and 400 g. of potassium bromide in 1 l. of water. The solution was filtered and the residue, after washing with a solution containing 100 c.c. of water, 5 c.c. of sulphuric acid, and 1 g. of potassium bichromate, was dried, ignited, and weighed. Application of the method to the various structural constituents of steel showed that iron carbide, phosphide, and sulphide, and manganese in the amounts usually present dissolve under these conditions; nickel is partially oxidised. The presence of carbon, silicon, manganese, and chromium causes erroneous results, and needles of iron nitride are undissolved. The method is thus not applicable in all cases.—L. A. C.

Steels; Magnetic researches of nitrogenised ——. K. Kido. Sci. Rep. Tohoku Imp. Univ., 1922, **10**, 471—478.

Ten samples of steel containing from 0·084 to 3·02% of carbon were pulverised and then nitrogenised by heating in a current of dry ammonia gas at 650° C. for periods varying from 5 mins. to 15 hrs. After treatment the surface of the steel varied in colour from silver grey to dark grey, according to the duration of nitrogenation. The samples were then submitted to magnetic analysis. It was observed from the change of intensity of magnetisation with temperature that four transformations were possible at 250°, 350°, 470° and 620° C., respectively, the actual number of these transformations taking place in any given sample depending upon the composition. The magnetic transformation at 250° C. is due to the compound, Fe_2N, that at 470° C. to $Fe_{12}N$, whilst the transformations at 350° C. and 620° C. are attributed to two double carbides of iron and nitrogen termed α and β, respectively. On heating to 700° C. the nitrides of iron are rapidly decomposed into nitrogen and ferrite, the gaseous nitrogen escaping.—J. B. F.

Brazed joints; Dip-brazing with 80:20 *brass and the heat-treatment of* ——. E. V. Schaal. Chem. and Met. Eng., 1922, **26**, 1121—1125.

Preheating to a dull red heat just before brazing is desirable, but a higher temperature or continued heating should be avoided on account of oxidation of the surfaces to be brazed. The parts to be brazed should be coated with a paste made of borax and boric acid to prevent oxidation during preheating. Borax gives the best joints when brazing with 80:20 brass, but should be used in conjunction with a cooling flux, preferably of boric acid, in order to prevent surface oxidation. The proper brazing temperature is 1850° F. (1000° C.). The best joints are obtained when the surfaces to be brazed are fastened close together without the use of shims or spacers. The strength in pure tension of joints made with carbon steel untreated is approximately equal to the strength of the brass in tension; that of nickel steel joints heat-treated is nearly twice the strength of the brass. The strength of the joints in pure shear is also approximately equal to the tensile strength of the brass. Nickel steel joints tested in shear give approximately the same results as carbon steel joints. Heat treatment of brazed parts was found to deteriorate certain types of joints brazed with 80:20 brass, and no explanation of this could be found. Metallographic study of brazed joints reveals an intermediate constituent between the brass and the steel, which serves to hold the brass and steel together in the joint.

—H. C. R.

Iron and steel [galvanised] sheets; Method of determining the spelter coating on ——. D. M. Strickland. Amer. Soc. for Testing Materials, June, 1922. [Advance copy.] 6 pp.

A method, which may be used as a field method, of determining the weight of zinc on galvanised articles depends on the increase in temperature of the solution when the zinc coating is dissolved in a known quantity of hydrochloric acid. The volume of acid used (100—300 c.c.) regulates the conversion factor, *i.e.*, the value in grams for each 0·1° C. increase in temperature. Solution of the zinc is so rapid that the maximum temperature of the solution is reached in 30—40 secs., consequently radiation does not interfere with the accuracy of determination. Addition of antimony trichloride to the acid is not necessary, as the base metal may be attacked slightly without appreciable error. The apparatus required is simple and consists only of a glass container and a sensitive short-range thermometer.—C. A. K.

Copper-zinc alloys; Cold-rolling and annealing of ——. F. Körber and P. J. H. Wieland. Mitt. Kaiser Wilhelm-Inst. Eisenforsch. Düsseldorf, 1921, **3**, 57—87. Chem. Zentr., 1922, **93**, II., 1166—1167.

The effect of cold-rolling and annealing on the mechanical properties of copper-zinc alloys containing 28, 37, and 40% Zn has been studied. After cold-rolling all three alloys showed an increase in hardness, tensile strength, and elastic limit and a decrease in ductility and resistance to impact, to an extent depending directly on the amount of work done in the rolling. The tensile strength increased proportionally to the degree of rolling, and the ductility was especially decreased after rolling to reduce the thickness 30—50%, while the Brinell and scleroscope hardness increased rapidly at first, then more slowly, and the scratching hardness was unaffected. The relative alteration in tensile strength and hardness decreased with an increase in the zinc content of the alloys. The direction of rolling has a great influence on the ductility and resistance to shock, the metal being much more brittle perpendicular to this direction than parallel with it. Annealing at 200° C. improves the elastic and tensile properties of the 28% and 37% Zn alloys after severe rolling, but has the reverse effect on the 40% Zn alloy. Between 250° and 400° C. the tensile strength and elastic limit decrease rapidly and above 450° C. there is still a slight decrease. The test-pieces that had the most severe rolling had the highest tensile strength after annealing, and even after the most complete annealing the effect of the previous cold-rolling was noticeable. A fall in tensile strength on annealing corresponded with increase in ductility and a relatively greater decrease in hardness and brittleness. There was no change in the structure of the metal after annealing at 200° C., but at higher temperatures recrystallisation, characterised by the disappearance of slip bands and grain boundaries, commenced. The temperature at which this change occurred was lower the greater the degree of rolling undergone by the alloy, and was below that at which any change in the mechanical properties took place.

—A. R. P.

Brass; Physical properties of cartridge ——. C. Upthegrove and W. C. Harbert. Trans. Amer. Inst. Min. and Met., June, 1922. Min. and Met., May, 1922. [Advance copy.] 10 pp.

Cast brass containing approximately 68·42% Cu, 31·53% Zn, 0·03% Pb, and 0·02% Fe, was annealed and reduced in area, and then annealed at different temperatures (570°, 650°, and 750° C.) previous to the final reduction. The hardness was found to be influenced by both the temperature of annealing and the degree of reduction. Differences in hardness due to reduction disappeared when the metal was annealed at 600°—650° C., and also when the degree of reduction was increased. When annealed at 650° C. or above, after reduction in area by rolling, the hardness, tensile strength, and elongation were independent of the anneal, previous to rolling.—C. A. K.

[*Brasses, bronzes, and white metals;*] *Rapid electro-analysis* [*of* ——]. Kling and Lassieur. Ann. Chim. Analyt., 1922, **4**, 171—177.

Suitable electrolytes from which to deposit copper, lead, zinc, tin, and antimony by rapid electrolysis are given, and the following methods for the analysis of alloys containing these metals are recommended. *Analysis of brass.* 1 g. is dissolved in 5 c.c. of nitric acid (sp. gr. 1·3), the solution diluted to 85 c.c., and electrolysed for 20 mins. with 5 amp., using a rotating silver cathode and an iridio-platinum anode; copper is deposited on the former and lead peroxide on the latter. The residual liquid is boiled with 5 g. of sodium hypophosphite, and 15 c.c. of hydrochloric acid is added, a little at a time; boiling is continued for 10 mins. to remove completely the nitric acid. Caustic soda solution is added till the precipitate first formed just re-dissolves, then 20 c.c. of ammonia, and the cold liquid is electrolysed with 5 amp. for 20 mins., using the coppered cathode previously obtained. The zinc deposit is re-dissolved by spraying the washed cathode with 10 c.c. of 25% sulphuric acid, the solution is treated with caustic soda till the precipitate re-dissolves, then with an excess of 5 c.c. of acetic acid, and electrolysed as before, the zinc deposit being weighed this time. *Analysis of bronze.* 1 g. of alloy is dissolved in nitric acid containing 3 g. of crystallised aluminium nitrate, the solution is evaporated to dryness, and the residue heated for some time at 110° C., then digested with warm water and a little nitric acid. After addition of 2 g. of sodium nitrate the liquor is electrolysed as described above for copper and lead. The spent electrolyte is treated with 20 c.c. of strong hydrochloric acid, 4 g. of hydroxylamine hydrochloride, and 10 g. of ammonium oxalate, and electrolysed for 15 mins. with 5 amp. to deposit tin. *Analysis of white metal* (copper, lead, tin, antimony alloys). 1 g. is dissolved in hydrochloric acid and potassium chlorate, the solution is diluted to 100 c.c., made neutral to methyl orange with caustic soda, treated with 4—5 g. of tartaric acid, cooled, and transferred to a waxed conical flask. 10 c.c. of hydrofluoric acid is added and, after 30 min., 10 g. of sodium acetate crystals. The solution is diluted to 300 c.c. and saturated with hydrogen sulphide, and the precipitated lead, antimony, and copper sulphides are collected, washed, and digested with 80 c.c. of sodium sulphide solution (sp. gr. 1·14). The solution is filtered, the filtrate diluted to 150 c.c., treated with 4 g. of potassium cyanide, and electrolysed for 20 min. with a current of 3—4 amp. to deposit the antimony. The insoluble sulphides are dissolved in nitric acid, and the solution electrolysed for copper and lead as described above. The hydrofluoric acid solution containing the tin is treated with 10—15 g. of boric acid, transferred to an unwaxed beaker and boiled to expel hydrogen sulphide. The separated tin sulphide is dissolved, without filtering, by addition of hydrogen peroxide, the solution is cooled, treated with 20 c.c. of hydrochloric acid and 4 g. of hydroxylamine hydrochloride, and electrolysed for tin.—A. R. P.

Manganese-bronze; Occurrence of blue constituent in high-strength ——. E. H. Dix, jun. Trans. Amer. Inst. Min. Met. Eng., May, 1922. [Advance copy.] 16 pages.

In the manufacture of manganese-bronze, a third constituent, having a characteristic clear blue colour, appears in the α-β complex when sufficient hardening elements (aluminium, tin, iron, manganese) are added to produce a bronze of high tensile strength. The separation of this constituent is strongly influenced by the presence of iron, and it is precipitated from a copper-rich solid solution by the addition of zinc; it is therefore probably a solid solution of iron and copper, possibly containing also some tin, aluminium, or manganese. In the microstructure of manganese-bronzes this constituent appears, in unetched specimens, to be of a deeper blue colour than either the δ-constituent of the copper-tin series or the γ-constituent of the copper-zinc series, but the latter is rapidly dissolved by ammoniacal hydrogen peroxide, whereas the new constituent is hardly attacked. The presence of this constituent in reasonable amounts does not cause brittleness, nor does it reduce the elongation or tensile strength, although it is much harder than the α-β matrix. It cannot be dissolved by annealing for 8 hrs. at 850° C., followed by quenching or slow cooling.—A. R. P.

Nickel and monel [metal] wires; Some electrical properties of ——. M. A. Hunter, F. M. Sebast, and A. Jones. Trans. Amer. Inst. Min. and Met. Eng., June, 1922. Min. and Met., May, 1922. [Advance copy.] 6 pp.

Two samples of nickel wire obtained by the direct rolling of electrolytic nickel without melting the metal had specific resistance 7·55 and 7·60 respectively. Metal which had been melted and subsequently drawn into wire in no case gave so low a value. The addition of 1% of cobalt, iron, or manganese raised the specific resistance to 8·38, 8·82, and 9·41 for the respective elements. In order to obtain a nickel wire with the highest possible temperature coefficient of electrical resistance, the nickel must be the finest available, the addition of manganese must be as small as is compatible with good forging qualities, and the molten metal should be exposed to the effect of the furnace gases for as short a period as possible. The values for the specific resistance (ohms per mil.-ft.) at 20° C. of commercial metals examined are: Nickel grade A 64, grade C 84, grade D 117; monel metal 268.

—C. A. K.

Alloys of aluminium and zinc. T. Hemmi. Kōgyō-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, 25, 511—524.

The author studied the equilibrium diagram of aluminium-zinc alloys, especially of alloys rich in aluminium. Thermal and microscopical examination of the alloys rich in aluminium gave no decisive data, but measurement of the electrical resistance of quenched specimens revealed fairly well the field boundaries in the diagram. Mechanical tests were made on chill and sand castings of alloys containing up to 50% Zn. Aluminium dissolves zinc up to a concentration of 30% at ordinary temperature, forming a stable solid solution γ. The range 42—78[illegible] Zn is a solid solution δ, which is unstable below 256° C., and easily decomposes into two different phases, γ and α. A field of the mixture (γ+δ) exists between the regions of γ and δ above 256° C. When annealed below 256° C., the compound, Al_2Zn_3, which assumes a dendritic structure in casting, decomposes into a duplex structure of α and γ. The presence of silicon, contained in aluminium as an impurity, causes a series of arrests in cooling alloys containing up to 70% Zn. The results of the mechanical tests show that the upper limit for addition of zinc to pure aluminium for light castings is 25%, the limit being within the range of solid solution γ. The density and hardness increase linearly with the zinc content, some examples being as follows:

	Zinc %	Elastic limit, kg. per sq. mm.	Tensile strength, kg. per sq. mm.	Elong. on 50·8 mm. %	Red. of area %	Brinell hardness.	Sp. gr.
Chill cast	10·36	10·43	13·66	14	20·5	69	2·94
	19·42	16·59	23·40	6·5	11·8	81	3·09
	36·67	18·48	29·00	2·0	5·07	80	3·55
Sand cast	9·97	12·60	14·7	8·2	10·0	36	2·88
	19·53	17·37	19·86	1·8	3·7	61	3·07
	33·96	18·26	25·8	1·6	1·7	74	3·40

—K. K.

Aluminium; The hydrochloric acid test [for resistance to corrosion] for ——. F. Mylius. Z. Metallk., 1922, 14, 233—244.

The test is carried out by observing the time taken to reach the maximum temperature when a strip of the metal is placed in 20 c.c. of hydrochloric acid (containing exactly 100 g. HCl per l.) at 20° C. The increase in temperature divided by the time taken to reach the maximum is called the "reaction number" of the metal. The metal surface must be clean and should be scrubbed with soap and dried before carrying out a test; even after this treatment a different result is obtained in two successive tests on the same specimen, due to the surface covering being in a different physical state to the body of the metal. Cast or annealed metal has a higher reactivity than metal that has been cold-drawn or rolled. Commercial aluminium alloys may be divided into four classes, those, *e.g.*, aluminium free from iron, which have a reaction number lower than 4; those for which the number is between 4 and 10, *e.g.*, technically pure aluminium, aludur, and duralumin; those for which the reaction number is between 10 and 20, *e.g.*, alloys containing 1—3% of iron and silicon, and those with a number higher than 20. Electrolytic oxidation of aluminium in saturated boric acid and borax solutions and, more especially, in fused potassium nitrate, lowers the reactivity of the metal very considerably; thus a specimen treated by the latter method had a reaction number of only 0·01.—A. R. P.

Metals and alloys; Density determinations on —— at high temperatures. II. The systems copper-antimony, copper-zinc, and zinc-aluminium. K. Bornemann and F. Sauerwald. Z. Metallk., 1922, **14**, 254—258. (*Cf.* J., 1922, 421 A.)

The density and specific volume together with data on the contraction on cooling of alloys of the systems copper-antimony, copper-zinc, and zinc-aluminium have been determined and tabulated. The temperature coefficient of expansion of liquid alloys in the first-named system falls from the antimony end to a point corresponding to the compound, Cu_2Sb, after which it rises more sharply. In the copper-zinc system there is an inflexion in the curve at a point corresponding to the compound, Cu_2Zn_3. The specific volume of the alloys of zinc and aluminium in the liquid state may be calculated by the rule of mixtures.—A. R. P.

Aluminium alloys, especially duralumin; Analysis of ——. F. M. da Costa-Vet. Chem. Weekblad, 1922, **19**, 249—251.

Duralumin contains, besides aluminium, copper 3·5—4·5, manganese 0·5—1·0, and magnesium 0·5%. In precipitating iron, aluminium, and manganese in the usual way, care must be taken to keep the magnesium in solution; the precipitation is repeated, and filtration must be rapid each time. Some manganese left in solution is weighed with the magnesium as pyrophosphate, and afterwards estimated by re-dissolving the phosphates and titrating with permanganate. (*Cf.* J.C.S., July.) —S. I. L.

Binary alloys [of lead, tin, and bismuth]; Volume changes of ——. K. Gilbert. Z. Metallk., 1922, **14**, 245—253.

The coefficient of thermal expansion of tin-lead alloys remains constant with rising temperature up to about 170° C., then increases rapidly to a maximum at the melting point of the eutectic, and falls rapidly to a minimum at about 200° C., rising again to a second maximum, which is less than the first, between 220° and 230° C. corresponding with the melting of the excess of tin or lead over the eutectic ratio. In the tin-bismuth series the coefficient of expansion decreases steadily to a minimum at the melting point of the eutectic (139·8° C.), then increases a little, but almost immediately decreases very rapidly. Alloys in which tin is in excess have a negative coefficient above 100° C., *i.e.*, they expand on further heating. Tin-bismuth alloys undergo a contraction in volume when maintained at a constant temperature for any time. This contraction is greater and more rapid the higher the temperature, but it takes place even at room temperature. The same phenomenon is observed in the case of the tin-lead-bismuth eutectic. This alloy, on heating, has a constant coefficient of expansion up to 80° C., after which the coefficient falls to a minimum at 94·9° C., then rises to a maximum at 112·8° C., and again falls to a constant value somewhat higher than the first, at 140° C.—A. R. P.

Magnesium-cadmium alloys. L. Guillet. Rev. Mét., 1922, **19**, 359—365.

Magnesium and cadmium form a continuous series of solid solutions and one compound, CdMg, melting at 427° C. and soluble in all proportions in either metal. The solidus is very close to the liquidus and hence the alloys are very uniform in character, although at ordinary temperatures there are several different solid solutions characterised by different electrical conductivities and hardness. No change in the latter property is produced by quenching or by quenching and ageing at any temperature, and the magnesium-rich solid solutions are malleable either hot or cold, but alloys containing about 6—42% Mg are brittle at ordinary temperatures although they are capable of being forged at 300° C. Small quantities of cadmium increase the Brinell hardness of magnesium from 32 to 60—65.—A. R. P.

Non-ferrous metals; Gas absorption and oxidation of ——. B. Woyski and J. W. Broeck. Trans. Amer. Inst. Min. and Met. Eng., June, 1922. Min. and Met., May, 1922. [Advance copy.] 8 pp.

The discoloured fracture of a non-ferrous alloy, usually considered to be due to oxidation, is believed to be rather the result of a reducing atmosphere. Castings produced from a sealed Detroit arc furnace always showed a discoloured fracture, but a normal casting was obtained from a ventilated Detroit furnace, or from the Baily furnace, which is not air-tight. Discoloration has also been observed in bearings poured from open flame furnaces with decidedly reducing flames. Aluminium-bronze is very susceptible to gassing, but by using oxidising conditions in oil furnaces gassing can be prevented entirely. An oxidising condition in the furnace is less troublesome than a reducing atmosphere, provided that the metal is protected by a thin layer of mineral flux. The loss of metal is not appreciably greater and there is a saving in time and fuel. The one condition of success is that the metal must be stirred to bring the oxides in contact with the flux, because the specific gravity of some oxides is greater than that of the metal.—C. A. K.

Tungsten ores of Boulder County, Colo.; Treatment of the ——. [Analysis of ferrotungsten and tungsten powder.] J. P. Bonardi and J. C. Williams. Bull. 187, U.S. Bureau of Mines, 1921. 79 pp.

The tungsten ores of Boulder consist chiefly of fairly well crystallised ferberite in a quartzose gangue. The ore is crushed and concentrated on jigs and tables in the usual way, and the concentrates, if tin or other objectionable impurity is present, are treated electromagnetically for the production of a ferberite concentrate containing 65—70% WO_3. Full details and flow sheets of the methods used at different mines are given, as well as descriptions of the methods used in working up the concentrates into ferrotungsten, tungsten powder and tungstic acid. The ferrotungsten produced assays 70—80% W, <1%C, <0·5% Mn,

<1% Si, and not more than 1·1% S and P together. The following method is recommended for assaying ferrotungsten and tungsten powder, which should first be ground to pass a 200-mesh screen. 1 g. of the sample is fused for 5—7 mins. at 800° C. with 5 g. of sodium peroxide in a nickel crucible, the cold melt is leached with water, and the solution treated with an excess of hydrochloric acid and boiled. 40 c.c. of cinchonine solution (50 g. of alkaloid and 150 c.c. of hydrochloric acid in 2 l. of water) is added and, after standing over-night, the precipitate is collected on a filter, washed with weak cinchonine solution, ignited, treated with hydrofluoric and sulphuric acids, again ignited, and weighed as WO_3. Carbon is determined by combustion in oxygen, the evolved gases being passed through barium hydroxide solution and the barium carbonate produced weighed. The whole of the sulphur in the sample is evolved as hydrogen sulphide on treating it with hydrochloric acid; this gas is collected in cadmium chloride solution and the precipitate is titrated with iodine. Phosphorus is determined by fusing 1 g. with peroxide as for tungsten. The solution of the melt is partly neutralised with hydrochloric acid, the ferric hydroxide filtered off, the filtrate acidified with 30 c.c. of 40% acetic acid, treated with 2 c.c. of 5% uranium acetate solution, a slight excess of ammonia, and a further 2 c.c. of uranium acetate, and the precipitate is filtered off, washed with hot water, and dissolved, together with the ferric hydroxide precipitate, in 25 c.c. of strong nitric acid and 30 c.c. of water. The clear solution is nearly neutralised with 45 c.c. of ammonia (1:1) and treated with 50 c.c. of molybdate solution. After 15 mins. the precipitate is filtered off, washed with acid ammonium sulphate solution, dissolved in ammonia, the solution filtered, and the filtrate acidified with sulphuric acid and passed through a Jones "reductor." The reduced solution is titrated with permanganate; the iron factor multiplied by 0·0163 gives the phosphorus factor.
—A. R. P.

Metals; Acceleration of solution of —— in acids by reducible compounds. H. J. Prins. Proc. K. Acad. Wetensch., 1922, 23, 1449—1454.

The velocity of solution of a metal in an acid may be enhanced by the presence of a reducible substance. Nitrobenzene and benzaldehyde accelerate the rate of solution of iron, zinc, lead, tin, copper, nickel, aluminium, and silver in a large number of acids. In the presence of nitrobenzene the rate of solution is increased up to 1000 times. The increase in the action of the acid on the metal is accompanied frequently by an increased evolution of hydrogen. Benzaldehyde is selective in its action. Benzophenone retards the rate of solution of the metal and the rate of generation of hydrogen from zinc and acid.—W. E. G.

Metallic substances; Constitution of ——. C. A. Kraus. J. Amer. Chem. Soc., 1922, 44, 1216—1239.

Metals and intermetallic compounds are salt-like in character and in liquid ammonia solution the more electronegative metal functions as anion, and on electrolysis is deposited on the anode. The multiplicity of compounds derivable from a given pair of metals is explained by the fact that in their compounds the more electronegative elements form complex anions. The energy effect accompanying the formation of metallic compounds is of the same order of magnitude as that accompanying the formation of ordinary salts, and as in the case of salts, the energy change is the greater the more electronegative one element is with regard to the other. The property of "metallicity" is not an atomic one; it may be imparted to non-metallic elements by combination with other non-metallic elements and is due to the presence of uncombined negative electrons. The electrons which impart metallic properties to an element are those to which the chemical reactions of this element with other elements are due. The reaction between strongly electropositive and strongly electronegative elements or groups of elements consists essentially in a combination of the negative electrons of the electropositive constituent with the atoms of the electronegative constituent. (*Cf.* J.C.S., August.)
—J. F. S.

Patents.

Steel or iron work; Materials for and method of treating, or preserving —— against corrosion and rusting. G. H. Howse. E.P. 179,811, 2.5.21.

Iron or steel is coated with a mixture of an oxy-acid of phosphorus, *e.g.*, phosphoric acid, and chromium oxide or hydroxide, dissolved in a suitable solvent, *e.g.*, acetone, alcohol; oxide, hydroxide, or chromate of manganese, lead, or nickel may also be added. The metal may be painted subsequently. The process is intended to be applied where corrosion has already taken place, the active iron oxide being converted into an inactive condition by application of the mixture.—C. A. K.

Cast iron; Purifying —— and eliminating objectionable gases and oxides. J. R. Billings, Assr. to J. R. Billings Iron and Steel Co. U.S.P. 1,412,077, 11.4.22. Appl., 25.5.16. Renewed 25.8.21.

Reagents capable of eliminating hydrogen and phosphorus are added to the molten iron, and finely divided carbon is then introduced gradually into the body of the molten metal.—T. H. Bu.

[Iron] castings; Method of controlling the condition of [i.e., rendering malleable] ——. O. Sowers. U.S.P. 1,417,638, 30.5.22. Appl., 6.4.21.

An electric current is passed through the casting which is heated by resistance only, the electrodes or contact pieces being so shaped as to cause more current to pass through the thicker portions of the casting, thus obtaining uniform heating (for several hours) to a temperature near that at which combined carbon changes to temper and free carbon.—B. M. V.

Ferro-chromium alloys; Manufacture of ——. W. B. Ballantine. E.P. 179,992, 19.1.21.

High carbon ferro-chromium is subjected to the action of an oxidising blast while maintained well above its melting point in an electric furnace. The necessary flux is carried to the metal by means of the blast, which may impinge directly on, or at an angle to, the surface of the bath. The carbon content in a trial was reduced from 5·65% to 0·25% in 40 mins. when using an air blast at a pressure of 8 lb. per sq. in.—C. A. K.

Blast furnaces; Method of operating smelting and reducing furnaces, more particularly ——. H. Koppers. E.P. 156,765, 7.1.21. Conv., 23.10.18.

A portion of the hot gas evolved in the blast furnace is withdrawn from above the blast inlet level at a temperature of about 1400° C., and the whole or part of this gas is cooled to about 800° C. and then introduced again into the furnace at a somewhat higher level. The temperature zone in which carbon dioxide has an oxidising effect is thus eliminated, and a shorter shaft can be used, thus reducing the resistance of the charge and consequently reducing the power required for the blast.

The sensible heat taken from the withdrawn gas is utilised for preheating or drying the charge. —T. H. Bu.

Zinc; Method of extracting —— from lead-slags, zinc-retort residues, poor zinc ores or the like. Rheinisch-Nassauische Bergwerks- und Hütten-A.-G., and A. Spieker. E.P. 160,455, 17.2.21. Conv., 17.3.20.

The finely ground residues are briquetted with lime or silica in such a proportion that the resulting slag is either very basic or very acid and of a high melting point. The resulting briquettes are smelted in a shaft furnace, whereby the zinc is reduced and volatilised only when the briquettes reach the hottest zone, and a slag is obtained containing less than 0·5% Zn.—A. R. P.

Zinc ashes or zinc oxide containing chlorides; Method of working —— [for the recovery of zinc]. Oberschlesische Zinkhütten A.-G. G.P. 350,702, 14.4.21.

The ashes or other material containing zinc oxide and chloride are mixed intimately with calcined limestone or dolomite dust and water before reduction. The calcium chloride so formed is only decomposed at a very high temperature and does not interfere in the subsequent reduction.—A. R. P.

[Aluminium;] Process for the reduction of [—— from its] ores. C. A. Stevens, Assee. of C. G. Collins. E.P. 160,760, 14.2.21. Conv., 26.3.20.

The ore, ground to pass a 20- to 40-mesh screen, is mixed with about 5% of its weight of carbon, 3% of sodium chloride, and 2% of sawdust impregnated with alkali, and the mixture is heated in a closed furnace to about 1400° F. (760° C.). The sawdust may be replaced by oxalates.—A. R. P.

Chromium or alloys of chromium; Method for producing ——. Aktiebolaget Ferrolegeringar. E.P. 163,263, 28.4.21. Conv., 12.5.20. Addn. to 135,187 (J., 1921, 86 a).

At the end of the bessemerising process for the production of chromium alloys, the slag becomes relatively rich in chromium. This slag is retained in the furnace during the early part of the working of the following charge and when the removal of silicon has proceeded to the stage at which the content of chromium in the slag is at a minimum, the highly silicious, low-chromium slag is tapped off. The oxidation of silicon is then completed in the furnace, with the addition of basic materials if necessary, and the smaller quantity of high-chromium slag formed is used in the working of the following charge.—C. A. K.

Copper [nickel, and lead] ores; Treatment of oxidised ——. W. G. Perkins. E.P. 180,021, 14 and 21.2.21.

A magnetic product is obtained by heating the ore with sulphur or iron sulphide (pyrites) in a non-oxidising atmosphere, and is concentrated by magnetic separation. The ore is preferably heated in a reducing atmosphere before admixture with the pyrites.—C. A. K.

Slag; Process of granulating —— and separating moisture therefrom. T. Steen. E.P. 180,479, 23.3.21.

Slag, granulated by quenching in water, is spread in a thin layer over a floor of large area, and the water is drawn off rapidly, preferably by means of a suction apparatus. The hot slag may be allowed to dry naturally, or it may be dried by heat (*e.g.*, by the exhaust gases from a gas-engine) and then cooled rapidly by a current of air or water, this rapid cooling causing further granulation. —A. B. S.

Alloy. A. W. Randall. U.S.P. 1,417,348, 23.5.22. Appl., 29.11.20.

An alloy containing 80—87 (*e.g.*, 84)% Zn and 20—13 (*e.g.* 16)% Al.—C. A. K.

[Tungsten] alloy for contact bodies and ignition points. C. A. Laise. U.S.P. 1,418,081, 30.5.22. Appl., 2.5.21.

The alloy contains 87—97% W, 10—3% Mo, and a substantial amount of vanadium not exceeding 1%. —A. R. P.

Soldering composition. A. Traliot. U.S.P. 1,417,428, 23.5.22. Appl., 2.4.21.

A solder containing aluminium, sulphur, and a number of metals of low melting point.—C. A. K.

Ores and the like; Process for chlorinating —— in mechanical roasting furnaces. Metallbank und Metallurgische Ges. A.-G. G.P. 350,645, 10.4.14.

The heat necessary for the chlorination process is supplied by radiation from above to the upper chlorinating chamber, and the hot flue gases from this source of heat are led into the same chamber and pass out with the chlorinating gases. In this way the ore never comes in contact with hot surfaces, and is therefore not overheated, and the temperature of the top hearth of the furnace can be accurately controlled.—A. R. P.

Reducing gases; Process for the preparation of —— for metallurgical purposes. A/S. Norsk Staal. G.P. 350,647, 25.2.19. Conv., 4.9.15.

A fuel containing carbon monoxide is subjected, together with waste gases (containing carbon dioxide and/or steam) from metallurgical operations, to the action of a high-tension electric discharge, in a manner similar to that used in the combustion of nitrogen. The following reactions take place:—$C_mH_n + mCO_2 + 41{,}700m$ cals. $= 2mCO + n/2H_2$, and $C_mH_n + mH_2O + 31{,}000m$ cals. $= mCO + (m+n/2)H_2$.—A. R. P.

Burnt pyrites and the like; Process for removing zinc from ——. F. W. Neuhaus. G.P. 350,649, 20.11.20.

Desulphurised material, such as burnt pyrites, is heated to 1000°—1100° C. in an atmosphere of a reducing gas such as blast-furnace gas, whereby the zinc is reduced and volatilised, and the residue is obtained as an agglomerate of partially reduced iron, which may be smelted in the blast furnace. Addition of solid carbon is unnecessary.—A. R. P.

Iron and alloys of iron; Electrodeposition of metals upon ——. R. J. Fletcher, Assr. to Fletcher Electro Salvago Co., Ltd. U.S.P. 1,417,896, 30.5.22. Appl., 17.1.21.

See E.P. 162,391 of 1920; J., 1921, 436 a.

Copper-nickel matte; Treatment of ——. G. Haglund. E. P. 158,887, 7.2.21. Conv., 10.2.20.

See G.P. 343,079 of 1921; J., 1922, 379 a.

Lead; Refining of ——. H. Harris. U.S.P. 1,418,148, 30.5.22. Appl., 29.1.20.

See E.P. 142,398 of 1919; J., 1920, 456 a.

Aluminium alloy. H. C. Hall, Assr. to Rolls-Royce, Ltd. U.S.P. 1,418,303, 6.6.22. Appl., 18.2.21.

See E.P. 153,514 of 1920; J., 1921, 15 a.

Ores; Apparatus for grinding, classifying, and decanting ——. J. R. Broadley. U.S.P. 1,418,523, 6.6.22. Appl., 30.9.20.

See E.P. 154,434 of 1919; J., 1921, 70 a.

Removing enamel from metal. U.S.P. 1,416,865 *See* VIII.

XI.—ELECTRO-CHEMISTRY.

Colloids; Electrical precipitation of ——. C. H. Hall, jun. J. Amer. Chem. Soc., 1922, **44**, 1246—1249.

Colloidal suspensions in non-conducting liquids are not precipitated by either direct or alternating current of voltage from 10^4 to 2×10^5.—J. F. S.

Reversible reduction of organic compounds. Conant and others. *See* IV.

Power consumption in manufacture of calcium carbide. Furusaki. *See* VII.

Electro-analysis of brasses etc. Kling and Lassieur. *See* X.

Rapid electrolysis. Edgar and Purdum. *See* XXIII.

Patents.

Electric primary cells. L. Darimont. E.P. 180,120, 16.3.21.

In primary cells employing a zinc electrode immersed in an exciting solution of a chloride, such as sodium chloride, and a carbon electrode immersed in iron perchloride, powdered chalk or other anti-acid material is added to the former solution, and an agglutinant such as starch is added to retain the chalk in suspension. The chalk reacts with iron perchloride diffusing through the wall of the porous cell, and a semi-pervious layer is formed, which is prevented from becoming too thick by the addition of a mixture of chromic acid or chromium salts and hydrochloric acid to the depolarising fluid, to which sodium or potassium chloride is similarly added to regulate the osmotic pressure and precipitate hydroxides and oxides of iron, which would otherwise form insulating deposits on the carbon. To prevent creeping of iron perchloride on the wall of the porous vessel, that portion which is above the paste is made impervious by prolonged immersion in molten lead oleate or similar substance, with or without the addition of other metallic soaps, such as soaps of iron or manganese. The head of the carbon electrode is similarly treated. The bottom of the porous vessel is entirely or partially convex externally. The upper portion of the porous vessel is closed by wax, pitch, etc., through which passes a tube having a widened neck closed by a stopper provided with a slot or groove for the escape of gases. The zinc electrode need not be amalgamated. The cell is provided with a closing ring of cork or other compressible material.—J. S. G. T.

Dry batteries; Process for the preparation of —— with manganese dioxide-graphite electrodes. H. Riesenfeld. G.P. 350,248, 10.2.20.

The pressed electrodes of manganese dioxide and graphite are dipped into a colloidal solution so as to give them a coating of a colloidal material, which prevents the formation of cracks and the loss of small particles, and gives the cell a better conductivity and a smaller internal resistance, and, therefore, greater capacity.—A. R. P.

Electric cell. A.-G. Mix und Genest Telephon- und Telegraphen-Werke. G.P. 350,925, 1.10.20.

The cell is of the type in which zinc, carbon, and manganese dioxide are used, and the electrodes are separated by a semi-permeable diaphragm. An electrolyte of the usual kind is employed on the zinc side of the diaphragm, whilst on the other side a soluble substance with powerful oxidising properties, *e.g.*, a hypochlorite, is used, for the purpose of intensifying the depolarising action of, and revivifying, the manganese dioxide.

Electric furnace. F. W. Sperr, jun., and H. J. Rose, Assrs. to The Koppers Co. U.S.P. 1,418,984, 6.6.22. Appl., 14.3.21.

A relatively long and narrow heating chamber is formed by means of a series of juxtaposed heating units. A testing tube placed inside the heating chamber is heated progressively by connecting the units in circuit from one end to the other.
—J. S. G. T.

Electric furnace. H. G. Weidenthal, Assr. to Westinghouse Electric and Mfg. Co. Reissue 15,378, 6.6.22, of U.S.P. 1,304,425, 20.5.19. Appl., 25.3.20.

See J., 1919, 543 A.

Furnace; Electrically heated ——. C. W. Speirs, Assr. to Morgan Crucible Co., Ltd. U.S.P. 1,418,030, 30.5.22. Appl., 9.3.20.

See E.P. 144,802 of 1919; J., 1920, 575 A.

Alloy for contact bodies. U.S.P. 1,418,081. *See* X.

Reducing gases. G.P. 350,647. *See* X.

Treating meat, fish, etc. E.P. 180,497. *See* XIXA.

XII.—FATS; OILS; WAXES.

Olive oils and the Villavecchia reaction. J. Prax. Ann. Falsif., 1922, **15**, 159—161.

The formation of a red coloration with Villavecchia's reagent by abnormal olive oils (*cf.* J., 1921, 778 A) is prevented by treatment with alcoholic ammonia, and this is now shown to be due to the action of the ammonia.—W. G.

Head oil of the sea animals of the family Delphinidæ. S. Nakatogawa and S. Kobayashi. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, **25**, 158—168.

The authors have examined the jaw, head, and inner head oils of the following sea animals: "Ma-iruka" (*Delphinus longirostris*, Gray), "Kama-iruka" (*Lagenorhynchus acutus*, Gray), "Nezumi-iruka" (*Phocoena communis*, Less), "Sunameri" (*Neomeris phocoenoides*, Gray), "Nuribô," and "Gondô-kujira" (*Globiocephalus sieboldii*, Gray). The oils contained highly unsaturated fatty acids, as shown by the formation of polybromides, and notable proportions of lower fatty acids. The head oils and more especially the inner head oils (except *Neomeris* oil) contained more unsaponifiable matter than the jaw oils. The head and jaw oils were soluble in hot absolute alcohol, whereas the inner head oils were soluble in cold absolute alcohol. The solidifying points of the oils were far lower than those of other marine animal oils.—K. K.

Fatty oils; Mechanism of alkali refining of ——. S. Ueno. Kôgyô-Kwagaku Zasshi (J. Chem. Ind. Japan), 1922, **25**, 578—583.

Metallic and alkali soaps and oxidised acids are removed to a notable extent by alkali refining. Similar effects are observed on treating the oils with soap solution, but the action is slower. Substances acting as anti-catalysts in the hydrogenation of the oils are removed by using a very small quantity of alkali solution (about 2·5 c.c. of 20% sodium hydroxide solution for 50 g. of oil), and fish oils thus refined can be hardened smoothly, notwithstanding the oil has still an acid value of 3·2—10. Alkali refining is considered to be due to the adsorption of impurities by the emulsoid-like compounds formed by the addition of alkali to oils, whilst refining with acid-clay is ascribed to the adsorptive action of suspensoid-like compounds. Poisonous matters present in oils can easily be removed by alkali refining. In the hardening process, the hardened oil is electrically charged; the phenomenon is especially distinct in highly hardened samples.—K. K.

Vegetable oils; Decolorisation of ——. M. J. van Tussenbroek. Chem. Weekblad, 1922, 19, 266—267.

Generally Norit was found to have the best decolorising action on unwashed oils, and fuller's earth on oils washed free from acid. A carefully refined colourless sample of coconut oil, with an acid value of 0·08%, was coloured with 1% of aminoazobenzene, and heated to 90° C. for one hour with 1% of Norit, with the addition of quantities of "Ijsazijn" varying from 0·2—2·0%. The best results were obtained with 1·4—1·6% of "Ijsazijn." The efficiency of an adsorptive decolorising agent may be determined by tests with a substance easily soluble in oil and capable of being titrated, such as aniline or β-naphthol.—H. M.

Dihydroxystearic acid; Oxidation of ——. Y. Asahina and Y. Ishida. Yakugakuzasshi (J. Pharm. Soc. Japan), 1922, [481], 171—179.

Dihydroxystearic acid (504 g.) is easily oxidised to azelaic acid (202·5 g.) and pelargonic acid (130 g.), by treating with a mixture of sodium bichromate and sulphuric acid whilst introducing steam at 110°—120° C. By the same treatment, trihydroxystearic acid (480 g.) is oxidised to azelaic acid (89 g.) and œnanthylic acid (41·5 g.). (*Cf.* J.C.S., July.)—K. K.

Indian beeswax; Constants of ——. O. D. Roberts and H. T. Islip. Analyst, 1922, 47, 246—251.

Tables are given of the constants of 23 samples of honeycomb and wax collected under the supervision of District Officers in Bengal, Eastern Bengal, and Assam. The following are the minimum, maximum, and average values obtained respectively. Sp. gr. 0·9555, 0·9733, 0·9652; m.p. 60·4°, 66·4°, 61·4° C.; acid value, 3·7, 7·6, 5·8; ester value, 87·4, 96·0, 92·1; ratio of ester value to acid value, 12·2, 26·0, 16·7; iodine value, 4·5, 7·7, 5·6; Salamon and Seaber's test (J., 1915, 461), 52, 62, 57·6; hydrocarbons, 6·9, 12·9, 9·8%. The low acid values obtained are remarkable, being in many cases lower than 6, the figure hitherto accepted as the lowest representing unadulterated Indian beeswax. Both Weinwurm's test (Lewkowitsch, Chem. Technol. Anal. of Oils, Fats and Waxes, 1914 Ed., Vol. 2, 921) and Salamon and Seaber's test are shown to be untrustworthy. —H. C. R.

Iodine value of aliphatic and aromatic unsaturated compounds; Determination of the ——. D. Holde, P. Werner, I. Tacke, and C. Wilke. Chem. Umschau, 1922, 29, 185—188.

The determination of the iodine value is a valuable criterion of the purity of higher unsaturated fatty acids and their derivatives when other methods such as molecular weight determinations and melting points fail, and has been used by Holde and Wilke in the case of erucic acid (J., 1922, 260 a). In these instances the Hanus reagent is preferred (10 g. of iodine monobromide in 500 c.c. of glacial acetic acid), as it gives results in close agreement with Hübl's reagent, and is more easily prepared, more stable, and more rapid in action, standing for 15 mins. with about 50% excess of the reagent being sufficient to complete the reaction. Accurate results are also obtained with aromatic unsaturated compounds, *e.g.*, safrole, under similar conditions. Anomalous results are given by the Hübl-Waller solution and by Wijs' solution for both cholesterol and phytosterol, the former reagent giving abnormally low and the latter abnormally high results. With the original Hübl solution, however, consistent though slightly high results (73—77 compared with 65·7 theoretical) were obtained with cholesterol, but with phytosterol values varying from 41 to 76 were obtained according to the duration of the reaction and the excess of Hübl solution employed. With both alcohols Wijs' solution gave values of 135, that is approximately double the theoretical. A similar difference in the results with Waller's and Wijs' solutions has been observed with thick mineral lubricating oils and with naphthenic acids, which may indicate the presence of cholesterol derivatives in these natural products.—G. F. M.

Patents.

Oil and like extractor. K. F. Wilhelm. U.S.P. 1,418,503, 6.6.22. Appl., 11.11.13.

A double-walled hollow cylinder is supported on hollow shafts so that it can be rotated about a horizontal axis. Transverse filtering pipes which can be detached are arranged within the cylinder, and a discharge pipe carried along the outside of the cylinder communicates with the filtering pipes through apertures made in the cylinder wall, and also with the hollow shaft, so that liquid can be discharged during the rotation of the cylinder. Solvent can be introduced into the cylinder through one of the shafts and steam can be circulated through the space between the cylinder walls. A second discharge pipe is connected with the end wall of the cylinder near the circumference and affords communication between the cylinder and the hollow shaft, so that liquid can be drawn off from various altitudes within the cylinder.—H. C. R.

Oils and fats; Neutralisation of ——. E. R. Bolton and E. J. Lush, Assrs. to Technical Research Works, Ltd. U.S.P. 1,419,109, 6.6.22. Appl., 21.2.21.

See E.P. 159,587 of 1919; J., 1921, 310 a.

XIII.—PAINTS; PIGMENTS; VARNISHES RESINS.

Red lead; Volumetric estimation of lead dioxide in ——. A. Bonis. Ann. Falsif., 1922, 15, 157—159.

The following modified procedure for estimating lead peroxide by Diehl's method is advocated. 0·5 g. of the sample is macerated with 2·5 c.c. of nitric acid (sp. gr. 1·08) and the mixture is washed into a conical flask with 25 c.c. of a saturated solution of sodium acetate. To the suspension 10 c.c. of a 12% solution of potassium iodide in saturated sodium acetate is added, the whole is well shaken, and the iodine liberated is titrated with $N/10$ thiosulphate solution. If the sample of red lead contains iron oxide, instead of titrating the free iodine, an excess of the standard thiosulphate is added, and the whole is made up to 100 c.c. with the saturated sodium acetate solution. After filtering, an aliquot portion of the filtrate is titrated back with $N/10$ iodine solution.—W. G.

Whitewashes and aqueous lime paints; Investigation of ——. G. J. Fink. J. Ind. Eng. Chem., 1922, 14, 503—511.

Trials of 175 different aqueous paints prepared with milk of lime as basis were made, including exposure tests for 3 and 6 months respectively. Of the common ingredients of a non-binding nature added to the simple limewash, common salt proved of decided value, other inorganic substances, *e.g.*, sodium phosphate, fluoride, borate, and carbonate, whiting, calcium sulphate, asbestine, copperas, alum, or zinc oxide showing no effect or at most a doubtful improvement. Magnesium, calcium, and zinc chlorides proved of some slight value in enhancing durability. Of the binders or "siccatives," which comprised casein, glue, flour, sodium silicate, and soap, the first-named showed outstanding merit as an ingredient of limewash, the working qualities and durability on exposure being particularly marked when the composition also contained trisodium phosphate for accelerating the solution of the casein, and formaldehyde for rendering the casein film insoluble. Both glue and sodium silicate have a tendency to cause scaling of the film, but limewash containing both glue and trisodium phosphate gives satisfactory results in interior decoration, and if formaldehyde also be added, the dried film is resistant to soap and water. The benefit attendant on the use of drying oils as ingredients of whitewash is greatly discounted by their effect in diminishing the opacity of the lime pigment. —A. de W.

Varnishes; Testing ——. *III. Hardness tests.* H. Wolff. Farben-Zeit., 1922, **27**, 2555—2556.

An apparatus for testing the hardness of varnish films consists of a triangle formed by three wooden strips, the base of which is hinged to the face of a baseboard. At the apex of the triangle is fitted a blunt knife edge directed towards the face of the baseboard. Pressure is exerted on the knife edge by means of a small loaded dish set on the apex of the triangle directly over the knife edge and arranged to be counterpoised to zero load by a lever carrying a sliding weight and set at right angles into the hinged base of the triangle in a direction away from the apex. The varnished test plate is fixed to two strips which slide in guide rails fastened to the baseboard, and is moved at a definite rate, so that the film comes in contact with the knife edge. By means of a paper scale attached to the test-piece a number of "cuts" can be made at varying loads and compared. By substituting a strip of tinned iron in place of the knife edge and taking observations at loads slightly above zero, the progress of drying of a varnished surface can be observed by the adhesion or otherwise of the testing edge.—A. de W.

Phenol-aldehyde condensation products; Comparative examination of —— *as substitutes for shellac in spirit varnishes and polishes.* E. Fonrobert. Chem.-Zeit., 1922, **46**, 513—514.

Ten phenol-aldehyde condensation products from different sources were submitted to tests with a view to their evaluation as substitutes for shellac in spirit varnishes and polishes. The melting-points (incipient sintering to complete fusion) ranged from 40°—46° C. to 97°—105° C.; one sample, showing an incipient melting-point of 80° C., failed to melt completely and, moreover, was the only one not completely soluble in alcohol. The ash content in no case exceeded 0·6%. The acid values of eight samples ranged from 1·1 to 9·0, another sample showing a value of 42·6. Paleness of colour was in most cases accompanied by a strong odour of cresol, the samples possessing strong odours furthermore usually deepening in tint when the films from the alcohol solutions were maintained at 100° C. for 24 hrs. Only two of the samples were free from smell of cresol at ordinary temperatures, and some of them contained a proportion of cresol sufficient to produce unpleasant effects as a result of contact of the skin of the hand with the varnished surface. Elasticity of the film, due to the presence of free cresol, was only transient, as was shown by observation of the films after submission to a rapid ageing test (exposure at 100° C. for 24 hrs.). All the samples were much inferior to shellac in regard to hardness and elasticity. The films from the varnishes varied from a condition of sensitiveness to hand-warmth in the early stages, to brittleness after stoving at 100° C. for 24 hrs., two samples, however, giving films which were fairly elastic after stoving. Phenol-aldehyde condensation products must be regarded as poor substitutes for natural shellac.—A. de W.

Abietic acid and certain metal abietates. L. L. Steele. J. Amer. Chem. Soc., 1922, **44**, 1333—1341.

Abietic acid may readily be prepared by boiling white rosin with 98% acetic acid for 2 hrs. under a reflux condenser and then, after filtering the mixture, leaving it to cool overnight. The acid is best recrystallised from 98% acetic acid. The abietates of lead, manganese, cobalt, nickel, chromium, and iron were prepared by pouring a neutral solution of sodium abietate into an excess of an aqueous solution of one of the salts of the corresponding metal. (*Cf.* J.C.S., Aug.)—W. G.

Patents.

Carbon black, lampblack and hydrogen; Method of manufacturing ——. H. J. Masson, Assr. to J. M. Gerard. U.S.P. 1,418,385, 6.6.22. Appl.,17.7.20.

A substance containing carbon is decomposed by passing it through a body of molten catalytic material, the temperature of which is sufficiently high to decompose the substance into minute particles of carbon and hydrogen, the carbon thus formed being removed from the molten catalyst with sufficient rapidity to maintain the black colour and softness of the carbon produced.—A. de W.

Lampblack; Preparation of ——. W. K. Lewis, Assr. to The Goodyear Tire and Rubber Co. U.S.P. 1,418,811, 6.6.22. Appl., 13.8.18.

Imperfect combustion of natural gas for the production of lampblack is effected by burning the gas in the presence of approximately 15—20 vols. of combustion gas.—A. de W.

Phenol-aldehyde condensation products. Condensite Co. of America, Assees. of D. S. Kendall. E.P. 159,164, 17.11.20. Conv., 19.2.20.

A phenolic condensation product, permanently fusible below 218° C., is obtained by heating together in a closed digester at 200°—220° F. (93°—104° C.), a phenol and acetaldehyde or a polymer thereof in the presence of a quantity of an inorganic acid condensing agent, *e.g.*, hydrochloric or sulphuric acid, not exceeding 0·5% of the phenol used, until the acetaldehyde has substantially all reacted with the phenol. During the reaction external heating is stopped and a cooling medium applied to the digester to maintain the temperature within the specified limits. Excess of phenol and water are removed from the product, *e.g.*, by distillation, and the acid condensing agent is also removed, or neutralised and separated. The fusible resin thus obtained may be treated with methylene-containing substances, *e.g.*, hexamethylenetetramine, so as to form an infusible substance on the application of heat. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 18,258 of 1913; J., 1914, 841.)—A. de W.

Phenolic condensation product; Process of making a ——. D. S. Kendall, Assr. to Condensite Co. of America. U.S.P. 1,418,718, 6.6.22. Appl., 10.5.20.*

A liquid mixture of phenol, formaldehyde, and water containing dissolved hexamethylenetetramine in which the formaldehyde is present in sufficient quantity to react with the phenol to form a fusible resin, and the hexamethylenetetramine sufficient to react with the resin to form an infusible product, is

heated to cause reactions between the phenol, formaldehyde, and hexamethylenetetramine and obtain a fusible resin containing hexamethylenetetramine in solution but substantially no uncombined formaldehyde.—A. de W.

Printing inks; Process for the manufacture of black ——. Rütgerswerke A.-G., and H. Teichmann. E.P. 166,117, 15.6.21. Conv., 8.7.20.

Solutions obtained as described in E.P. 131,588 and 160,467 (*cf.* G.P. 320,056; J., 1920, 622 A) by treating coal and other organic material, such as wood, peat, straw, cotton, and the like, with tar oils at, *e.g.*, 300° C., or resinous, bituminous residues obtained in distilling such solutions, are suitable for use in the manufacture of printing inks. For example, 58 pts. of coal extract resin oil produced as described in E.P. 131,588, is ground with 12 pts. of lampblack and 30 pts of straw extract oil. Other materials, such as petroleum pitch, asphalt, coumarone resin, or oils, such as boiled linseed oil, resin oils, or the like, as well as colouring matter to modify the shade, may also be added.—L. A. C.

Paints, varnishes, etc.; Removal of ——. W. Tiddy, Assr. to Rainey-Wood Coke Co. U.S.P. 1,417,955, 30.5.22. Appl., 19.5.21.

Heavy coal-tar bases, substantially free from pyridine, are used to remove paints, varnishes, etc.
—C. I.

Preservation of wood, pasteboard, masonry, leather, sheet iron, etc.; Coating for the ——. E. Reck, Assr. to Freeses Patent Eisenchutz und Schraubenwellenbekleidung für Schiffe G.m.b.H. U.S.P. 1,418,172, 30.5.22. Appl., 6.1.21.

See E.P. 153,293 of 1920; J., 1922, 65 A.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber; State of —— *in its solutions.* P. Bary. Caoutchouc et Gutta-Percha, 1922, **19**, 11393—11395.

Einstein's formula for the viscosity of suspensions if applied to the viscosity of very dilute solutions of rubber, and Hatschek's formula for emulsoids at slightly higher concentrations, both indicate that rubber, when dissolved in benzene, enters into combination with more than 100 times its weight of the solvent. Solutions of rubber in benzene containing above 1% of the dry material are regarded as more or less fluid jellies. Maximum swelling of the rubber occurs at a concentration of about 0·3%. Below this concentration the jelly probably disintegrates in the solvent with simultaneous reduction in the degree of swelling of the rubber. The position of maximum swelling is influenced by the quality of the rubber and also by the nature of the solvent.—D. F. T.

Patents.

Vulcanisation of rubber employing amines and open-chain aldehydes and similar substances and products obtained thereby. S. M. Cadwell, Assr. to Naugatuck Chemical Co. U.S.P. 1,417,970, 30.5.22. Appl., 28.5.21.

Rubber is vulcanised after being mixed with a vulcanising agent and a product obtained by the interaction of an aliphatic aldehyde and an amine.
—D. F. T.

Rubber; Treatment of ——. W. A. Beatty. U.S.P. 1,418,271, 6.6.22. Appl., 6.6.18.

A base for chewing gum is prepared from raw rubber by treating the latter with a solvent for the nitrogenous substances present therein, separating the resulting solution, and subjecting the residual rubber to the action of heat and an inert gas to remove volatile substances.

Accelerator [*of vulcanisation*]. *Vulcanising rubber.* R. B. Naylor, Assr. to Fisk Rubber Co. U.S.P. (A) 1,418,824 and (B) 1,418,825, 6.6.22. Appl., 26.8. and 21.10.20.

The vulcanisation of rubber with sulphur is assisted by (A) a condensation product of formaldehyde and *p*-toluidine or (B) phenylhydrazine.—D. F. T.

Rubber and other like substances; Vulcanisation of ——. B. D. Porritt, Assr. to North British Rubber Co. U.S.P. 1,418,166, 30.5.22. Appl., 7.3.19.

See E.P. 129,798 of 1918; J., 1919, 688 A.

Caoutchouc; Art of vulcanising ——. C. W. Bedford and R. L. Sibley, Assrs. to Goodyear Tire and Rubber Co. U.S.P. 1,418,771, 6.6.22. Appl., 24.11.19.

See E.P. 173,545 of 1920; J., 1922, 149 A.

Caoutchouc; Art of vulcanising ——. C. W. Bedford, Assr. to Goodyear Tire and Rubber Co. U.S.P. 1,418,772, 6.6.22. Appl., 24.11.19.

See E.P. 130,857 of 1918; J., 1919, 731 A.

Caoutchouc and caoutchouc-like product; Manufacture of ——. P. Schidrowitz, Assr. to Catalpo, Ltd. U.S.P. 1,418,976, 6.6.22. Appl., 19.7.21.

See E.P. 170,682 of 1920; J., 1921, 898 A.

Rubber, caoutchouc, balata, guttapercha and similar substances; Machines for washing, milling, macerating, and cleaning ——. H. Berry and Co., Ltd., and P. G. Bradford. E.P. 180,831, 6.4.21.

Treating leather with rubber. E.P. 179,969. *See* XV.

XV.—LEATHER; BONE; HORN; GLUE.

Tannins; The "hormone" theory of the formation of ——. W. Moeller. Z. Leder- u. Gerb.-Chem., 1921—2, **1**, 64—67, 73—80, 107—114, 143—145, 171—183.

Sugars are capable of yielding polyphenols, which are vegetable "hormones." The polyphenols are oxidised to the insoluble peptising substances which function largely in the production of leather. These insoluble tannins are present in plants in the form of glucosides and are thus rendered soluble. Humic acid contains a peptising system, and only those phenols which can pass through an intermediate quinone state can be oxidised to humic acid. The evidence of other research workers is adduced in support of the author's peptisation theory.—D. W.

Synthetic tannins; Properties of the sulphonic group in —— *II.* W. Moeller. Z. Leder- u. Gerb.-Chem., 1921-2, **1**, 203—210.

Various synthetic tannins in which the sulphonic group is combined with bases such as aluminium, chromium, or iron do not hydrolyse pelt to the same extent as does Neradol, in which the sulphonic group is free; and hence leathers tanned with these materials are more resistant to the hot-water test.—D. W.

Lime liquors used in the tannery; Chemistry of ——. W. R. Atkin. J. Soc. Leather Trades Chem., 1922, **6**, 200—206.

The theories of Procter and Wilson (J., 1916, 156, 645) and of Loeb (J. Gen. Physiol., 1918—1920) are extended to the alkaline swelling of hide in lime liquors. "Sharpening" agents, such as sodium sulphide and sodium carbonate, produce greater swelling because the osmotic pressure of sodium collagenate is greater than that of calcium collagenate at the same hydrion concentration. The smooth grain of skins unhaired with arsenic sulphide is due to the fact that only calcium collagenate is formed. The addition of salt to collagen, swollen by means of alkali, causes a repression of swelling exactly as in the case of pickling. A mixture of barium hydroxide and sodium chloride produces more swelling than barium hydroxide alone because of the interaction of the barium collagenate with the sodium chloride producing sodium collagenate, which has a greater swelling effect. There is no need to remove all the salt from salted hides before liming. The swelling properties of lime liquors should be determined by experiments on hide powder. The swelling should be compared with the p_H value, and graphical records preserved for successive liquors.—D. W.

Chrome tanning; A possible theory of ——. F. C. Thompson and W. R. Atkin. J. Soc. Leather Trades Chem., 1922, **6**, 207—209.

The existence of a negatively charged colloidal complex in chrome tanning solutions is indicated by the precipitate obtained when chromic chloride solutions are shaken with an amyl acetate solution of benzidine. Bassett and Pauli have both shown the probable existence of negatively charged colloidal chromium complexes. It seems possible that chrome tanning is effected by a negatively charged anion or colloidal particle containing chromium, which is produced from the green form of chromium sulphate. —D. W.

[*Gelatin;*] *Relation between hydrolysis* [*of*] *and adsorption* [*by* ——]. V. W. Moeller. Z. Leder- u. Gerb.-Chem., 1921-2, **1**, 160—165, 183—188.

Dry gelatin powder was soaked in water and various acids at $N/10$, $N/20$ and $N/100$ concentrations for from 1 hr. to 5 days and the amount of dissolved gelatin determined. The effect of some of the acid solutions, notably butyric acid, was to cause a diminution in the amount of hydrolysed gelatin. In most cases there was a re-adsorption of the hydrolysed gelatin after 5 days in $N/10$ solutions of organic acids, and in $N/100$ solutions of lactic and butyric acids. These results confirm the views of Kuhn (J., 1922, 111 A) that the swelling and hydrolytic effects of mineral acids differ from those of organic acids, but they also show that the action of acetic acid differs from that of lactic and butyric acids, the latter being the most suitable for tanning since they provide the necessary swelling with the least possible loss of hide substance.—D. W.

[*Leather chemistry;*] *Researches in the proteins* [*connected with*] ——. W. Moeller. Z. Leder- u. Gerb.-Chem., 1921-2, **1**, 188—203.

Blood fibrin as a typical true protein is less resistant to the action of alkalis, adsorbs very little vegetable tannin, is much hydrolysed by chrome liquors, and combines with a large amount of formaldehyde. Hide pelt which contains large amounts of true proteins, *e.g.* elastin and muscle protein, will tan differently to pelt from which these have been removed by strong liming or bating. True proteins readily adsorb chromium compounds, and their presence is disadvantageous for chrome-tanned upper leathers, as the excessive adsorption of chromium renders the leather hard and brittle. The true proteins are of value in sole leather, imparting firmness and resilience to the product, but they should be removed from pelts for vegetable-tanned upper leathers.—D. W.

Leathers; Resistance of different —— *to the action of acids.* W. Moeller. Z. Leder- u. Gerb.-Chem., 1921-2, **1**, 217—224.

Hydrochloric acid has the greatest destructive action on leather; sulphuric acid is less detrimental, and acetic acid has very little effect. Leathers tanned with quebracho and chestnut are equally affected by the action of acids, but leather tanned with quebracho extracts free from sulphite is much less resistant towards acetic acid. Sulphuric acid added during tannage up to a certain concentration is not absorbed by the pelt, but the same concentration of hydrochloric acid causes considerable hydrolysis. The addition of acetic acid during the tanning process produces a leather with a greater resistance to water.—D. W.

Protein systems [*gelatin*]; *Sol-gel equilibrium in* ——. R. H. Bogue. J. Amer. Chem. Soc., 1922, **44**, 1313—1322.

Viscosity-plasticity measurements made on gelatin solutions of various concentrations over a temperature range, 25°—60° C., with a MacMichael torsional viscosimeter, indicate that gelatin in aqueous solution follows the law of viscous flow at the higher temperatures, whilst at lower temperatures it exhibits plastic flow. The transition between the sol and gel form does not take place at any definite temperature, but extends throughout a rather indefinite period of temperature. At a given temperature the increase or decrease in viscosity with time is dependent on the hydrogen-ion concentration, the nature of the inorganic ions present, and the amount of hydrolysed protein in the system. It is considered that the viscosity of pure gelatin at any given hydrogen-ion concentration is inversely proportional to some function of the temperature. —W. G.

Elastic gels [*gelatin*]; *Structure of* ——. R. H. Bogue. J. Amer. Chem. Soc., 1922, **44**, 1343—1356.

The author re-states and amplifies his theory as to the catenary or fibrillar structure of gelatin-water systems (*cf.* J., 1920, 605 A), and in support quotes results on the influence of the electrolytes, of varying hydrogen-ion concentration, and of the valency of the combining ion on several of the characteristic properties of gelatin, namely, swelling, viscosity, jelly consistency, foam, turbidity, and alcohol number. Smith's data on mutarotation (J., 1919, 228 A) and Loeb's occlusion theory (J. Gen. Physiol., 1921, 3, 827; 1921—22, 4, 73, 97, 351) are shown to be in accord with the author's theory. (*Cf.* J. C. S., Aug.)—W. G.

Patents.

Hides; Process for unhairing ——. Soc. Pichard Frères. E.P. 163,294, 22.4.21. Conv., 12.5.20.

Well-dried hides are immersed in liquid air or other cold medium below −100° C. to render the hairs brittle, allowed to drain, and the hair removed by any suitable means.—D. W.

Tanning substances; Manufacture of artificial ——. M. Melamid. E.P. 180,353, 26.11.20. Addn. to 163,679 (J., 1922, 261 A).

Cresols, higher phenols derived from anthracene oil, or naphthalene, together with sulphuric acid in sufficient quantity to yield the sulphonated product, or the sulphonated products of these substances, are treated with acetylene in presence of mercury compounds. The product is dissolved in water, neutralised if necessary, and insoluble mercury compounds are filtered off.—D. W.

India rubber; Process for the treatment of leather with ——. A. McLennan. E.P. 179,969, 19.11.20.

Leather, after treatment with a mixture of carbon bisulphide or carbon tetrachloride with acetone, ether, benzene, paraffin, or petrol and sulphur, for the removal of grease, is buffed on the flesh side and is then soaked for 24—48 hrs. in a solution of rubber in a mixture of coal tar and petroleum solvents. It is then removed and worked by hand, after which the soaking and working are repeated. The leather is afterwards soaked in a rubber solution to which at intervals are added solutions containing gutta-percha, balata, gum mastic and dammar, and lastly a solution of sulphur chloride.—D. F. T.

Gelatin or similar material; Process and apparatus for producing uniform colorations of the exact shade required on ——. [Preparation of photometer scales.] O. Bornhauser. G.P. 351,243, 31.8.20.

Layers of gelatin or the like impregnated with a suitable precipitant are covered with an aqueous solution of a material which reacts with the precipitant to form a coloured, transparent precipitate in the gelatin layer. For example, gelatin is steeped in formaldehyde solution and then covered with ammoniacal silver solution, whereby a uniform dark brown precipitate of silver is formed in the gelatin. If permanganates are used as colouring agents, the gelatin requires no previous treatment. Graded photometer scales are prepared by pressing a frame separated into a number of compartments by partitions on to a layer of gelatin, and then pouring different quantities of the colouring solution into each compartment.—L. A. C.

XVI.—SOILS; FERTILISERS.

Calcium content of some virgin and cultivated soils of Kentucky; Comparison of the —— by an improved method for the estimation of this element. O. M. Shedd. Kentucky Agr. Exp. Stat. Bull. 236, Oct., 1921, 305—330.

Examination of certain soils indicates that cultivation has lowered the calcium content sufficiently to necessitate consideration of a possible deficiency of calcium as a plant food. The best types of soil usually contain the largest amounts of calcium, phosphorus, sulphur and iron. Determinations of "easily soluble" calcium by extraction with $N/5$ nitric acid and with carbonated water, indicate that the relative solubility of this element varies considerably in different soils. The method of estimating total calcium in soils has been improved. (*Cf.* J.C.S., July.)—A. G. P.

Soil; Micro-organisms concerned in the oxidation of sulphur in ——. III. Media used for the isolation of sulphur bacteria in the soil. S. A. Waksman. Soil Sci., 1922, 13, 329—336.

The classification of sulphur-oxidising organisms on physiological and morphological grounds is preferred to one determined by the type of oxidation or by the optimum reaction at which the organism acts. A review of the literature and of the media used by various investigators is given.—A. G. P.

Mineral plant food [from soils]; Removal of —— by drainage waters. J. S. McHargue and A. M. Peter. Kentucky Agr. Exp. Stat. Bull. No. 237, Nov., 1921, 333—362.

Analyses of numbers of samples of water from rivers, streams, etc., are recorded. The largest quantities of mineral matter were found in waters from limestone areas and the least in waters from sandstone areas, although the latter contained more potash than the former. The phosphate content of drainage waters varies with the amount present in the soil. High phosphate contents were always accompanied by high nitrate content. Waters containing most nitrates did not contain the greatest quantities of mineral matter. The leaching out of plant nutrients by drainage waters can be minimised by growth of clover crops on land which would normally be fallowed.—A. G. P.

Soil; Effect of limes containing magnesium and calcium on the chemical composition of the —— and upon plant behaviour. W. Mather. Soil Sci., 1922, 13, 337—354.

Soils treated with various types of lime and limestone were cropped for a number of years and periodical examinations of the soils are reported. Hydrated magnesian and calcic limestones produced practically the same crop yields. The effects of magnesium and calcium in limes and limestones on soil reaction are practically the same if the materials are applied in equivalent quantities. In limes both render the aluminium of the soil relatively insoluble. The calcium:magnesium ratio of soils treated with magnesian limestones was similar to that of unlimed soils. Variations of this ratio produced no apparent effect on plants. Magnesian limestones tend to increase the total nitrogen content of soils. Hydrated lime and magnesium oxide did not reduce the nitrogen content of the soil but slightly increased the amount of organic matter. —A. G. P.

Phosphates of aluminium, iron, and calcium; Comparative agricultural value of insoluble mineral ——. J. S. Marais. Soil Sci., 1922, 13, 355—409.

Comparison was made of the value of various mineral phosphates in pot-cultures and with various crops. The phosphates of aluminium and iron in some cases are superior to calcium phosphate, but in others are inferior. With all the phosphates assimilation is assisted by the rapid nitrification of urea. The chemically pure phosphates of the three metals are all equally available to plants, but the mineral phosphates of aluminium and iron in the form of basic hydrated phosphates are less available. This can be remedied by ignition. Lime improves the availability of pure and mineral aluminium phosphates, is without effect on iron phosphates, and tends to decrease the solubility of calcium phosphates. The effect on aluminium phosphates is explained by the removal of aluminium as insoluble calcium aluminate, and that on calcium phosphate by a disturbance of the equilibrium between the tri- and di-phosphates and carbonic acid. An alkaline soil solution tends to dissolve aluminium phosphate and thus aids its assimilation by the plant. Intimate contact between the plant roots and mineral phosphates is an important factor in their assimilation.—A. G. P.

Phosphates; Regularity of the assimilation of —— by plants. M. von Wrangell. Landw. Jahrb., 1922, 57, 1—78. Chem. Zentr., 1922, 93, I., 1387.

The conception that the assimilation of natural phosphates by plants is greater in those plants having a high $CaO:P_2O_5$ ratio (*cf.* J., 1921, 54 A) is confirmed. The ratio $CaO:P_2O_5$ for any particular plant varies with the reaction of the soil in which it grows. The assimilation of phosphate is lessened by the presence of calcium salts. There is a stoichiometric relationship between the amounts of lime and phosphoric acid taken up by a particular plant. The basic constituent of phosphatic fertilisers is important. The utility of calcium, iron, aluminium, and magnesium phosphates varies with the nature of the plant, and the non-utilisable constituents may be harmful. Thus cereals feeding on calcium phosphate leave residues of free lime and mustard treated with magnesium phosphates tends to liberate alkaline magnesium oxide.—A. G. P.

Patents.

Nitrates; Treatment of ——, particularly those used for fertiliser purposes. R. G. Browning and H. G. T. Boorman. E.P. 180,180, 27.4.21.

The hygroscopicity of commercial calcium and sodium nitrates is largely prevented by the admixture of a non-deliquescent, non-hygroscopic base, *e.g.*, carbonates of sodium, calcium, magnesium, etc.—A. G. P.

Soil mixture for a forced growing of potatoes and method for its manufacture. J. Husson. U.S.P. 1,417,248, 23.5.22. Appl., 28.12.20.

Sand is mixed with fertilisers containing nitrogen, phosphorus, and potash in the proportions 2—3% of nitrogen, 3—4% of water-soluble phosphoric acid, and 1—2% of potash.—A. G. P.

Potassium compounds; Treatment of leucitic rocks for the purpose of rendering —— available. G. A. Blanc and F. Jourdan. U.S.P. 1,418,356, 6.6.22. Appl., 21.10.20.

The rock is calcined, reduced to an impalpable powder, and treated with an organic acid.
—A. G. P.

Fertilisers containing phosphoric acid and potash; Process for the production of ——. T. Haege. E.P. 180,027, 15.2.21.

See U.S.P. 1,411,696 of 1922; J., 1922, 385 A.

Insecticides. U.S.P. 1,417,232 and 1,418,848. *See* XIXb.

XVII.—SUGARS; STARCHES; GUMS.

Beet juices treated with magnesium bicarbonate; Simultaneous saturation applied to ——. K. Andrlik and W. Kohn. Z. Zuckerind. Czechoslov., 1922, 46, 404—410, 411—415.

Beet juices, syrups, and molasses were treated in the laboratory with sufficient lime to impart an alkalinity of about 0·1%, filtered, mixed with a solution of magnesium bicarbonate, and submitted to the process of simultaneous saturation previously described (Urban, J., 1922, 428 A). A considerable diminution of the colour and an appreciable increase in the purity of the product thus clarified resulted. Magnesium bicarbonate was prepared for this purpose from dolomitic lime by dissolving out the calcium hydroxide with a solution of sucrose and carbonating the residue.—J. P. O.

[Beet] juice; Distillation of ammonia from limed and carbonated —— and its influence on the composition of this juice. W. Kohn. Z. Zuckerind. Czechoslov., 1922, 46, 431—438.

In laboratory experiments limed beet juice when distilled in an apparatus provided with a dephlegmator yielded only 0·01 and 0·016% NH_3 when the volume of the distillates was 6 and 14% respectively. Juice which had been both limed and carbonated yielded 0·008 and 0·012% respectively. Generally juice which had been thus distilled was lower in purity, darker in colour, and higher in calcium content than that obtained according to the ordinary routine.—J. P. O.

Lactose; Action of ozone on solutions of ——. O. W. Schonebaum. Rec. Trav. Chim., 1922, 41, 422—424.

Ozone of low concentration does not decompose neutral or acid solution of lactose, even when ozonisation proceeds for 3 hrs. at 70° C. In alkaline solution the ultimate products are carbon dioxide and water, formic acid occurring as an intermediate product.—H. J. E.

Patents.

Adhesive; Manufacture of an —— from potato-starch. A. G. Bloxam. From J. Kantorowicz. E.P. 179,765, 23.3.21.

Potato flour is treated, without making a milky mixture, and in a medium containing no caustic alkali, with a peroxide or per-salt having an alkaline reaction, or with a neutral peroxide or per-salt in an alkaline medium. The proportions are such that complete transformation into soluble starch is avoided, *e.g.*, 100 kg. of flour is mixed with 2·5 kg. of ammonium persulphate and 1 kg. of ammonia solution (22° B.). After standing for at least 1 day, the product gives, when mixed with ten times its weight of water, a paste approximately equal in viscosity and softness to wheat starch paste.—A. G. P.

Dextrin substitute; Process for the production of a —— from extracted beet residues. F. Sichel, Chem. Fabr. "Liminer," and E. Stern. G.P. 351,002, 10.4.19.

Extracted beet slices are systematically leached with water at 70°—100° C. Leaching is stopped when the slices begin to pulp. Solutions thus obtained are easier to work up than those from the acid and pressure processes, and the residues are of value as a cattle food.—A. G. P.

Edible product obtained from the sugar juices of beets and process of obtaining it. P. Kestner. U.S.P. 1,419,057, 6.6.22. Appl., 30.6.20.

See E.P. 135,235 of 1918; J., 1920, 76 A.

XVIII.—FERMENTATION INDUSTRIES.

Zymase; Problem of the formation of —— in yeast. F. Hayduck and H. Haehn. Woch. Brau., 1922, 39, 97—100, 105—107, 110—113, 118—119, 122—123, 128—130.

The authors discuss the different theories which have been advanced to explain why certain yeasts capable of inducing active fermentation, such as those produced by the aeration process, are quite unsuitable for the preparation of active zymase or permanent yeast, the yeasts employed in Buchner's work being almost exclusively of the bottom fermenting brewery type. The experimental results obtained support the view that zymase exists in the yeast cell both in the free state and also in combination with the protoplasm as so-called plasma zymase, the zymase being largely in the uncombined condition in bottom brewery yeasts, but almost entirely combined in the yeast prepared by the aeration process. At the present time, however, many of the brewery yeasts in use in Germany are practically devoid of free zymase, the amount of the latter formed being apparently small owing to the deficient nutrition of the yeast resulting from the prevailing economic conditions; further, this small amount of enzyme and also the corresponding co-enzyme are destroyed by the action of the endotryptase and lipase respectively. By prevention of the action of the endotryptase during the maceration of the yeast by suitable alteration of the hydrogen-ion concentration, an extract is obtained which brings about active fermentation of sucrose in presence of added co-enzyme. On the other hand experiments made with yeast rendered permanent by treatment with acetone or by Lebedew's method show that German bottom-fermentation brewery yeasts yield amounts of free zymase similar to those observed under pre-war conditions. As regards the influence of toluene in restricting fermentation by living yeast cells, the results obtained support the view that a protecting layer of emulsion is formed, this preventing access of the sugar to the zymase. The authors have carried out a number of series of experiments with the *Torula* largely grown in Germany during the war for use as fodder and known as "mineral yeast." This organism is poor in zymase but rich in catalase, whereas with brewery yeast the reverse is the case. If, however, the torula is grown, in absence of air, in molasses solution containing nutrient salts, its content of zymase is considerably increased and that of catalase markedly decreased, but no relation can be traced between the fermentative power and the proportion of nitrogen present in the organism. When repeatedly grown under anaerobic conditions, the cells of the torula assume a more spherical shape than they originally possess, but they continue to exhibit the high content of free nucleic acids characteristic of true torulæ; at the same time the baking value becomes at least equal to that of commercial yeast prepared by the aeration process, although the yield is decidedly less than that obtained with aeration. Close parallelism exists between the formation of zymase and that of nucleic acids in this organism, and a good idea of the fermentative activity may be obtained by the extent of the green spots formed when the cells are fixed by heating and then treated successively with Carbol-Methylene Blue, water, and diaminophenylacridine.—T. H. P.

Yeast; Capacity of —— to decompose acid amides. W. Dieter. Z. physiol. Chem., 1922, **120**, 281—291.

Experiments with a top-fermentation pure culture yeast show that when the conditions are such that the yeast ferments but does not grow, it does not remove the amide nitrogen from asparagine and other acid amides.—S. S. Z.

Determining sugars by fermentation. Costantino. *See* XVII.

Yeast nucleic acid. Steudel and Peiser. *See* XX.

Patents.

Yeast; Manufacture of ——. R. Gilmour. E.P. 180,043, 17. and 23.2.21.

Diluted molasses is acidified and boiled with bone charcoal and clarified by the addition of malt combings or other albuminoid material, and filtered. Suitable yeast foods, *e.g.*, ammonium salts, phosphates, etc. are added to the mixture, which is neutralised, if necessary, with ammonia. After filtration the liquor is seeded with yeast and allowed to ferment. Neutrality is maintained by periodic additions of potassium, calcium, or magnesium carbonates. Towards the end of the fermentation lactic acid is added. After a further few hours the yeast is separated and pressed. The initial treatment with bone charcoal and with malt combings may be carried out in two separate stages.—A. G. P.

Colouring matter for beer; Process of manufacturing a ——. H. Lüers. U.S.P. 1,418,945, 6.6.22. Appl., 18.2.21.

See G.P. 347,891 of 1919; J., 1922, 431 a.

Leavening bacteria. G.P. 350,874. *See* XIXa.

Hygienic food. U.S.P. 1,417,412. *See* XX.

XIXa.—FOODS.

Fat obtained from the milk of Egyptian goats. A. Azadian. Bull. Soc. Chim. Belg., 1922, **31**, 171.

In order to fix a standard, 104 samples were examined. The maximum, minimum, and mean values were: for total solids, 16·55, 10·65, 12·54; for fat, 7·35, 2·45, 4·04; and for solids-not-fat, 9·95, 7·6, and 8·50% respectively. Six samples of goats' milk butter were also examined and the detailed results are given.—H. J. E.

Potato flour; Estimation of moisture in ——. E. H. Vogelenzang. Chem. Weekblad, 1922, **19**, 251—253.

Though this determination is of considerable commercial importance, the methods usually employed for it are unsatisfactory, and lead to inaccurate and varying results. It is desirable that a standard method should be adopted; drying should not be carried out in the air, unless specially dried air is used, and precautions should be taken to prevent the dried flour taking up moisture whilst cooling in the desiccator, since it is very hygroscopic. —S. I. L.

Vitamins; The testing of foodstuffs for ——. J. C. Drummond and A. F. Watson. Analyst, 1922, **47**, 235—246.

Details are given of the method of carrying out physiological tests on rats for the presence of the three vitamins in foodstuffs. Young, healthy rats of not more than 50 g. body-weight are fed on a ration of purified foodstuffs from which all traces of the vitamin to be tested for have been removed. These rations are specified for each of the three vitamins. When the rats have shown no further increment of weight for 14 days, the substance to be tested is administered in a daily ration of known weight. A curve is given, showing the sharp recovery which follows the administration of 0·05 g. daily of cod-liver oil, and a series of curves showing the loss of growth-promoting power in a sample of coal-fish liver oil during aeration at 100° C. The method has been used to show that samples of butter vary very considerably in the amount of vitamin they contain. Oleo oil also shows marked variations, which appear to be seasonal and dependent on the state of the pasturage. The amount of vitamin B in milk depends entirely on the food of the cow. Many commercial yeast extracts are almost the richest sources of this vitamin available as foodstuffs. The monkey is the best animal for testing for vitamin C, but the guinea-pig is generally used. Testing is rendered more difficult by the fact that the guinea-pig is entirely herbivorous. The potency of the food supplement added is judged from the "dosage" necessary to prevent the onset of, or to cure established scurvy. The antiscorbutic value of milk is dependent on the diet of the animals. Lemon-juice possesses a very much higher antiscorbutic potency than lime juice.—H. C. R.

Vitamins. S. Fränkel. Pharm. Monatsh., 1922, **3**, 17—18. Chem. Zentr., 1922, **93**, II., 1225—1226.

The action of substances rich in vitamins in accelerating the rate of yeast fermentation was determined. The amount of carbon dioxide liberated in a given period of time was proportional to the vitamin content. The vitamin was prepared as follows: The material was exhausted with nearly boiling 90% alcohol, and then heated with water. The aqueous extract was concentrated *in vacuo*, alcohol was added, and, after filtering, the alcoholic filtrate was added to the initial alcoholic extract. The whole was concentrated and extracted with ether to remove fats etc. The residual liquor was treated with basic lead acetate, filtered, and excess of lead was removed with hydrogen sulphide. The purified solution contained unaltered vitamin, and was further treated with mercuric chloride, excess of which was removed with hydrogen sulphide, and the hydrochloric acid removed with lead and with silver.

Other inactive material was removed with picrolonic acid, and finally the active substance was precipitated with phosphotungstic acid; 99·8% of the inactive substances was thus removed. Most animal organs were poor in vitamins; more was found in the nerve-system, and most in the grey outer layer of the cerebellum. Among plant foods leeks showed the greatest activity. Roasted coffee is considerably more active than unroasted. The acceleration of fermentation by these substances was apparent with yeast juice as well as with the yeast itself. Choline and β-amino ethyl alcohol retarded fermentation. Vitamins have basic characteristics. The accelerating action of vitamins on the action of extra-cellular enzymes such as pepsin, trypsin, diastase, and catalase was very small.—A. G. P.

Vitamins; Distribution of fat-soluble —— in marine animals and plants. J. Hjort. Proc. Roy. Soc., 1922, B 93, 440—449.

Rats which had been previously kept on a diet deficient in fat-soluble vitamin showed a marked increase in growth on administration of dried green algæ and dried cod's roe, also of extracts of these substances prepared with fat-solvents. It is suggested that the fat-soluble vitamins in the sea originate in plants and that their distribution may have important bearings on the periodicity in the growth of fishes.—C. R. H.

Carbohydrate content of navy beans. M. Eichelberger. J. Amer. Chem. Soc., 1922, 44, 1407—1408.

The author draws attention to results obtained by herself in 1919 which are in fairly close accord with those of Peterson and Churchill (J., 1921, 525 A) on the composition of navy beans (*Phaseolus vulgaris*).—W. G.

Protamines. R. E. Gross. Z. physiol. Chem., 1922, 120, 167—184.

When clupeine is heated for 80 mins. with 4% (by vol.) sulphuric acid at 160° C. it loses the property of giving the biuret reaction. The hydrolysed product contains arginine, monoamino acids, and a compound similar to a dipeptide consisting of a combination of at least two molecules of arginine. By precipitating with phosphotungstic acid in alcoholic solution it is possible to separate free arginine from the arginine peptide. The authors confirm Nelson and Gerhardt's observations that in clupeine the monoamino acids are linked together.
—S. S. Z.

Saponins [in lemonade etc.]; Differentiation and quantitative determination of ——. L. Kofler. Z. Unters. Nahr. Genussm., 1922, 43, 278—287.

By employing the usual methods it is impossible to determine the identity of a saponin when it is not available in the pure state or must be isolated from a substance such as lemonade. In addition to the hæmolytic action of saponins the author makes use of their foaming power, the "foam number" being obtained by shaking 10 c.c. of a series of solutions of the saponin of different concentrations in test tubes 16. mm. wide for 15 secs. The foam number is given by the dilution in that tube in which the foam stands 1 cm. high after 15 mins. The hæmolytic index is determined in the usual way. If the hæmolytic index is divided by the foam number a quotient is obtained which is independent of the state of purity of the saponin. This quotient varies very markedly in the case of the six different saponins investigated, and has a characteristic value for each of them varying from zero in the case of glycyrrhizin to 10 in the case of Merck's digitonin. By this means saponins separated from artificial lemonades by methods of Brunner and Rühle (J., 1908, 954; Z. Unters. Nahr. Genussm., 1912, 23, 566; 1914, 27, 192) can be readily identified and quantitatively determined by comparing the hæmolytic index and foam value obtained with those tabulated for the saponin in question. It should be possible to specify a maximum value for the "poison/foam" quotient, which should not be exceeded by saponins used in foodstuffs. The figure 1 or 0·5 is suggested.—H. C. R.

Synthetic sweetening agents. Beyer. *See* XX.

Patents.

Food products; Manufacture of —— from meats and vegetable substances. W. and C. O. Spear. E.P. 179,705, 21.2.21.

Meats, vegetables, etc., are cleaned with warm water, with or without antiseptics, pulped, dried, and if necessary smoked by the means described in E.P. 166,698 (J., 1921, 673 A).—A. G. P.

Casein products; Production of ——. H. V. Dunham. E.P. 180,018, 12.2.21.

An alkali casein solution is treated with sufficient acid material containing citric acid to render the liquid acid to litmus and produce a suspension of finely divided or deflocculated casein, the operation being conducted at a temperature which is higher or lower according to the higher or lower concentration of the solutions used. The product is dried for use as a substitute for skim-milk powder. The dried product produces with water a colloidal suspension of casein free from substantial quantities of fatty material.—H. H.

Meat, fish, and like edible substances; Treating —— for curing and like purposes. P. C. Rushen. From International Meat Smoking Corp. E.P. 180,497, 2.4.21.

The meat etc. is electrified, and while in that condition is subjected to the action of a gas or smoke. A pulsating direct current of a voltage sufficient to produce 8-in. sparks in air may be used. The meat may be suspended within the treating chamber from one electrode between two electrodes of the opposite polarity, or may be suspended from conveyor chains which are connected with one electrode and move through the chamber between electrodes of the opposite polarity.—H. H.

Food substances; Reducing semi-fluid —— to dry powdered form. J. C. MacLachlan. U.S.P. 1,417,083, 23.5.22. Appl., 9.4.21.

Cooked oatmeal, in a semi-fluid condition, is discharged centrifugally into a chamber and meets blasts of hot dry steam and heated air. The product is a dry, coarse powder.—A. G. P.

Edible product and process of making same. C. Ellis. U.S.P. 1,417,893, 30.5.22. Appl., 16.12.18.

A composition comprising medicinal petroleum oil, hydrogenated oil, butyric glyceride, and water, and having a consistency from that of butter-fat to that of lard.—H. H.

Evaporating pan [for milk etc.]. C. E. Rogers. U.S.P. 1,417,943, 30.5.22. Appl., 25.1.19.

The pan is fitted with a series of superposed steam heating units, each independently connected with the steam main. Each unit is in the form of an inner and an outer coil connected together at adjacent ends with a common inlet and a common outlet. The spaces between the coil ends of adjacent units are on opposite sides of the pan.
—H. H.

Bacteria capable of forming lactic and acetic acids; Process of producing and utilising pure cultures of leavening ——. E. Beccard. G.P. 350,874, 21.2.20.

Aqueous extracts of flour, after sterilisation by a cold process, are added at the lowest possible temperature to a concentrated solution of gelatin or agar, so that the solution solidifies in the cold. The leavening bacteria, isolated by means of cultures on the nutrient medium prepared as described, are added together with yeast to dough.—L. A. C.

Mineral waters and beverages; Preparation of artificial —— *containing silicic acid.* Lecinwerk E. Laves. G.P. 350,247, 9.4.19. Addn. to 337,796 (J., 1921, 637 a).

Artificial mineral waters containing a higher percentage of silicic acid than naturally occurring waters are prepared with the use of stable solutions of colloidal silicic acid prepared as described in the chief patent. A solution of an alkali silicate is mixed with a solution containing an excess of an inorganic or organic acid, with or without the addition of compounds which evolve carbon dioxide, salts with a therapeutic action, vegetable extracts, flavouring essences, and sweetening agents. The constituents of the two solutions may be prepared beforehand in the form of powders, granules, or tablets.—L. A. C.

Flour and grits from cereals; Method of sterilising —— *whilst at the same time improving the baking quality.* K. Dienst. E.P. 180,496, 2.4.21.

See G.P. 335,406 of 1917; J., 1922, 30 a.

Organic matters and particularly meat and fish; Process for preserving in the fresh condition ——. L. A. C. Cholet. U.S.P. 1,418,233, 30.5.22. Appl., 10.1.21.

See E.P. 171,637 of 1921; J., 1922, 30 a.

Hygienic food. U.S.P. 1,417,412. *See* XX.

XIXb.—WATER PURIFICATION; SANITATION.

Formaldehyde; Lamp for producing ——. E. Berger. Comptes rend., 1922, 174, 1471—1474.

A modified form of Tollens' lamp (J., 1895, 592) is described, in which two types of catalyst are used, namely compressed lampblack containing 20% of copper oxide, and, secondly, silvered asbestos board. The heat from the compressed catalyst in the first case or from the gauze container of the catalyst in the second case is used to vaporise the methyl alcohol as it is brought up from the container by a cottonwool wick. The lamp uses about 100 g. of methyl alcohol per hour, and the yield with the first type of catalyst is 30% and with the second type 35—40% (in one case a yield of 45% was obtained). The second type of catalyst needs to be heated to a red heat in an external flame before use, but it gives the best result, and has been adopted for use in disinfecting surfaces.
—W. G.

Patents.

Water purifiers. J. B. Gail and N. Adam. E.P. 180,420, 21.2.21.

An automatic apparatus for clarifying water by treatment with lime water and another reagent, *e.g.*, sodium carbonate. Lime water is added mechanically in controlled amounts to the main flow. Means are provided for thorough mixing of the reagents with the water before filtering.
—A. G. P.

Water; Process of purifying and decolorising ——. M. F. Newman, Assr. to W. B. Scaife and Sons Co. U.S.P. 1,418,013, 30.5.22. Appl., 5.9.19.

Water contaminated with soil acids, vegetable extracts, etc., is clarified and decolorised by treating it successively with an alkali in association with a bleaching agent, a coagulant, and a reagent for removing excess of bleaching agent.—H. H.

Sewage and the like; Treatment of ——. *Treatment of sewage, water, and the like.* H. Daw. E.P. (a) 179,896 and (b) 180,272, 17.1.21.

(a) Sewage etc. is aerated by allowing it to fall through the air, a portion being withdrawn for this purpose from the sewage on its way from the storage chamber to the sedimentation chamber and allowed to fall as fine spray back into the storage chamber. (b) A sewage treatment plant consists of a sedimentation chamber and a sludge chamber, the former being at a higher level than the latter and provided with passages to the latter at the lowest point of its sloping side. The sedimentation chamber has also longitudinal baffles for assisting in settling and directing any gas that may be evolved to the open air.—B. M. V.

Hydrocyanic acid; Method of generating —— [*for fumigating*]. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler, and O. Liebknecht. E.P. 180,118, 15.3.21.

Alkali cyanides are mixed with partially dehydrated salts of metals forming unstable cyanides, *e.g.*, magnesium or aluminium sulphates. The heat necessary to drive off hydrocyanic acid from the moistened mixture is supplied by the heat of hydration of the salts themselves or of other salts added for that purpose.—A. G. P.

Insecticides; Method of making ——. H. H. Dow, Assr. to The Dow Chemical Co. U.S.P. 1,417,232, 23.5.22. Appl., 6.2.19. Renewed 24.10.21.

A suitable lead compound is treated with excess of arsenic acid, and the residual acid neutralised with excess of an alkaline-earth hydroxide.—A. G. P.

Arsenate insecticides; Process of making ——. W. H. Swenarton. U.S.P. 1,418,848, 6.6.22. Appl., 10.12.19.

An alkali salt is mixed with sufficient arsenic acid to convert the major portion of the salt into a soluble arsenate, and to this mixture is added a salt of a metal forming an insoluble hydroxide. The insoluble arsenate is filtered off and the cycle of operations repeated, utilising the above filtrate.
—A. G. P.

Water, sewage, or the like; Process for automatically regulating the addition of a treating agent to ——. J. S. Simsohn. E.P. 180,586, 8.7.21.

See U.S.P. 1,388,613 of 1921; J., 1921, 788 a.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Yeast nucleic acid. III. H. Steudel and E. Peiser. Z. physiol. Chem., 1922, 120, 292—295. (*Cf.* J., 1921, 60 a; 1922, 153 a.)

Guanylic acid can be obtained from yeast nucleic acid when the sodium salt of the latter is treated in alkaline solution. The guanylic acid portion of the molecule can in this way be completely removed if the reaction takes place at ordinary temperature. No guanylic acid is removed by similar treatment at 0° C.—S. S. Z.

Sweetening agents; Synthetic ——. O. Beyer. Z. angew. Chem., 1922, 35, 271—272.

The methods given for the quantitative separation of *o*- and *p*-toluenesulphonamide and of saccharin and *p*-sulphaminobenzoic acid by the author in his book *Kontrolle und Herstellung von Saccharin* were never put forward by him as being either reliable or accurate, but only recorded to show on what lines experiments had been made by others. —G. F. M.

Vanillin glyceride. F. D. Dodge. J. Amer. Chem. Soc., 1922, 44, 1405—1407.

A crystalline deposit formed in a flavouring mixture of alcohol, glycerol, and vanillin on standing was shown to be vanillin glyceride, m.p. 160°—162° C., formed by the condensation of 1 mol. of each compound. The reaction between these two compounds is much accelerated by the presence of mineral acids, but, on the other hand, the resulting glyceride is readily hydrolysed by acids.—W. G.

Reduction of organic compounds; Use of the oxides of platinum for the catalytic ——. I. V. Voorhees and R. Adams. J. Amer. Chem. Soc., 1922, 44, 1397—1405.

When chloroplatinic acid is fused with sodium nitrate at about 450° C. a brown oxide of platinum is obtained which is an excellent catalyst for the reduction of various types of organic compounds (vanillin, ethyl methyl ketone, phenol, salicylaldehyde, nicotinic acid). The speed of reduction with this catalyst is greater than when ordinary platinum black is used. The most satisfactory conditions for preparing this oxide in its most active form have yet to be worked out.—W. G.

Catalysis. II. Dehydration and addition reactions of ethyl alcohol: the formation of acetal and mercaptans. F. A. Gilfillan. J. Amer. Chem. Soc., 1922, 44, 1323—1333.

Ethyl alcohol vapour alone or in the presence of carbon dioxide is not decomposed when passed over pumice at 500° C. Thorium oxide does not act exclusively as a dehydrating catalyst for this alcohol, as, under certain conditions, a considerable amount of acetaldehyde is produced by dehydrogenation. In the presence of carbon dioxide a quantity of acetal is obtained with thorium oxide as catalyst. The oxide is inactivated as a dehydrating catalyst if it is strongly calcined or heated for a long time at a low temperature before use. Up to about 340° C. the blue oxide of tungsten is a more effective dehydrating agent than is thorium oxide, but at higher temperatures the two oxides are of practically equal efficiency. Titanium oxide has no dehydrating action up to 355° C. In no case was any ether produced from the alcohol. Using any of the three metallic oxides as catalysts at 300°—400° C., a mixture of absolute alcohol and carbon bisulphide gave considerable quantities of ethyl mercaptan, titanium oxide being the most active catalyst for this reaction. Pure dry carbon bisulphide is not decomposed when vaporised over pumice or the blue oxide of tungsten at 400° C., but in the presence of a trace of moisture hydrogen sulphide is obtained.—W. G.

Acetone; Source of error in the colorimetric detection of ——. A. Troise. Ann. Chim. Analyt., 1922, 4, 177—178.

Istycin (1.8-dihydroxyanthraquinone) gives a violet coloration with Lieben's reagent (sodium nitroprusside in acetic acid and ammonia) similar to that produced by acetone. (*Cf.* J.C.S., August.) —A. R. P.

Iodine value. Holde and others. *See* XII.

Saponins. Kofler. *See* XIXa.

Patents.

Aromatic [hydr]oxyaldehydes and their derivatives; Manufacture of ——. Soc. Chim. des Usines du Rhône. E.P. 160,765, 24.2.21. Conv., 24.3.20.

Aromatic hydroxyaldehydes are obtained, in most cases in pure condition and in good yield, by condensing a phenol with an ester or ether of the hypothetical methylene glycol, $CH_2(OH)_2$, by means of an acid condensing agent in presence of a nitroso-compound. *Example.* A mixture of 40 pts. of guaiacol, 100 pts. of methylal, and the nitrosodimethylaniline obtained from 80 pts. of dimethylaniline is heated on a water bath for 1—2 hrs. in 500 pts. of methyl alcohol, whilst gaseous hydrogen chloride is continuously bubbled through. The product is then cooled, diluted with water, and freed from alcohol by steam distillation. Vanillin is extracted from the resulting aqueous solution with ether or benzene. Instead of methylal, methylene chloride, methylene diacetate, or methylene sulphate may be used with similar results.—G. F. M.

Amino-phenols or aromatic amino-acids; Production of ——. W. Lewcock, W. G. Adam, N. E. Siderfin, and W. L. Galbraith. E.P. 179,753, 19.3.21.

Aminophenols or aromatic amino-acids may be obtained by the reduction of nitro- or azo-phenols or aromatic acids with hydrogen sulphide in presence of an alkali carbonate. The compound to be reduced may be dissolved wholly or in part in a solution of the alkali carbonate, or the latter may be added to an already prepared solution of the alkali phenoxide or salt. The hydrogen sulphide need not be pure, but may be employed, for example, in the form of the waste gases from the ammonia scrubbers of gasworks, containing only about 15% H_2S and a large proportion of carbon dioxide. *Example.* 50 pts. of benzeneazosalicylic acid is added to 44 pts. of sodium carbonate dissolved in ten times its weight of water, and the mixture is treated in a still at about 100° C. with a waste gas until no more hydrogen sulphide is absorbed and no more aniline passes over. The solution is allowed to cool in an atmosphere of the gas, and sulphur and aminosalicylic acid are fractionally precipitated by the cautious addition of acid. The yield is 85—90%.—G. F. M.

Formaldehyde or its polymers; Preparation of —— from mixtures of carbon monoxide and hydrogen. E. J. Lush. E.P. 180,016, 12.2.21.

When mixtures of carbon monoxide and hydrogen in suitable proportions, such as may be obtained by the purification of "suction" or water-gas, are passed rapidly over catalysts prepared preferably from a mixture of 4 pts. of nickel, 1 pt. of copper, and 5 pts. of alumina, large quantities of formaldehyde or its polymerisation products are formed, and the residual gas consists mainly of methane and hydrogen. The gas is preferably forced through the catalyst at an initial temperature of 300°—400° C. and under 10 atm. pressure, and as rapidly as will ensure that the temperature does not fall below 160°—180° C. on leaving the catalyst. To promote rapid cooling thereafter the high-pressure gas is allowed to issue from a small constriction and is then led into water scrubbers to remove the formaldehyde. In order to restore the activity of the catalyst, steam is blown through periodically, or, preferably, is mixed with the gaseous mixture.—G. F. M.

Formaldehyde; Production of —— from ethylene. R. Willstätter. G.P. 350,922, 9.4.18.

A mixture of ethylene and a large excess of oxygen over that required to oxidise the ethylene to formaldehyde, maintained under reduced pressure and/or mixed with an inactive gas as diluent, is heated for a short time above 500° C., and the formaldehyde produced is rapidly separated from the mixed gases.—L. A. C.

Medicine and hygienic food. J. C. Richard. U.S.P. 1,417,412, 23.5.22. Appl., 14.3.14.

Fruit juice mixed with a non-toxic neutralising agent is subjected to lactic acid fermentation with *B. bulgaricus.*—A. G. P.

Olefines, etc.; Process of oxidising ——. C. Ellis, Assr. to S. B. Hunt. U.S.P. 1,418,368, 6.6.22. Appl., 17.5.18.

Ketones and fatty acids are obtained from the acid extract of olefines from cracked petroleum by diluting the acid extract and treating it with dilute nitric acid.—T. A. S.

Acetylene; Method for the chlorination of ——. K. Róka, Assr. to Holzverkohlungs-Ind. A.-G. U.S.P. 1,418,882, 6.6.22. Appl., 3.2.22.

Chlorine and acetylene are caused to interact at high temperature with the aid of steam.—H. H.

Iodine-malt preparations; Manufacture of ——. Gehe und Co. A.-G. G.P. 348,412, 22.2.21.

An aqueous solution of malt extract is evaporated *in vacuo* with such a quantity of an alcoholic solution of iodine that the dry product contains 0·1% I. Instead of an alcoholic solution of iodine, an aqueous solution of sodium iodide and iodate together with hydrochloric acid may be used. The product, which is of therapeutic value, does not give a blue colour with starch test-paper.

Butyric aldehyde; Manufacture of ——. D. A. Legg, Assr. to M. A. Adam. U.S.P. 1,418,448, 6.6.22. Appl., 22.11.21.

See E.P. 173,004 of 1920; J., 1922, 197 A.

Mono- and di-β-[hydr]oxyethylaminobenzoic esters; Process for the manufacture of ——. J. Altwegg and J. Landrivon, Assrs. to Soc. Chim. Usines du Rhône. U.S.P. 1,418,900, 6.6.22. Appl., 13.6.19.

See E.P. 128,552 of 1919; J., 1920, 280 A.

[Hydr]oxyaldehydes; Process for the manufacture of aromatic ——. F. Bidaud, Assr. to Soc. Chim. Usines du Rhône. U.S.P. 1,418,904, 6.6.22. Appl., 26.2.21.

See E.P. 160,765 of 1921; preceding.

Tropinone monocarboxylic-acid esters and preparation of the same. R. Willstätter, O. Wolfes, and H. Maeder. U.S.P. 1,419,091, 6.6.22. Appl., 26.8.21.

See G.P. 344,031 of 1919; J., 1922, 270 A.

Tropinone monocarboxylic-acid esters; Preparation of ——. O. Wolfes and H. Maeder. U.S.P. 1,419,092, 6.6.22. Appl., 26.8.21.

See E.P. 153,917 of 1920; J., 1922, 436 A.

Purifying organic substances. E.P. 179,991. *See* III.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

[Photographic] desensitisers; New ——. R. E. Crowther. Brit. J. Phot., 1922, **69**, 351—353.

Two new desensitisers, "Pinakryptol" and "Pinakryptol Green," were investigated and compared with Phenosafranin. As regards desensitising efficiency, "Pinakryptol" is equal to Phenosafranin, and "Pinakryptol Green" is more efficient. The new dyes, moreover, are practically non-staining, a maximum of ten minutes' washing sufficing to remove all signs. The effects of the dyes on development were investigated for several developers, and the results are tabulated. "Pinakryptol" causes a pronounced retardation of development. The dyes do not interfere with the "speed" of a given plate.—W. C.

Patents.

Photographic dry plates or films; Method of treating ——. J. D. Bagley. U.S.P. 1,417,791, 30.5.22. Appl., 7.2.21.

Photographic dry plates or films are treated with alcohol after exposure and before development and subjected to the action of a photographic developer while still wet with alcohol.—W. C.

Photographic film; Antistatic ——. A. F. Sulzer, Assr. to Eastman Kodak Co. U.S.P. 1,418,405, 6.6.22. Appl., 25.4.21.

The support for the sensitive coating of an antistatic photographic film comprises sufficient nitrocellulose to produce, if alone, static markings in the coating, and sufficient of a cellulose ether to prevent the static markings being formed.—W. C.

Photographic film. E. Wolff. G.P. 345,734, 15.8.20.

On the actual film support a number of films each sensitised for a certain colour are arranged in suitable order. Colour selection is thereby rendered possible for visible and invisible rays without the use of filters. In addition to these, sensitisers, such as Dicyanin for red, and Erythrosin for green, an absorbing dye for blue rays, *e.g.*, Filter Yellow K, may be added to the emulsion. The different sensitiveness of the constituent emulsions can be equalised in this way. The exposure required is considerably shorter than with filters, and no diffuseness is obtained. The sequence red, green, blue is best for cinematograph films, but in colour photography other arrangements are better.
—W. C.

Photographic developers. J. Hauff und Co. E.P. 154,198, 22.11.20. Conv. 23.10.18.

See G.P. 327,111 of 1918; J., 1921, 371 A. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 1736 of 1891; J., 1893, 374.)

Photometer scales. G.P. 351,243. *See* XV.

XXII.—EXPLOSIVES; MATCHES.

Detonators; The lead-plate test as applied to commercial ——. B. Grotta. Chem. and Met. Eng., 1922, **26**, 1126—1132.

The test is described and two simple forms of apparatus are illustrated. A series of six standard markings on the lead plates are illustrated. These were obtained by tests with No. 6 commercial detonators and give the effect of detonators of various qualities down to complete ineffectiveness on the plates. Comparative tests carried out on samples of commercial dynamite indicate that detonators giving plates corresponding to the first three standard plates are suitable for use in blasting operations. The influence of the size of the charge, moisture, potassium chlorate content, indentation of shells, and hardness of shells on the detonation, as indicated by the lead-plate test, is dealt with.—H. C. R.

Nitrotoluenes. Binary systems of m-nitrotoluene with another nitrotoluene. J. M. Bell and J. L. McEwen. J. Ind. Eng. Chem., 1922, **14**, 536—537.

The binary system, *m*-nitrotoluene-*o*-nitrotoluene forms a stable eutectic at −31·65° C. containing 48% of the *m*-constituent and a metastable eutectic containing 46% of the same constituent at −39° C. The system *m*-nitrotoluene-*p*-nitrotoluene forms an eutectic at −2·8° C. containing 37% of the *p*-constituent.—J. F. S.

Patents.

Priming compositions; Manufacture of ——. W. Friederich. E.P. 180,605, 31.8.21.

Combinations of explosive and non-explosive compounds with azides of heavy metals, such as lead azide, are obtained in the form of mixed crystals by gradually mixing solutions of readily soluble salts of the particular compounds and readily soluble azides with solutions of metallic salts. Alternatively, crystals serving as core crystals may be levigated in one of the solutions to be precipitated so that on subsequent precipitation crystals are obtained covered with layers of different compounds used in priming compositions. The elongation of the crystals of lead azide is thus overcome and the explosive obtained in a form more suitable for loading. Basic lead azide, lead carbonate, basic chlorides and sulphates, neutral and basic salts of nitrated phenols and other nitro compounds may thus be associated with lead azide.—H. C. R.

High explosive and process of preparing the same. T. L. Davis. U.S.P. 1,419,027, 6.6.22. Appl., 16.4.21.

A high explosive consists of pentanitronaphthol. —H. C. R.

Priming composition. Rheinisch - Westfälische Sprengstoff A.-G. G.P. 309,210, 1.5.18.

Lead trinitroresorcinate is used alone or in admixture with other explosives, with the exception of mercury fulminate. Normal lead trinitroresorcinate explodes successfully if heavily tamped. Fuses can be made with the aid of a damping material, and these are cheaper than those produced from mercury fulminate and are insensitive to hammering, cutting or crushing. They burn easily with little deflagration, without detonation, and are not injured by treatment in water and will explode an explosive without the use of a detonator. The velocity of detonation is somewhat higher than that of mercury fulminate fuses and varies from 6000 to 7000 m. per second according to the kind of damping agent employed.—A. G.

XXIII.—ANALYSIS.

Membrane filters; Treatment of ——. G. Jander. Z. angew. Chem., 1922, 35, 269.

To restore a smooth glazed surface to membrane filters which have become rough, the membrane is heated in distilled water for about ½ hr. at 75°—80° C., and then clamped tightly between two plate glass surfaces, care being taken that no air bubbles are enclosed. The whole is then heated again for 1 hr. in distilled water in a porcelain dish at the same temperature, the clamps being tightened up from time to time. After cooling the glass plates are unclamped and the membrane, which now has the desired glossy surface, is removed. The pores of the membrane will have been to a certain extent closed by this treatment and filtration will be somewhat slower. To preserve the membrane filter in good condition it should always be kept under water in closed vessels, and for preventing the growth of moulds a bright piece of copper foil placed in the bottom of the vessel is quite effective.—G. F. M.

Electrometric titration; Simple method of —— in acidimetry and alkalimetry. P. F. Sharp and F. H. MacDougall. J. Amer. Chem. Soc., 1922, **44**, 1193—1196.

A number of constant and reproducible electrodes have been prepared which are electrometrically equivalent to hydrogen electrodes dipping in solutions of various known hydrogen ion concentrations. Such electrodes are extremely useful in cases where it is necessary to titrate a solution of an acid to an end point corresponding to a definite hydrogen ion concentration. In such a case the half cell containing a hydrogen electrode and the solution to be titrated is connected with the electrode which has the same PD as the hydrogen electrode will have when the titration is completed. A solution of alkali is then run into the acid until a galvanometer indicates that the whole cell, comparison electrode/KCl (sat)/titration liquid /H_2,Pt, has a zero EMF. The following are the comparison electrodes together with the potentials against a normal calomel electrode, and the equivalent hydrogen ion concentrations.

Cadmium amalgam with 12–12·5% Cd—		
0·52 c.c. KI in 100 c.c. sol.	EMF, 0·5195 volt	= $H^{\cdot}\ 10^{-4}N$
2·90 c.c. KI ,, ,, ,,	,, 0·5609 ,,	= $H^{\cdot}\ 10^{-4.7}N$
6·14 c.c. KI ,, ,, ,,	,, 0·5786 ,,	= $H^{\cdot}\ 10^{-5}N$
67·50 c.c. KI ,, ,, ,,	,, 0·6378 ,,	= $H^{\cdot}\ 10^{-6}N$
Lead amalgam with 12–12·5% Pb, and lead iodide—		
100 c.c. $CdSO_4$ + 0·20 c.c. KI ..	EMF, 0·6967 volt	= $H^{\cdot}\ 10^{-7}N$
10 c.c. $CdSO_4$ + 10 c.c. KI in 100 c.c. sol.	,, 0·7560 ,,	= $H^{\cdot}\ 10^{-8}N$
100 c.c. $CdSO_4$ + 26·40 c.c. KI	,, 0·8151 ,,	= $H^{\cdot}\ 10^{-9}N$
2 c.c. $CdSO_4$ + 48·7 c.c. KI in 100 c.c. sol.	,, 0·8743 ,,	= $H^{\cdot}\ 10^{-10}N$

The numbers of c.c. of potassium iodide and cadmium sulphate refer, respectively, to 2*N* and 0·5*N* solutions.—J. F. S.

Volumetric analysis; New physicochemical method of ——, applied to some problems of inorganic chemistry. P. Dutoit and E. Grobet. J. Phys. Chim., 1922, **19**, 324—327.

A method is described by which solutions of acids may be titrated with bases using a thermometer graduated in 0·01° C. as indicator. The solution to be titrated is placed in a small Dewar vessel, which stands in a larger Dewar vessel; a mechanical stirrer is placed in the solution and the alkali added at regular intervals in amounts which cause the temperature to increase by not more than 0·02° C. The burette is wrapped in asbestos paper and the stopcock operated by a long pair of pincers. The number of c.c. of alkali added is plotted as abscissæ and the temperatures after successive additions as ordinates. The end point is marked by a decided change of direction of the curve. Not only is this point fixed by the curve, but all other points at which a change in the nature of the reaction occurs are fixed. Thus with sulphuric acid the points corresponding with the completion of the formation of the bisulphate and the normal sulphate are both accurately shown. In the titration of phosphoric acid with sodium hydroxide the points where the formation of NaH_2PO_4, Na_2HPO_4, and Na_3PO_4, respectively, is complete are well marked. In the titration of normal sodium phosphate with nitric acid the points where the formation of NaH_2PO_4, Na_2HPO_4, and H_3PO_4 is complete are clearly marked. The titration of the nitrates of zinc, lead, and magnesium with alkali by this method indicates the completion of the formation of definite basic salts and in the case of the two first-named metals, of zincates and plumbites, respectively. Titration of salts of cobalt, copper, and nickel with ammonia in the same way indicates the formation of the various ammonia complexes. This method yields identical results with those obtained by electrometric and conductivity titrations, and in addition it also indicates the formation of derivatives which these methods do not.—J. F. S.

Resorcinol; Application of —— in qualitative inorganic analysis. Lavoye. J. Pharm. Belg., 1921, **3**, 889—890. Chem. Zentr., 1922, **93**, II., 1154.

Characteristic colours are produced by mixing 1 c.c. of very dilute solutions of the following metals with 1 c.c. of 10% resorcinol solution and 2 c.c. of 10% ammonia solution, heating for a short time, and allowing the mixture to stand: Zinc, yellow-green, then dark blue; cadmium, a less intense blue; manganese in presence of ammonium salts, blue-green; nickel, blue-green; cobalt, red-violet, then blue-violet; copper, blue; platinum, garnet red; mercury, no colour but crystalline precipitate on evaporation. Acids turn all the solutions red. —A. R. P.

Uranium; Estimation of —— in presence of phosphoric acid. A. Schoep and W. Steinkuhler. Bull. Soc. Chim. Belg., 1922, **31**, 156—159.

Previous methods having proved unsatisfactory, the following is recommended: Silica and the elements which are precipitated in acid solution by hydrogen sulphide are first separated. The filtrate is freed from hydrogen sulphide by boiling and uranium oxidised by a few drops of nitric acid. The phosphoric acid is then precipitated by molybdate solution, and, in the absence of chlorides etc., this serves as a means of estimating phosphate. Ammonia is then added in slight excess and the solution gently heated, but not allowed to boil, after which ammonium sulphide is added until the liquid turns blood-red. After 20 mins. on the water bath a brown precipitate of uranium sulphide is produced, and when this has become black and granular heating is stopped. The precipitate is washed with warm dilute ammonium sulphide to which a few drops of ammonia have been added, the washing being continued until the washings no longer give a molybdenum reaction. If the operation has been carried out properly there is no need to dissolve and re-precipitate the uranium sulphide.—H. J. E.

Water; Estimation of —— by the apparatus of Meihuizen. K. Mohs. Woch. Brau., 1922, **39**, 139—141.

Tests with Meihuizen's drying apparatus (E.P. 114,620; J., 1918, 357 A) are described. Using steam heat and maintaining a temperature of 99° C., the moisture-content of flours, starches, etc., may be determined by heating for 50—60 mins. If xylol is used in place of water a drying temperature of 139° C. can be maintained and heating for 15—25 mins. is sufficient.—A. G. P.

See also pages (A) 533, *Gas calorimeter* (Boys); *Mixtures of paraffin hydrocarbons and hydrogen* (King). 535, *Iodine values of petroleum oils* (Kawai); *Sludge values of transformer and turbine oils* (Schwarz and Marcusson). 540, *Cellulose in wood etc.* (Heuser and Casseus); *Chlorine consumption value of sulphite pulps* (Sieber). 541, *Cellulose acetates* (Entat and Vulquin). 544, *Phosphoric acid* (Ross and others); *Hypochlorite bleaching solutions* (Royer); *Sodium bisulphites* (Kühl). 545, *Alkalis in calcium carbonate* (Singleton and Williams); *Copper and iron in copper sulphate* (Wöber). 550, *Slag in steel* (Wüst and Kirpach). 551, *Spelter coating on galvanised sheets* (Strickland); *Electro-analysis of brasses etc.* (Kling and Lassieur). 552, *Resistance of aluminium to corrosion* (Mylius). 553, *Aluminium alloys* (Costa-Vet); *Ferrotungsten and tungsten powder* (Bonardi and Williams). 556, *Olive oils* (Prax). 557, *Iodine value* (Holde and others); *Lead dioxide in red lead* (Bonis). 558, *Hardness test for varnishes* (Wolff). 563, *Moisture in potato flour* (Vogelenzang); *Testing foodstuffs for vitamins* (Drummond and Watson). 564, *Soponins* (Kofler). 566, *Acetone* (Troise).

Patents.

Gas calorimeters; Recording and integrating ——. The Secretary of the Board of Trade, and C. V. Boys. E.P. 180,080, 24.2.21.

In a recording gas calorimeter of the water-flow type the rate of flow of water is adjusted accurately to a predetermined value by trapping a stream of water in a vessel which is tipped and drained at regular intervals, the tipping being effected by the trapped water. While the vessel is tipped the stream of incoming water is delivered to a water-wheel or similar device driving the gas-controlling mechanism. The gas is delivered to a wet gas meter of which the drum is rotated on a screwed spindle by gas pressure independently of the driven spindle, so that longitudinal movement of the drum is produced by relative rotation of the drum and spindle, and this longitudinal movement operates a control for the gas inlet. The rate of gas delivery to the burner of the calorimeter is maintained at a constant value (measured under standard conditions of temperature and pressure) irrespective of changes of temperature and pressure by automatic variation of the liquid level in the meter in accordance with changes of temperature and pressure. The gas is saturated with water vapour. The calorimeter proper comprises a combustion circuit and heat interchanger, each of which is readily removable and replaceable. It includes a hot operative thermometer chamber and a cold operative thermometer chamber. An operating lever co-operates with both chambers so as to magnify the differential movement of the chambers in an inverse ratio to the relative linear movements of the individual chambers, with common temperature rise but in opposite directions. A recording arm is supported upon a lantern capable of rocking about a vertical axis, and mechanism is provided for integrating the departure of the recording arm from a predetermined position.—J. S. G. T.

Distilling apparatus [; Laboratory ——]. P. Anders and P. M. Ginnings. U.S.P. 1,418,691, 6.6.22. Appl., 25.2.21.

The upper end of the main column of a distilling head is closed by a stopper, and the side outlet tube projects inwards approximately to the centre of the column, the end of the projecting part being provided with a circular lip.—J. S. G. T.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given; they are on sale at 1s. each at the Patent Office Sale Branch, Quality Court, Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Baron (Signal Ges.). Apparatus for removing gases from liquids. 18,695. July 7.

Ikeda, Isobe, and Okazawa. Extraction of volatile oils from gases. 17,708. June 27.

Johns-Manville, Inc., and Walsh. Drying materials. 18,682. July 7.

Johns-Manville, Inc., and Walsh. Drying apparatus. 18,683. July 7.

Lodge-Cottrell, Ltd. (Anderson). 18,028. *See* XI.

Lyall. Grinding-machines. 17,963. June 30.

Major. Distillation etc. of liquids. 18,807. July 8.

Mauss. Centrifugal separators etc. 17,587. June 26.

Rigby. Drying. 17,498. June 26.

Tyler. Apparatus for disintegrating and screening pulverulent material. 18,131. July 1.

Wake. Mixing-machines. 17,950. June 29.

Complete Specifications Accepted.

36,169 (1920). Traun's Forschungslaboratorium Ges. Filter presses. (155,834.) July 12.

3373 (1921). Barbet et Fils et Cie. Evaporating apparatus. (158,569.) July 12.

5890 (1921). Soc. Gén. d'Evaporation. Process and apparatus for crystallising. (159,815.) July 5.

8274 (1921) and 3623 (1922). Petzel. Bodies for filling columns, towers, etc. through which gas is passed in an opposite direction to liquid. (160,180 and 175,273.) July 5.

10,095 (1921). McIntyre. Mixing, reducing, or grinding and like machines. (181,877.) July 5.

10,177 (1921). Vallez. Rotary filters. (181,879.) July 5.

11,642 (1921). Chapman. Magnetic separators for removing solids from liquids. (181,898.) July 5.

19,804 (1921). Fabry. *See* II.

9361 (1922). Wade (Schneible). *See* XVIII.

15,388 (1922). Traun's Forschungslaboratorium Ges. Filter presses. (181,023.) July 12.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Avébène Soc. Anon. Fuel briquettes. 17,909. June 29. (Fr., 19.5.22.)

Brown. Retort setting. 17,786. June 28.

Chemical Research Synd. Motor fuels. 18,605. July 6. (U.S., 27.10.21.)

Combustione Economica é Impianti Elettrici Soc. Anon. Combustion of pulverised solid fuels. 17,721. June 27. (Fr., 1.7.21.)

Coote, and Spencer Chapman and Messel. Treatment of waste acids from mineral-oil refiners. 18,716. July 7.

Danks. Retorts for recovering by-products from coal etc. 18,165. July 3.

Davidson. Retorts. 18,457. July 5.

Ges. f. Kohlentechnik. Separation of ammonia and benzol hydrocarbons from gas. 18,489. July 5. (Ger., 7.7.21.)

Hodgkinson and Ridge. 17,585. *See* XII.

Koppers. Coking or carbonising. 17,834. June 28.

Lynch and Mahan. Cracking oils. 17,600. June 26.

Morgan. Fuel for internal-combustion engines. 18,240. July 3.

Riedel A.-G. Fuel for internal-combustion engines. 18,594. July 6. (Ger., 15.8.21.)

Salerni. Retorts for distilling or heat-treating carbonaceous etc. material. 18,390. July 4.

Complete Specifications Accepted.

98 (1921). Rigby. Treatment of peat. (182,149.) July 12.

6004 (1921). Haddan (Torfverwertungsges. Pohl u. von Dewitz). Dry distillation and coking of raw peat etc. (159,464.) July 12.

6343 (1921). Rigby. Drying peat etc. (182,157.) July 12.

8144 (1921). Alexander. Apparatus or kilns for drying and distilling carbonaceous substances. (181,794.) July 12.

11,222 (1921). Low-Temperature Carbonisation, Ltd., and Davidson. Retorts. (181,894.) July 5.

11,438 (1921). Marks (Shell Co.). Still for fractionating petroleum oils. (182,247.) July 12.

12,670 (1921). Kratochwill. Artificial fuel. (182,262.) July 12.

12,975 (1921). Bismarckhütte. Coking-chambers for gas-producers. (163,012.) July 12.

17,818 (1921). Collin A.-G. Vertical retorts. (165,744.) July 12.

19,804 (1921). Fabry. Centrifugal drying-machine for coal etc. (182,006.) July 5.

30,941 (1921). Dowson and Mason Gas Plant Co., and Wilson. Gas-producers. (182,053.) July 5.

III.—TAR AND TAR PRODUCTS.

Application.

Ges. f. Kohlentechnik. 18,489. *See* II.

IV.—COLOURING MATTERS AND DYES.

Applications.

Durand & Huguenin Soc. Anon. Manufacture of mordant-dyeing colouring matters. 17,699 June 27. (Fr., 15.7.21.)

Scottish Dyes, Ltd., and Thomas. Manufacture of dyestuff intermediates. 18,804. July 8.

Complete Specifications Accepted.

35,647 (1920) and 21,708 (1921). Green, Saunders, and British Dyestuffs Corp. Manufacture of soluble acid colouring matters and intermediate compounds. (181,750.) July 5.

16,368 (1921). Durand & Huguenin A.-G. Manufacture of halogen derivatives of basic acridine dyestuffs. (165,721.) July 5.

22,991 (1921). British Dyestuffs Corp., Green, Saunders, and Adams. Manufacture of colouring-matters. (182,031.) July 5.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Dreaper. Manufacture of artificial silk etc. 18,174. July 3.

Dreyfus. Manufacture of artificial textile products. 18,560. July 6.

Johns-Manville, Inc., and Walsh. Drying and carbonising fabrics. 18,684. July 7.

Nitrogen Corp. Cellulose solutions. 18,149 and 18,150. July 1. (U.S., 2.7 and 21.11.21.)

Nitrogen Corp. Method of making cellulose compounds. 18,151. July 1. (U.S., 23.12.21.)

Rheinisch Westfälische Sprengstoff A.-G., and Seyfferth. Manufacture of radioactive plastic compositions from cellon, celluloid, etc. 17,823. June 28.

Complete Specifications Accepted.

2598 (1921). Dreaper. Manufacture of artificial silk etc. (181,758.) July 5.

8685 (1921). Dreyfus. Manufacture of artificial silk etc. (182,166.) July 12.

11,766 (1921). Courtaulds, Ltd., and Callimachi. Manufacture of threads, filaments, strips, or films of cellulose. (181,900.) July 5.

11,769 (1921). Courtaulds, Ltd., and Hegan. Manufacture of threads, films, etc. of cellulose. (181,901.) July 5.

11,770 (1921). Courtaulds, Ltd., and Wilson. Manufacture of coloured threads, filaments, strips, or films of cellulose. (181,902.) July 5.

30,466 (1921). Jentgen. Production of artificial threads, films, etc. from viscose. (171,691.) July 5.

1036 (1922). Claessen. Manufacture of waterproof material. (174,588.) July 12.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Blicquy and Callebaut. Dyeing-machines. 18,187. July 3.

British Alizaran Co., Dawson, Harley, and Nichol. Discharging agents and processes employing same. 18,522. July 12.

Geigy Soc. Anon., and Lüttin. Solutions for dyeing and printing fabrics etc. 18,696. July 7.

Geigy Soc. Anon. Process of dyeing or printing fabrics etc. 18,697. July 7. (Ger., 29.7.21.)

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Coote and others. 18,716. *See* II.

Freeth and Munro. Production of ammonium chloride and sodium carbonate. 18,758. July 8.

Ges. f. Kohlentechnik. 18,489. *See* II.

Guggenheim Bros. Leaching caliche and recovering nitrate. 18,460. July 5. (U.S., 7.11.21.)

Soc. d'Etudes Chimiques pour l'Industrie. Employing residues from decomposition of calcium cyanamide by acid. 17,544. June 26. (Switz., 25.6.21.)

Teillard. Purification of sulphate of baryta etc. 18,576. July 6. (Fr., 18.7.21.)

Threlfall. Manufacture of phosphorus pentoxide. 18,589. July 6.

Topp. 18,732. *See* XIII.

Westermann. Manufacture of pure sodium chloride. 17,760. June 28.

Complete Specifications Accepted.

35,720 (1920). Nitrogen Corp. Synthesis of ammonia. (155,592.) July 5.

36,516 (1920). Aluminum Co. of America. Manufacture of aluminium chloride. (163,975.) July 12.

5626 (1921). Dutt and Dutt. Preparation of titanium dioxide from bauxite. (181,775.) July 5.

10,482 (1921). Ebbw Vale Steel, Iron, and Coal Co., and Thickins. Manufacture of dry neutral sulphate of ammonia. (181,884.) July 5.

13,812 (1921). Nitrogen Corp. Preparation of hydrogen and ammonia. (163,323.) July 5.

17,574 (1921). Hunt. Recovery of sulphur, sulphides, etc. from a condition of emulsion. (181,984.) July 5.

13,444 (1921). Courtaulds, Ltd., and Jones. Separation of sodium carbonate from liquors or solutions containing caustic soda. (182,411.) July 12.

VIII.—GLASS; CERAMICS.

Applications.

Deutsch-Englische Quarzschmelze Ges., and Hirschberg. Manufacture of quartz etc. articles impervious to gases. 17,576. June 26. (Ger., 7.7.21.)

Rowart. Manufacture of sheet glass. 18,491. July 5. (Belg., 11.7.21.)

Soissan. Enamelling metals, wires, etc. 18,189. July 3. (Fr., 5.7.21.)

Complete Specification Accepted.

24,531 (1921). Westinghouse Lamp Co. Manufacture of glass. (170,563.) July 12.

IX.—BUILDING MATERIALS.

Applications.

Cuckow. Treatment of building materials. 18,137. July 1.

Gunn. Preserving and colouring brick, stone, etc. 17,993. June 30.

Riedel. Manufacture of hydraulic binding agents. 18,717. July 1.

*Wray. Composition for making bricks. 18,541. July 6.

Complete Specifications Accepted.

8408 (1921). Merz and McLellan, and Weeks. Cement manufacture. (181,811.) July 5.

9482 (1921). Schneider. Coating natural and artificial stone. (182,213.) July 12.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Adam and Davies. Detinning tinned iron scrap. 18,496. July 5.

Angell and Williams. Coating iron, steel, etc. with non-corrosive surface. 17,676. June 27.

Baker and Crawford. Composition for silver-plating metal. 18,771. July 8.

Chem. Fabr. Griesheim-Elektron. Casting oxidisable metals. 18,503. July 5. (Ger., 27.10.21.)

Dony and Spirlet. Concentrating iron ores. 17,849. June 28.

Gillespie, and Metallisation, Ltd. Protecting metal articles subjected to high temperatures. 17,649. June 27.

Jones, and Steel-Nickel Process Synd. Coating metals. 18,146. July 1.

Jones. Deposition of metals and alloys. 18,545. July 6.

Kubo. Manufacture of malleable cast iron. 17,632. June 27.

Kuehnrich. Manufacture of steel. 18,105. July 1.

Levoz. Cupola furnaces. 17,715. June 27. (Belg., 18.10.21.)

Saltrick. Iron and steel. 18,008. June 30.

Saltrick. Alloys. 18,009 and 18,010. June 30.

Ziegler. Operating melting and reducing furnaces. 18,464. July 5. (Austria, 5.7.21.)

Complete Specifications Accepted.

5759 (1921). Jackson (Leadizing Co.). Coating iron or steel articles with lead. (181,781.) July 5.

8529 (1921). Pacz. Production of alloys. (160,426.) July 5.

8705 (1921). Gillespie and Buckley. Manufacture of metallic powders. (181,831.) July 5.

8858 (1921). Pearson, Craig, and Durelco, Ltd. Reduction of oxides of tungsten and molybdenum. (181,837.) July 5.

9734 (1921). Wellman-Smith-Owen Eng. Corp., and Kemp. Furnaces for metallurgical etc. purposes. (181,863.) July 5.

9909 (1921). A.-G. Brown, Boveri u. Co. Electrically-heated muffle furnaces. (181,875.) July 5.

12,391 (1921). Hibbard. Metallurgical furnaces. (162,624.) July 5.

32,866 (1921). Miami Metals Co. Open-hearth furnaces. (182,399.) July 12.

XI.—ELECTRO-CHEMISTRY.

Applications.

Armstrong. Electrically-heated furnaces. 18,278. July 4.

Baum, and Chem. Fabr. Weissenstein. Anodes for forming per-compounds. 18,740. July 7.

John. Electrolytic apparatus. 17,684. June 27.

Kuehnrich. Electric furnaces. 18,106. July 1.

Lodge-Cottrell, Ltd. (Anderson). Electrical precipitation of suspended particles from gases. 18,028. June 30.

Oldham and Oldham. Galvanic batteries. 17,734. June 27.

Complete Specifications Accepted.

9131–2 (1921). Plauson. Carrying out electrochemical reactions. (181,848–9.) July 5.

9322 (1921). Aron. Electric dry battery cells. (160,807.) July 12.

9909 (1921). A.-G. Brown, Boveri u. Co. *See* X.

XII.—FATS; OILS; WAXES.

Applications.

Hodgkinson and Ridge. Purifying oils etc. 17,585. June 26.

MacIlwaine. Extraction of oil by volatile solvents. 18,595. July 6.

Complete Specifications Accepted.

8881 (1921). Schueler. Oil or like presses. (182,171.) July 12.

13,114 (1921). Pineger. Detergent. (181,923.) July 5.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Consort. f. Elektrochem. Ind. Improving artificial resins. 18,479. July 5. (Ger., 12.8.21.)

Jackson (American Cotton Oil Co.). Pigments and pigment compositions. 17,728. June 27.

Petroff. Production of phenol-aldehyde condensation products. 18,712–3. July 7.

Smith. Mills for grinding paints, inks, etc. 18,333. July 4.

Topp. Production of lead compounds and manufacture of paints etc. 18,732. July 7.

Wuyts. Preparation of artificial resins and oleoresins. 17,956. June 29.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Dunlop Rubber Co., Thomas, and Twiss. Vulcanisation of rubber etc. 17,995. June 30.

Jackson (Morgan and Wright). Manufacture of vulcanised rubber etc. 17,959. June 29.

Stevens (Firestone Tire and Rubber Co.). Drying rubber. 17,923. June 29.

Complete Specification Accepted.

8313 (1921). Wheatley, and Victoria Rubber Co. Heat-vulcanisation of rubber. (181,802.) July 5.

XV.—LEATHER; BONE; HORN; GLUE.

Complete Specifications Accepted.

9762 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of glue. (181,865.) July 5.

10,775 (1921). Richter. Depilation of hides and skins. (182,240.) July 12.

14,654 (1921). Glover and Martin. Preparation of a tanning agent for chrome tanning. (182,289.) July 12.

XVI.—SOILS; FERTILISERS.

Application.

Brewer. Fertilisers and production thereof. 18,204. July 3.

XVIII.—FERMENTATION INDUSTRIES.

Applications.

Guthrie, and McEwan and Co. Treatment of beer, stout, and liquid by-products from manufacture thereof. 18,136. July 1.

Harris. Production of alcohol. 18,482. July 5.

Complete Specification Accepted.

9361 (1922). Wade (Schneible). Distilling alcoholic and other liquids. (182,069.) July 5.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Plauson's (Parent Co.), Ltd. (Plauson). Preserving foods etc. 17,757. June 28.

Treble (Vakil). Manufacture of substitute for butter or ghee. 18,591. July 6.

Complete Specifications Accepted.

6624, 7576, and 9086 (1920). Watson, Jones, and Woodlands, Ltd. Manufacture of bread. (182,140.) July 12.

9485 (1921). Piqué, and Imperial Trust. Cooling and freezing fish etc. (182,214.) July 12.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Bloxam (Chem. Fabr. Griesheim - Elektron). Manufacture of aryl esters of phosphoric acid. 17,720. June 27.

Eckert. Oxidising aromatic compounds. 18,075. June 30. (Ger., 2.7.21.)

Imray (Soc. Chem. Ind. in Basle). Manufacture of aryloxynaphthylketones. 18,074. June 30.

Johnson (Elektrizitätswerk Lonza). Manufacture of metaldehyde. 17,806. June 28.

Complete Specifications Accepted.

8825 (1921). Bloxam (Chem. Fabr. Griesheim-Elektron). Manufacture of liquid esters of phosphoric acid. (181,835.) July 5.

18,731 (1921). Johnson (Badische Anilin u. Soda Fabr.). Manufacture of urea. (182,331.) July 12.

21,455 (1921). Soc. Chim. de la Grande-Paroisse. Preparation of aromatic aminonitro-compounds. (169,688.) July 12.

XXI.—PHOTOGRAHIC MATERIALS AND PROCESSES.

Applications.

Cohen. Transferring photographs to fabrics, paper, etc. 17,682. June 27.

Diernhofer. Production of transparencies for projecting photographs in natural colours. 17,730. June 27. (Ger., 28.6.21.)

Hochstetter. Photographic mediums. 17,851—2. June 28.

Landau and Landau. Photographic processes. 18,311. July 4.

Complete Specifications Accepted.

8695 (1921). Obergassner. Production of opaque photographs in natural colours. (182,167.) July 12.

XXII.—EXPLOSIVES; MATCHES.

Applications.

Bash. Matches. 18,259. July 4.

Rathsburg. Initial priming-compositions and their manufacture. 17,952. June 29. (Ger., 4.11.21.)

Rathsburg. Manufacture of priming-compositions. 18,060. June 30.

XXIII.—ANALYSIS.

Application.

Slater. Estimation of small quantities of substances in gases or liquids. 18,523. July 6.

I.—GENERAL; PLANT; MACHINERY.

Molal entropy of vaporisation as a means of determination of heats of vaporisation. W. K. Lewis and H. C. Weber. J. Ind. Eng. Chem., 1922, 14, 485—486.

Using Hildebrand's statement (J. Amer. Chem. Soc., 1915, 37, 970) that the molal entropies of vaporisation of all liquids are nearly the same when compared at identical values of vapour concentration, the authors have devised a method of graphing which they consider more useful than the original method. In this method the ratio of the molal heat of vaporisation to the absolute temperature at which vaporisation takes place is plotted as the ordinate of the curve, whilst the abscissa is the pressure in atmospheres at which vaporisation takes place multiplied by 1000 and divided by the absolute temperature. The data include a list of substances of boiling point ranging from that of liquid hydrogen to that of boiling cadmium and zinc, but the authors have limited the pressures to one atmosphere or less, since the heats of vaporisation at greater pressures are seldom required.—S. G. U.

Rectifying columns for binary mixtures; Efficiency and design of ——. W. K. Lewis. J. Ind. Eng. Chem., 1922, 14, 492—497.

On the assumptions (1) that the column is so large that its surface is small compared with the amount of vapour passing through it, or that the column is so lagged that the heat lost through the sides is negligible compared with the heat passing through the column, (2) that the condensation of a mole of the constituent of higher boiling point from the vapour evolves sufficient heat to evaporate one mole of the constituent of lower boiling point from the liquid, the following basic equations of general applicability have been derived:—

$$dx/dn = y_n - x_n - V_c\ (y_c - y_n)/O_{n+1}$$

The integration of this equation will give the number of plates required with perfect rectification to enrich from x_1 to x_2, *i.e.*,

$$\Delta n = \int_{x_1}^{x_2} \frac{dx}{y_n - x_n - V_c\ (y_c - y_n)/O_{n+1}}$$

In a similar manner the number of plates below the feed plate for perfect rectification is given by

$$\Delta m = \int_{x_1}^{x_2} \frac{dx}{y_m - x_m - (O_f - V_c)\ (y_m - x_w)/(O_f + O_{n+1})}$$

where dn/dx = rate of increase of concentration of liquid per plate; y_n = mole fraction of more volatile component in the vapour V_n; V_n = vapour passing from plate n to plate $n+1$; x_n = mole fraction of more volatile constituent in plate n; V_c = moles of distillate produced per unit time; O_{n+1} = moles of overflow from plate $n+1$; y_c = mole fraction of more volatile component in distillate produced; y_n = mole fraction of more volatile component in vapour V_m; x_w = mole fraction of more volatile component in waste liquor; O_f = moles of mixture fed to the column per unit time. By means of these equations, when the terminal conditions and the amount of overflow are known, it is possible to calculate the theoretical rate of rectification within the column. As, however, the above assumptions do not hold in practice, the actual number of plates will differ from the theoretical number calculated from the above formulæ. The ratio of the actual number of plates to the theoretical number of plates is termed the plate efficiency of the column. This efficiency will depend upon type of plate and rate of flow of vapour and of reflux. If, therefore, the influence of these factors upon the plate efficiency is experimentally determined, the above equations can be safely used in problems of column design. An example is given showing how the formulæ can be used in the design of a column to determine the minimum overflow, the best practical overflow, the number of plates required, and the point of introduction of the feed. —S. G. U.

Heats of vaporisation; Determination of —— *from vapour pressure data.* W. K. Lewis and H. C. Weber. J. Ind. Eng. Chem., 1922, 14, 486—487.

Owing to the great curvature of vapour-pressure curves, difficulty arises in accurate interpolation when only a few points are known. This difficulty is overcome by adopting a method, developed by Johnston (Z. physikal. Chem., 1908, 62, 336), of plotting a temperature/temperature graph instead of a temperature/vapour pressure graph. The second temperature is the temperature of another liquid, termed the reference liquid, when its vapour pressure equals the vapour pressure of the first liquid. The resulting curve is very flat, often sufficiently so to be considered as a straight line over a wide range of temperature. Assuming that both vapours obey the gas laws, Clausius' equation is now applied, which gives $dp/pdT = L/RT^2$ for the original liquid, and $dp_w/p_w dT_w = L_w/RT_w{}^2$ for the reference liquid. Since $p = p_w$ and $dp = dp_w$, these on division give $dT_w/dT = L/L_w \times (T_w/T)^2$, from which L can be found, since dT_w/dT can be easily determined, since it is the slope of the T_w/T graph, which is practically a straight line. As this method depends upon the vapour pressures obeying the gas laws, it is only applicable with pressures at or below one atmosphere. (Note: p = vapour pressure of liquid under discussion; L = molal heat of vaporisation; T is the gas constant; and R the absolute temperature in ° C.)—S. G. U.

Plate efficiency of alcohol still. Robinson. *See* XVIII.

Patents.

Distillation; Apparatus for fractional ——. E. A. R. Chenard. E.P. 156,218, 3.1.21. Conv., 3.1.20.

The column constituted by concentric pipes in the apparatus of E.P. 130,992 (J., 1920, 92 a) is replaced by a rectifying column, and a large purifier is provided between the still and the column or between the distilling and the rectifying columns, according as the apparatus is discontinuous or continuous. Around each drip pipe in the rectifying column is provided a cylinder, open above and below, and so adjusted as to admit liquid, from below only, into the space between the cylinder, the bottom wall, and the level discharge pipe. The semi-adiabatic condenser is combined with the column in such a manner that the condensed products are systematically returned to the column compartments, the richer the condensed liquid the higher being the compartment to which it is returned. A filter or steam-trap formed of wire gauze strip, tightly rolled into a spiral around a closed tube, is provided at the outlet of each compartment of the rectifying column to retain liquid carried over by the vapours.—H. H.

Distilling, concentrating, or drying apparatus. T. Rigby. E.P. 180,963, 24.12.20 and 26.5.21.

Upright rotary drums, heated internally by vapour, are so grouped within a casing as to leave a central passage for the flow of vapour generated from the material. A liquid to be distilled or concentrated is caused to flow down the outer surfaces of the drums. Material to be dried is fed to the gaps between pairs of adjacent drums and is thus spread as a film on the drum surfaces. Above and below the drums vapour spaces partitioned off within the casing communicate with the interiors of the drums through hollow spindles each mounted in a vapour-tight gland in the partition, and the driving-mechanism is enclosed in the lower vapour space. Incrustration or scale or dried material is removed from the drums by scrapers. Each partition is connected with the adjacent upper or lower end of the casing by a duct into which passes the evolved vapour or the dried or concentrated material. The apparatus is applicable for carrying out the process described in E.P. 181,035 (*cf. infra*), and when constituting a unit of a multiple-effect dryer, its heating vapour inlet is fitted with an automatic throttle for ensuring predetermined temperature differences between the units. The material may be spread on the drums by the coaction with each drum surface of a second rotary member of different radius of curvature and/or different peripheral speed.—H. H.

Drying of peat or similar material. T. Rigby. E.P. 181,035, 7.12.20, 24.12.20, and 18.1.21.

Peat or the like is dried, or a solution or suspension of solid matter in a liquid evaporated to dryness, by feeding it in thin films on to the external surfaces of vertical rotary drying drums grouped together in the vapour spaces of drying units arranged in multiple effect. The material is fed into the bite of pairs of such drums revolving in opposite directions, the dried product being continuously scraped off. The material may be subjected to preliminary filtration or settling before treatment in the evaporator. The water of condensation from the heating surface of one effect passes to another effect at a lower pressure, under such control as to allow of the flashing off of steam, which is added to the vapour evolved from the material and is passed therewith into the heating vapour space of the next effect. The dried material may be cooled recuperatively by placing it in communication with a heating vapour space where a lower pressure prevails than that in the space where the material was dried. The rates, and extent of drying in each separate effect are controlled independently, and the products from the separate chambers may be either mixed or removed separately. The sensible heat of the non-condensable gases is recovered and added to that of the heating medium in subsequent stages. Undue fluctuations in temperature difference in the series of effects are avoided by an automatic vapour control throttle.—A. R. M.

Evaporating liquids; Process for ——. L. H. A. Bohrmann. E.P. 181,406, 10.12.20.

The liquid mixture to be evaporated is sprayed or atomised on to or under another liquid maintained at a temperature much above the boiling point of the constituent which is to be evaporated. The two liquids may either mix completely (*e.g.*, weak caustic soda may be sprayed into strong caustic soda) or form an emulsion (*e.g.*, an aqueous solution of salt may be sprayed into hot oil).—B. M. V.

Evaporating apparatus; Means for controlling the level of liquids in ——. W. H. P. Creighton. U.S.P. 1,419,824, 13.6.22. Appl., 31.12.20.

The level of the liquid within a vessel under steam pressure is maintained by an overflow device such as an inverted U-tube which is also connected with the steam space so as to be under the same steam pressure as the interior of the vessel, its height being adjusted by rocking or rotating it in a vertical plane.—B. M. V.

Still. S. E. Oliver. U.S.P. 1,419,894, 13.6.22. Appl., 6.5.20.

A dome-shaped cover, fitted with an internal and an external gutter which completely encircle the cover at its lowest point, is fixed to the top flange of the still. The cooling medium is sprayed over the upper part of the dome, runs down the outer surface and is collected in the outer gutter. The vapour from the still condensed on the inner surface of the cover is collected in the internal gutter, which is connected by a pipe with a receiver to which the distillate passes.—S. G. U.

Drying solid substances; Apparatus for use in ——. N. S. Kilner. E.P. 180,023, 14.2.21.

Attached to the inner surface of a vertical cylindrical casing are several layers of horizontal shelves, one edge of each shelf being inclined downwards at an angle of 30°—45° so as to act as a guide to the rising currents of hot air. Each layer consists of a number of shelves, so arranged that the discharging edge of each shelf is directly over the horizontal portion of a corresponding shelf on the layer underneath. Above the top layer of shelves are a number of bars performing the double function of distributing the material on to the shelves and supporting a central boss, in which rotates a shaft carrying a number of radial arms which scrape the material off the shelves, thus causing it to fall through a current of air on to the shelves below. Bolted to the upper flange of the cylinder is a conical casing provided at the top with a ventilator for the removal of the air. Coaxial with the casing is a small vertical shaft carrying a disc and a series of arms which rotate inside an inverted conical hopper. A horizontal shaft fitted as a screw conveyor, working in a trough, drives through bevel gearing this small vertical shaft and conveys the material into the conical hopper from which it passes to the rotating plate; it is thrown outwards from the plate on to the fixed arms and thence drops on to the first layer of shelves. —S. G. U.

Drying apparatus. D. J. Watrous, Assr. to Airdry Corp. U.S.P. 1,419,707, 13.6.22. Appl., 21.7.20.

A series of nozzles are so arranged that they can be individually rotated so that their axes point in any direction within a limiting angle of about 180°. Each of these nozzles is connected through its own valve with a compressed air supply pipe, and is fitted with an electric heating coil to warm the air as it passes through the nozzle. The valves are operated by spindles attached to hand-operated levers held in the open position by means of pins, upon the removal of which the valves are automatically closed by springs. The spindles also carry a device for operating an electric switch, so arranged that on opening the valve the switch is closed and a current flows through the heating coil of that particular nozzle, but on closing the valve this switch is opened and the current cut off from the heating coil.—S. G. U.

Drying machine. J. G. Bassette, Assr to Airdry Corp. U.S.P. 1,419,712, 13.6.22. Appl., 21.7.20.

The casing of a fan is supported by two large trunnion bearings in one of which the motor required for driving the impeller is housed. The other trunnion acts as the suction pipe of the fan and is fitted with an electric heater. The fan casing is provided with a nozzle through which the heated air is discharged, and a rib which extends partly round the casing, forming a friction surface concentric with the axis of rotation of the casing, and upon which a shoe is pressed by a spring. This rib terminates in a cam at one end and a shoulder stop at the other.—S. G. U.

Desiccator [for liquids]. H. B. Faber and W. H. Harding, jun., Assrs. to Atomised Products Corp. U.S.P. 1,419,664, 13.6.22. Appl., 26.3.17.

The liquid to be desiccated is sprayed into a current of heated air in a tower and the moist hot air and entrained solids are passed through two "condensers," the first of which condenses some moisture upon the entrained solid particles and delivers both to the supply tank; the second condenser contains a coil through which the liquid from the supply tank is circulated and is preheated by the heat in the saturated air after it has been freed from solids.—B. M. V.

Drying apparatus. C. H. Brown and A. A. Coldrey. E.P. 181,082, 2.3.21.

The patent relates to mechanical improvements in apparatus of the type in which articles to be dried are carried through a drying chamber by a conveyor.

Scrubber. W. G. Laird, Assr. to H. L. Doherty. U.S.P. 1,419,867, 13.6.22. Appl., 6.9.16.

The scrubber is made up of a number of flanged sections bolted together, the bottom section being provided with a gas inlet and liquor outlet, whilst the top section is fitted with a liquor inlet and a gas outlet. Each of the intermediate sections is fitted internally with a channel which increases in depth towards one end. Sloping perforated trays having holes sufficiently small to prevent the downward passage of the liquid whilst gas is passing upwards through the perforations, cover the space bounded by the inner edges of these channels. The vertical edges of these trays dip into the channels, thus forming a seal preventing the passage of the gas between the edges of the trays and the sides of the apparatus. The trays slope alternately from left to right and right to left and a weir is provided for the overflow from the channel at the deepest section of the channel. This overflow is directed on to the highest point of the tray beneath, down which it flows to the deepest portion of the channel immediately below this tray. During its passage across the tray gas is bubbled through the liquid. The slope of these trays can be adjusted from outside whilst the plant is in operation.—S. G. U.

Separation or grading of powdered materials and the treatment thereof by air or other gases or vapours; Effecting the —— and apparatus to be employed therein. W. H. Reynolds, W. W. Dickin, and G. L. T. Kenyon. E.P. 181,560, 25.4.21.

The powdered material is sprinkled into the top of a tower and the finer or lighter material drawn off by an air current from about the middle of the tower, preferably by means of an internal axial pipe with slits or perforations in its circumference. —B. M. V.

Centrifugal separators. G. C. Barnes and J. R. Morgan. E.P. 159,217, 21.2.21. Conv., 19.2.20.

A conical frame is formed of two unequal discs joined by a series of screwed rods passing through holes drilled near their outer edges. To these rods are fixed blades so as to form a helix or spiral to assist in carrying the material from the narrow to the wide end. Another and slightly larger conical frame is made in the same manner, but using T-bars instead of screwed rods. Frames fitted with wire gauze are bolted between these bars, thus forming a conical wire gauze cage. To permit of the discharge of material too coarse to pass through the gauze, this does not extend up to the larger disc. These frames, placed one within the other, are mounted on ball bearings; those carrying the smaller frame run on a fixed horizontal shaft, whilst the second pair of ball bearings, running on sleeves projecting from the outer surfaces of the smaller pair of discs, support the discs used in the larger cage. The sleeve of the larger disc of the smaller frame is extended to carry the driving pulley; an extra ball bearing between the shaft and sleeve is fitted at the outer end. Rotation of the outer frame is effected through a train of spur wheels, worm and screw gear, and bevel wheels arranged at the driving end of the machine. The shaft round which these frames rotate is hollow and divided into two portions. At the end of this shaft, near the smaller end of the frames, a hopper with worm gear is fitted, the feed taking place through the hollow shaft, which is cut away underneath for this purpose. The point of distribution of the feed is regulated by a sliding plate operated by a rack and pinion. Two pipes enter the other portion of the hollow shaft from the driving end, and are used for the supply of media to wash or dry the material during its passage through the machine. The frames rotate within a housing so arranged that the material which passes through the gauze is discharged at the one end, whilst the coarse material is withdrawn at the other.—S. G. U.

Furnaces of steam boilers and other similar furnaces; Heating method applicable to the ——. C. Magnée and E. Demeure. E.P. 163,270, 11.5.21. Conv., 12.5.20.

The advantages resulting from the decomposition of carbon dioxide on contact with the coal in ignition are utilised. To obtain for this purpose a mixture in regulated proportions of air and inert products at the desired temperature, without using a superheater, a portion of the combustion products is sucked from the furnace by air under pressure. The air is injected into a mixing tube, connected at its upper part directly with the furnace and at its lower part with the ash-pit, and provided with means for regulating the supply of air and of the products recovered from the furnace.—H. H.

Furnaces. S. A. Sears and W. R. Twigg. E.P. 179,965, 11.11.20.

In a furnace with a double set of preheating chambers the lower portion of the preheater casing is divided into two by a central brick partition extending the full depth of the furnace. Horizontal tiles are built between the outer walls, and the partition thus sub-divides each half into a series of parallel chambers of rectangular cross-section extending the full depth of the furnace. The tiles have a series of holes near their edges into which are fitted a number of tubes in such a manner that the air entering the lowest chamber, No. 1, is led through one set of tubes past chamber No. 2 immediately overhead, and discharged into chamber No. 3, from which it passes through chambers Nos. 5 and 7, etc., to the preheater chamber. The gas enters chamber No. 2, flows past chamber No. 3 into chamber No. 4 and through No. 6 to the preheater chamber. Each of these chambers is fitted with tiles which cause the gas or air to flow across the chamber and back again before reaching the outlet tube. If the furnace is designed for regenerative working, each set of chambers terminates in a preheating chamber, half the breadth of the hearth, where the gas and air mix and then flow through ports on to the hearth. In the recuperative design of furnace two preheating chambers, placed one above the other and extending the full breadth of the hearth, are used, each chamber being connected with the hearth through its own set of ports. When working regeneratively the hot spent gases pass downwards through one set of chambers, while the gas and air travel upwards through the other set in the manner indicated above. The flow of spent gases, air, and gas can be directed and controlled by change-over valves. When working as a recuperative furnace the hot spent gases pass downward through the 6th, 4th, and 2nd chambers of one section, and the 7th, 5th, 3rd, and 1st chambers of the other section, the gas passing up the remaining chambers of the one section and the air up the remaining chambers of the other. By a different arrangement of piping the furnace can be adapted for regenerative and recuperative working. The furnace can also be built as a furnace with a single set of preheating chambers, and can be arranged for either regenerative or recuperative working. In this design only the air is heated, the gas being blown directly on to the hearth.—S. G. U.

Annealing kilns. B. Wallis. E.P. 180,944, 20.8.21.

In an annealing kiln the fire-grate is placed at the middle of the back wall and the entrance door at the front of the kiln or at the side of the main flue, so as to provide a stronger roof. Four short downcasts in the floor of the kiln are connected with the main flue at a central point.—A. B. S.

Cooling and liquefying air and other gases; Process and device for ——. Heylandt Ges. für Apparatebau m.b.H., and M. von Unruh. E.P. 167,144, 11.3.21. Conv., 28.7.20.

The patent relates to a process for liquefying air and other gases of the type in which high-pressure gas is divided into two portions, which are expanded with and without doing work respectively, and in which the exhaust from the expansion engine, together with any unliquefied gas remaining from the portion which is expanded without doing work, are used to cool the latter portion of the gas, before expansion, in a heat interchanger. The interchanger is provided with an extension in which the combined exhaust gases cool further both the incoming streams of high-pressure gas. The inlet valve of the expanding engine is entirely within the high-pressure conduit of the engine, thus avoiding leaks to the external air. It is opened by the piston just before the latter reaches dead centre, and is closed by the high-pressure air behind it as soon as the piston has moved far enough on the expansion stroke to permit this. To keep the clearance low the piston head and cylinder head are made frusto-conical.—B. M. V.

Precipitating dust from gases by electricity. Siemens-Schuckertwerke Ges.m.b.H. E.P. 170,601, 24.10.21. Conv., 22.10.20.

In a plant for precipitating dust from gases by the action of a rotary field, the brush-discharging electrodes are preferably of smaller superficial area than the others, and are composed of a number of rods surrounded by a separating electrode of large superficial area. The former are connected with the individual phases of a polyphase source of current of such high voltage that substantial quantities of electricity flow from the charged to the separating electrodes, the discharge producing a rotary field.—J. S. G. T.

Insulator for electrodes of electrical gas purifiers. The Lodge Fume Co., Ltd. From Metallbank u. Metallurgische Ges. A.-G. E.P. 181,284, 28.9.21.

An insulator for the electrodes of electrical gas purifiers is disposed in an arch or recess in the gas main, preferably in the gas intake, the opening of the recess being turned away from the gas current. The interior of the recess is accessible from outside through doors, and the gas-distributing surfaces form a casing for the insulators.—J. S. G. T.

Heat-transferring systems. T. Sugden and A. Hall. E.P. 179,258, 28.1.21.

A coil arranged as a superheater is coupled directly to the working coil, situated in the chamber or vessel to be heated. The outlet of the latter coil is connected to the inlet of a separator, the outlet of which is coupled to the suction of a centrifugal pump by means of which the working fluid is returned to the superheater coil. The working fluid can thus be circulated in a cycle a number of times, any condensed liquid being removed from the circuit through the separator. If steam is used the loss due to condensation is made up by connecting the plant through a reducing valve with a boiler.—S. G. U.

Pulverisers and crushing mills. F. G. Brettell. From Soc. Anon. Les Ateliers Réunis. E. P. 180,890, 25.5.21.

A series of hammers are arranged around the periphery of a rotating disc within a casing, the working faces of the hammers being of larger area than the rear ones. Radial vanes are provided on the side of the disc remote from the feed in order to assist in the pulverising and create a draught through the machine.—B. M. V.

Pulverising or grinding apparatus. The Powdered Fuel Plant Co., Ltd., Assees. of Soc. Anon. La Combustion Rationelle. E.P. 181,290, 20.10.21. Conv., 27.6.21.

The apparatus is constructed with a number of rings of closely spaced blades, similar to a steam turbine, except that the broader working faces of the blades are parallel to the shaft, the material being caused to travel longitudinally by a draught provided by a fan separate from or contained in the machine. A preliminary crushing device of known disintegrator type may be incorporated, and the "turbine" vanes may be so shaped as to be set in motion by air under pressure, which air will also convey the material through the machine.—B. M. V.

Grinding; Fine ——. H. M. Plaisted, Assr. to Williams Patent Crusher and Pulverizer Co. U.S.P. 1,418,735, 6.6.22. Appl., 21.3.19.

A series of hammers, the heads of which have convex inner and outer surfaces, are pivoted on a rotor which revolves inside a cylindrical chamber, the hammer heads being substantially tangential to the inner surface of the casing. The material to be ground is fed into the machine from a hopper placed so that its discharge is tangential to the chamber at a point on a level with the axis of the rotor. The finely ground material is discharged through a pipe placed well above, and on one side of the rotor, and having its axis parallel with the axis of the rotor. Provision is made for retaining the larger particles within the casing of the machine and returning them through passages formed by guide plates to the rotor chamber.—S. G. U.

Filter for wines, sugar liquors and the like. L. Tottereau. E.P. 180,935, 21.7.21.

The filter consists of a number of pockets of filter cloth attached by nipples to a collector formed by the double walls of the containing cylinder. The pockets are maintained in an expanded condition by means of woven cord. The liquor is filtered by passing from the outside to the inside of the pockets, which are washed by circulating a water current in the opposite direction.—A. G. P.

Filtration of colloidal matter from liquid mixtures; Vacuum ——. W. Mauss. E.P. 181,123, 8.3.21.

Colloidal deposit is detached from the surface of a vacuum filter leaf by a thin continuous sheet of water impinging at a slight inclination to the leaf surface at a very high velocity while the leaf and the nozzle through which the water is delivered are moved past one another. Slight air pressure may be set up during stripping to cause rucking of the filter fabric at the point of impact of the water. The leaves may be oscillated between a filter tank and a stripping tank, and means actuated from the oscillating shaft may be provided to bring the nozzles into operation as the leaves are being withdrawn from the stripping tank.—H. H.

Evaporator. H. W. Paulus, Assr. to Royal Baking Powder Co. U.S.P. 1,418,878, 6.6.22. Appl., 26.7.20.

The evaporator consists of a tank containing the liquor to be evaporated and a series of U-tubes immersed in the liquor. Means are provided for supporting the U-tubes.—T. A. S.

Catalytic processes involving gaseous or vapourous carbon compounds; Carrying out of ——. Chemical Fuel Co. of America, Assees. of E. W. Stevens. E.P. 160,466, 3.3.21. Conv., 18.3.20.

See U.S.P. 1,374,119 of 1921; J., 1921, 339 A. The process is applicable to the production of hydrogen from water-gas and steam and to the cracking of hydrocarbon oils in presence of a catalyst. The sparking is produced by placing the catalyst in circuit with a source of high-potential, rapidly oscillating alternating current.

Centrifugal decantation. W. Mauss, Assr. to Continuous Centrifugal Separators, Ltd. U.S.P. 1,419,285, 13.6.22. Appl., 19.2.20.

See E.P. 164,418 of 1920; J., 1921, 535 A.

Vacuum filter. W. Mauss, Assr. to Continuous Centrifugals, Ltd. U.S.P. 1,419,286, 13.6.22. Appl., 3.9.20.

See E.P. 176,395 of 1920; J., 1922, 315 A.

Heat interchangers. [*Air heaters.*] Merz and McLellan, E. G. Weeks, and H. H. Baker. E.P. 181,501, 16.3.21.

Filtration of liquids. E.P. 181,044. *See* XIXb.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Fundamental study of Japanese ——. C. Iwasaki. Tech. Rep. Tôhoku Imp. Univ., 1921, 2, 235—275.

In continuation of his previous work (J., 1920, 620 A), the author has investigated the physical properties of the South Sakhalin coals. The results of his analyses have been plotted on triangular diagrams, and it is shown that the moisture content of the coals is a good indication of their caking or non-caking character. Most of the coals are of low grade, but the author describes a cannel coal of a caking character, although the volatile matter is very high for a coal of this nature. The coals highest in moisture are the non-caking coals. Most of the Sakhalin coal consists of fundamental matter, and it belongs to the sapropelic species, whilst charcoal of a bulky variety occurs, which the author describes as differing entirely from the fusain of Stopes. This charcoal is supposed to have been produced by forest fires during the process of drift formation, and occurs mainly in the coal of the Noborippo group, in which the ash is very low. In general the ash content is inversely proportional to the moisture content, from which the author concludes that the water is an essential constituent of the "woody" matter. The original vegetation of the region differed from the present vegetation, since dicotyledon fossils have been found in the coal, whilst the present vegetation is coniferous. —A. G.

Coal; The oxidisability of —— and the determination of moisture. E. Mertens. Bull. Fed. Ind. Chim. Belg., 1922, 361—364.

A sample of fat coal weighing 3 g., ground to pass through a sieve of 4900 holes per sq. cm., was spread over the bottom of a dish of 4 cm. diameter and placed in a drying oven heated to 105° C. The dish was suspended by a fine non-oxidisable metal wire to the beam of a balance, the wire passing through the top of the drying oven so that the sample could be weighed without removal from the oven, and the oven was sufficiently remote from the balance to prevent any error due to heat. The coal sample was heated for a period of 1400 hours, and the results were plotted against time. Two curves are reproduced, one showing the total time of heating and the other being plotted for the first seven hours. The loss in weight occurred during the first quarter of an hour, after which period the sample steadily gained in weight, indicating that oxidation was taking place. Distillation with xylol gave approximately the same figure as heating for 15 minutes at 105° C. After heating for about 36 hours the weight of the sample was the same as at the beginning, the loss in weight of 1% due to evaporation of moisture having been counterbalanced by oxidation to this extent. At the end of 1400 hours there was an increase in weight of 5·97% on the original weight. The author recommends the determination of the moisture content of coals by the xylol distillation method, using a large quantity of coal, *e.g.*, 50 g., thus eliminating the error due to oxidation.—A. G.

Combustion; Temperatures of ——. J. Bronn. Z. angew. Chem., 1922, 35, 328.

The value of the temperature of combustion for hydrogen in pure oxygen given in the "Chemiker-Kalender," viz., 6670° C., corresponds to a value of 0·485 for the specific heat of steam, but this value for the specific heat is valid only for steam at a temperature of 800° C. If the value 0·85 be used for the specific heat at 4000° C. of steam (this value was obtained by extrapolation from published data for temperatures up to 3000° C.), the calculated temperature of combustion of hydrogen in oxygen is 3900° C. Other temperatures of combustion calculated in a similar manner are 5000° C. for carbon monoxide, 4400° C. for methane, and 6200° C. for acetylene, in oxygen; and 2260° C. for hydrogen, 2400° C. for carbon monoxide, 2070° C. for methane, and 2670° C. for acetylene, in air. Methane may be used with advantage for welding as it supplies a large amount of heat, whilst its temperature of combustion is not so high as to injure the metals operated on. The flame temperatures of gases are greatly influenced by the velocities of flame propagation. The velocities of flame propagation of ethylene, acetylene, and benzene differ.—H. M.

Benzene; Determination of —— in gases. A. Krieger. Chem.-Zeit., 1922, **46**, 468—469.

The method of determining benzene in distillation gases by absorption with activated charcoal (*cf.* Berl, J., 1921, 567 A) possesses many advantages over the petroleum oil absorption method, and is recommended for works' control. The petroleum method is, however, quite trustworthy; it is the more suitable for the determination of benzene when only a few litres of gas are available, and may be used for checking the accuracy of the charcoal method.—W. P. S.

Carbon monoxide and small quantities of combustible gases [hydrogen and methane]; Determination of ——. G. Wollers. Stahl u. Eisen, 1922, **42**, 1050—1053.

Carbon monoxide is only absorbed completely after at least two treatments with ammoniacal cuprous chloride, followed by a third treatment with a fresh solution. The absorption capacity of the solution is influenced by the presence of hydrogen, methane and other hydrocarbons; nitrogen has the least effect. Hence in the determination of carbon monoxide in, say, producer gas, it is desirable to remove the hydrocarbons as completely as possible. The author's method is first to dry the gas over calcium chloride and phosphorus pentoxide, condense out the hydrocarbons by cooling to −85° C., and finally cool to −190° C. The gas thus obtained is essentially carbon monoxide, nitrogen, and hydrogen. The absorption capacity of the ammoniacal cuprous chloride solution is also materially affected by the concentration of the carbon monoxide in the gas. In calculating the calorific value of producer gas, coke-oven gas, or coal gas from an analysis of the gas, results of sufficient accuracy are obtained by assuming that the heavy hydrocarbons are composed of $\frac{1}{5}$ benzol, $\frac{3}{5}$ ethylene, and $\frac{1}{5}$ propylene, and a mixture of such composition has a calorific value of approximately 18,500 cals. per cub. m. For the determination of hydrogen and methane combustion with copper oxide or combustion in a platinum capillary or by platinum wire in a quartz capillary gives more accurate results than the explosion method. A method of determining hydrogen by means of palladium black is also described.—J. B. F.

Bitumen; Attempted isolation of —— in its original form from bituminous rocks. E. Hentze. Z. angew. Chem., 1922, 35, 330—331.

Instead of the process of Narbutt (*cf.* J., 1922, 452 A), which consists in extracting the bitumen from the rock, the procedure used by the author consisted in dissolving the rock from the bitumen. Green kieselguhr and Esthonian oil shale or "kukkersite" were tested, the respective contents of bitumen being about 4% and 28%. Two kg. of each sample was repeatedly treated with dilute hydrochloric acid in the cold and washed with warm water for a period of 14 days to dissolve calcium and iron compounds. The kieselguhr was then treated for four weeks and the kukkersite for 14 days, first with dilute and then with 40% hydrofluoric acid to remove silica and clay. The residues were still not free from ash, and they were extracted with chloroform to obtain the bitumen free from inorganic matter. To compare the extracted bitumen with that present in the rock the extracts were mixed with clay and calcium carbonate to represent the composition of the original rock and distilled in a glass retort, as also were the original rocks. Isolated bitumen from kieselguhr gave 1% less, and the bitumen from kukkersite 5% less volatile products than the original bituminous rock, but the quantities of light-boiling products in the resulting tar were much higher in the isolated bitumens, and the cokes produced by the latter were richer in carbon. Polymerisation seems to have occurred in the extracted bitumens, followed by cracking on distillation. It is proposed to attempt the isolation of bitumens in an unchanged state by electro-osmotic separation from a colloidal suspension.—H. M.

Alcohol-petrol; Limit of inflammability of the vapours of the system —— and of a ternary system with a basis of alcohol and petrol. R. G. Boussu. Comptes rend., 1922, 175, 30—32.

A study of the variation of the lower limit of inflammability of the binary system alcohol-petrol and of the ternary system petrol-alcohol-ether, using the method of Le Chatelier and Boudouard (*cf.* J., 1898, 651, 652). The results verify the formula $n/N+n'/N'=1$, where N and N′ are the limits of inflammability of each of the two vapours and n and n' the proportions of each present in the mixture under examination.—W. G.

Hydrocarbons; Detonation characteristics of blends of aromatic and paraffin ——. T. Midgley, jun., and T. A. Boyd. J. Ind. Eng. Chem., 1922, 14, 589—593.

The effect of the addition of varying percentages of benzene, toluene, and xylene on the detonating or "knocking" tendencies of paraffin hydrocarbons when used as fuel in automobile engines was investigated, using as a standard of comparison paraffin fuels containing small amounts of xylidine, which in common with other aromatic amines exerts a powerful suppressing action on detonation. The relative intensities of different detonations were measured by means of a bouncing pin combined with the standard pressure element of the Midgley Indicator which is screwed into the combustion chamber of the engine. When detonation occurs the pin jumps upwards, and the fluctuations of the pin over a period of time were integrated by means of contact points in a circuit enclosing a sulphuric acid voltameter. The bouncing of the pin closed the points and the amount of gas evolved was measured and compared with that evolved by a fuel of similar "knocking" characteristics run immediately before and after it. The results are recorded in tables and curves, from which it appears that xylene is more effective than toluene, and toluene than benzene in suppressing detonation. The addition of a small percentage of aromatic hydrocarbon to the paraffin fuel has only a slight effect, but with 20% or more the effect increases rapidly, and if the concentration of the aromatic hydrocarbon is expressed as a molecular percentage, the effectiveness for suppressing detonation varies directly as the square of the concentration up to concentrations of 70%.
—G. F. M.

Floridin; The limits of the adsorptive receptivity of ——. M. A. Rakusin. Petroleum, 1922, 18, 797—798.

A 1% solution of Grozny petroleum free from paraffin was decolorised by standing with 5% of floridin (aluminium-magnesium hydrosilicate) for 24 hours, and formed a polarimetrically clear solution. A further addition of floridin did not improve the result. The same result was attained by the action of 1% of floridin for 96 hours. It is suggested that much smaller quantities of floridin would have the same effect if the time of contact were prolonged, and that its action resembles that of catalysts, or of the trypsins in digestion, in which the quantity of enzyme multiplied by the time of action is a constant.—H. M.

Solubility of hydrocarbons in liquid sulphur dioxide. Zerner and others. *See* III.

Patents.

Brown coals and peat; Process for improvement of inferior ——. K. W. J. H. Jacobs. E.P. 157,794, 10.1.21. Conv., 28.7.19.

The material is freed from water and the bulk of carbon dioxide by distillation. Heat is supplied to the material until the temperature reaches 250°—270° C., when an exothermic reaction begins, by the heat of which the distillation is continued. By this means, and the further application of heat, low-temperature tar is distilled off until a maximum temperature of about 350° C. is attained. The resulting residue is said to be a valuable long-flame fuel. Superheated steam not exceeding about 10% of the weight of the fuel may be admitted into the distillation vessel.—A. R. M.

Gas-coal substitute; Process for the production of a fuel capable of application as a ——. K. W. J. H. Jacobs. E.P. 157,795, 10.1.21. Conv., 28.7.19.

Brown coal, lignite, peat, or the like, after partial drying, is heated in a vessel capable of being closed, the heating being carried out with the outlet open until traces of low-temperature tar are carried over, whereupon the oultet is completely or nearly closed, so that the material is subjected to further external or spontaneous exothermic heating under pressure. The resulting product is a good quality semi-coke which may be used as a substitute for gas-coal.—A. R. M.

Combustion of gaseous fuel in furnaces; Means for effecting the ——. Soc. Anon. d'Exploit. des Brevets Cousin dite le Chauffage Industriel. E.P. 165,745, 30.6.21. Conv., 1.7.20.

A chamber packed with refractory chequerwork is interposed between the combustion space and the working space of a furnace. This chamber is of such depth that solid particles cannot fall into the working space, and its floor extends beyond the pile of chequerwork so that particles cannot fall into the combustion space. Doors are provided to facilitate replacement or re-arrangement of the chequerwork. Porous material may be added to secure surface combustion in the upper part of the chequerwork. —H. Hg.

Gas manufacture. G. Helps. E.P. (a) 181,403, (b) 181,404, and (c) 181,665, 10.12.20.

(a) Coal is treated in a combined gas-producer and retort to produce a rich gas, which is withdrawn from the top of the retort, and producer-gas which rises in an annular space around the retort and is then burnt in the top of a chamber surrounding an independent vertical retort. The products of combustion pass upwards through a similar chamber surrounding a retort containing coal at a lower temperature. The chambers are so interconnected that the producer-gas may be burnt alternately in either chamber according to which retort was last charged with coal. The volatile products from the low-temperature retort are passed into the retort around which producer-gas is burning at a point about one-third of its height from the top; all the products thus pass through the hottest zone before they are finally withdrawn from the retorts. A number of retorts may be arranged in conjunction with one producer and worked either in series or in parallel. Part of the producer-gas or some other hot, low-grade gas may be passed into the retorts and mixed with the coal-gas. (b) Producer-gas is passed intermittently through a vessel containing coke, which is heated to incandescence by the alternate admission of air. The heated gas then passes downwards through a vertical retort containing coal undergoing partial carbonisation and is thereby enriched. The waste gases produced by blowing air through the coke are passed through a chamber surrounding the retort, or the retort may be placed in the centre of the chamber containing the incandescent coke, in which case the waste gases pass direct to a chimney. (c) A number of retorts, each of which is in turn heated by the combustion of producer-gas, and the remainder of which are heated by waste gases as described above, are arranged in series.—H. Hg.

Gas producer; Convertible heating stove and ——. H. C. L. Holden, T. G. Tulloch, and D. J. Smith. E.P. 181,450, 8.3.21.

An anthracite stove of the slow-combustion type is provided with a branch pipe fitted with two throttle valves, so that when being used as a heating stove the products of combustion are passed up the chimney to waste, whilst when in use as a producer the producer-gas generated is deflected through another pipe to an internal-combustion engine, furnace, or the like. The grate is provided with an annulus containing water, the level of which can be adjusted externally, and which provides the steam for use in generating producer-gas. The grate can be rocked by a protruding arm, which effects removal of the ash and also stirs the fuel bed to produce better gasification. An annular boiler can be fitted as desired to utilise the heat of combustion of the anthracite.—A. G.

Hydrogen; Methods and apparatus for production of —— [*in coal carbonisation*]. Cumberland Coal Power and Chemicals, Ltd., J. H. West, and A. Jaques. E.P. 181,062, 9.2.21.

The gases evolved during the initial stages of the carbonisation of coal are passed together with steam over partially carbonised coal or coke at a temperature between 1000° C. and 1100° C., the carbonisation being effected at a rate sufficiently slow to allow of the decomposition of nearly all the hydrocarbon products in contact with the hot coke. Not only are the tarry vapours of condensable hydrocarbons decomposed, but also a high percentage of the so-called non-condensable gases, *e.g.*, ethylene and methane, whereby largely increased yields of hydrogen are obtained. The apparatus consists of a bank of six ovens arranged to work in pairs, the individual ovens of each pair being connected by means of detachable pipes (provided with steam jets) secured to the doors of the ovens so that the gases can pass from one oven through the other of the pair before passing into a common delivery conduit.—H. R. D.

Gas; Treatment [*cleansing and enriching*] *of* ——. T. G. Tulloch and D. J. Smith. E.P. 181,102, 4.3.21.

Gas from a producer is freed from suspended particles and simultaneously enriched by causing it to pass through a wall or screen of absorbent material, preferably arranged as a cylindrical wick which provides an enclosed chamber, closed at the bottom by a seal of oil or other enriching medium and at the top by a gas-tight casing, the inlet to the chamber being within it and the outlet from the apparatus being on the other side of the screen. A by-pass connexion, which may be wholly or partly closed by a valve, connects the inlet with the outlet outside the cleansing chamber. A constant oil level is provided by means of a float-feed chamber, and a sludge-cock or similar device provides means for running off the oil or deposited refuse from the inclined surfaces of the bottom of the apparatus. —A. R. M.

Acetylene gas; Materials for purifying ——. J. R. Booer, and The District Chemical Co., Ltd. E.P. 181,571, 9.5.21.

A basic purifying material is made by incorporating kieselguhr with a mixture of ferric chloride and ferric oxide, either dry or hydrated, and not more than 0·05% of mercuric chloride is added. After mixing, the material is left to stand for 2—12 months.—A. G.

Coal; Coking ——. F. Puening. U.S.P. 1,419,908, 13.6.22. Appl., 30.11.17.

A layer of the coal to be coked is placed between two hollow boxes, which are then heated internally. —A. G.

Separating oils [*from emulsions*]; *Process of* ——. Trent Process Corp., Assees. of W. E. Trent. E.P. 167,738, 13.4.21. Conv., 11.8.20.

The process is designed to deal with such emulsions as "base sediment," refining acids, and sludges.

When such emulsions are agitated with comminuted carbon, the oil and carbon unite, forming an agglomerate from which the water and the other substances separate. The carbon used is fine enough to pass through a 100- to 200-mesh sieve, and the quantity used is 2 lb. of carbon to 1 lb. of oil in the mixture. The oil-carbon mixture sinks in still water, and may be used direct as fuel or distilled to recover the oil.—T. A. S.

Fuel for internal combustion engines. A.-G. für Anilin-Fabr. E.P. 169,428, 17.6.21. Conv., 20.9.20.

The fuel consists of a mixture of hydronaphthalenes with suitable cyclohexanes, *e.g.*, a mixture of 50—70% of methylcyclohexane and 50—30% of tetrahydronaphthalene.—T. A. S.

Petroleum or other hydrocarbon oils; Process and apparatus for treating ——. J. P. Persch. E.P. 181,034, 6.12.20.

The oil is treated with a hot gaseous fluid, preferably air, in an apparatus so arranged that an injector effect is obtained, the oil being drawn from bulk, passed through tubes, mixed with the air, and returned to the bulk. In an example given, oil of 38° B. (sp. gr. 0·833) was treated for 30 mins. with compressed air at 390° F. (200° C.). The temperature of the oil did not exceed 152° F. (67° C.). After treatment, the oil yielded 60% of gasoline, 7% of lubricating oil, and 3% of heavy lubricating oil. The gasoline yield from the original oil was 25%. An oil of 11°—15° B. (sp. gr. 0·993—0·966), after treatment for 30 mins., was much less viscous and retained this property indefinitely. —T. A. S.

Hydrocarbon material; Process of making unsaturated ——. A. A. Wells, Assr. to S. B. Hunt. U.S.P. 1,418,414, 6.6.22. Appl., 9.10.16.

Hydrocarbon oils are cracked under high pressure until "still bottoms" of a tarry consistency are formed. These "still bottoms" are distilled, and the distillate cracked again, under a pressure lower by at least one atmosphere than the original cracking pressure. By this process hydrocarbon material is obtained rich in unsaturated hydrocarbons, which can be extracted with sulphuric acid without undue rise in temperature.—T. A. S.

Petroleum; Apparatus for treating ——. L. Clark. U.S.P. 1,418,621, 6.6.22. Appl., 14.3.18.

Oil is fractionated or cracked by heating in the presence of a heated fluid, *e.g.*, flue-gases. The heated gases cause circulation of the oil and carry away the vapour. The apparatus consists of a shell suspended in a chamber to provide an annular passageway. The bottom of the shell is an open cone. A central pipe conducts the heated gas down the shell and discharges it at the bottom of the cone, whence it rises in the annular space and produces a circulation of the oil upwards in the annular space and downwards in the shell. The apparatus is arranged so that any temperatures and pressures may be used.—T. A. S.

Gasoline; Apparatus for recovery of —— from casing-head gas. W. R. McGinnis, Assr. to Pilsbry-Becker Engineering and Supply Co. U.S.P. 1,418,876, 6.6.22. Appl., 23.8.19.

Two scrubbers are used, each provided with baffles, refrigeration apparatus, and a sprinkling head. Means are provided for passing the gas down one scrubber and up the other, and also for reversing the direction of the gas.—T. A. S.

Oil separator. J. C. Pool. U.S.P. 1,418,970, 6.6.22. Appl., 18.2.20.

An apparatus for distilling oil from rock consists of a long vertical tube divided into preheating, distilling, and cooling sections. Arrangements are provided for drawing off the volatile oils from the distilling sections, for conveying heat from the distilling and cooling sections to the preheating section, and for the discharge of the residue from the bottom of the tubes.—T. A. S.

Emulsions; Process for resolving ——. H. A. Gill. From The Sharples Specialty Co. E.P. 180,447, 1.6.22.

Emulsions are resolved by adding to them colloidal solutions soluble in the continuous phase and which tend to reverse the emulsion. Soap may be added to a water-in-oil emulsion by preparing a reagent soluble in oil and yet containing soap. Such a reagent containing 25% of sodium soap, 10% of water, and 65% of oleic acid may be prepared by adding excess of oleic acid to a solution of caustic soda of 30° B. The addition of 1% of a reagent containing 40% of water, 35% of resin, and 25% of resin soap, with stirring, to a viscous oil emulsion, followed by centrifuging, resulted in a separation of water from the emulsion.—T. A. S.

Hydrocarbons; Process of separating and topping —— from a water mixture. W. A. Brown. U.S.P. 1,419,610, 13.6.22. Appl., 24.2.19.

The mixture is heated under a pressure sufficient to prevent the vaporisation of the water, thereby inducing the separation of the water from the oil. The hydrocarbons are then heated without heating the water, pressure being still maintained, and oil vapours are withdrawn.—T. A. S.

Low-boiling hydrocarbons; Process for the continuous production of —— from petroleum oils. R. W. Hanna, Assr. to Standard Oil Co. of California. U.S.P. 1,419,378, 13.6.22. Appl., 19.1.20.

The oil is distilled under reduced pressure so as to prevent cracking, the heavy oils being preferably withdrawn continuously. The high-boiling distillates to be cracked are carried forward to an apparatus kept at a pressure higher than atmospheric and a temperature sufficient for cracking. The addition of a solvent oil to the oil to be cracked prevents the formation of deposits in the system. The cracked products and residues are continuously removed.—T. A. S.

Acetylene [storage] tank. F. J. Metzger, Assr. to Air Reduction Co., Inc. U.S.P. 1,419,746, 13.6.22. Appl., 19.11.20.

See E.P. 180,273 of 1922; J., 1922, 536 A.

Explosive gases [acetylene] dissolved in liquids; Porous charge for containers serving for storage of ——. E. Klebert, Assr. to J. Pintsch A.-G. U.S.P. 1,419,862, 13.6.22. Appl., 3.1.20.

See E.P. 135,511 of 1919; J., 1920, 684 A.

Bituminous shales; Treating ——. J. H. Ginet. E.P. 181,126, 9.3.21.

See U.S.P. 1,371,160 of 1921; J., 1921, 291 A.

Drying peat. E.P. 181,035. *See* I.

Feeding fine materials to gas producers. E.P. 180,396. *See* X.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Retort; The "fusion" patent rotary ——. C. J. Goodwin. South Wales Inst. Eng., 20.4.22. [Reprint.] 12 pages.

The retort is designed for the recovery of oils from coal, shale, etc. It consists of an inner tube 18 in.

in diam., in which is situated eccentrically a four- or six-winged breaker or scraper, which is partially carried round by the rotation of the tube and then falls back, striking a glancing blow, and so keeping the heated surfaces free from scale, breaking up the material and preventing caking, deposition of carbon, and "cracking." This tube is surrounded by an outer rotating tube, about 2 ft. 6 in. in diam., which is directly heated by the combustion of gases in a chamber. The material under treatment is fed into the inner tube, and passing the length of that tube returns through the outer tube, from which it is discharged. The vapours evolved pass the length of the outer tube, return through the inner tube, and are thence discharged. A rubbing joint made of flexible steel and asbestos prevents the escape of vapours at the junction of the two tubes. The coke produced is in a finely divided state, and would require briquetting for most industrial purposes. 73·6 galls. of oil was obtained from Esthonian shale, 51·8 galls. from Nova Scotia torbanite, 131·7 galls. from Australian torbanite, and 52·5 galls. from Kimmeridge shale per ton of material. The carbon content of the residue varied from 9·50% to 26%. There was practically no "cracking" of the distillation products.—H. M.

Patents.

Thermionically-active substance [*filament*]. W. Wilson, Assr. to Western Electric Co., Incorp. U.S.P. 1,419,530, 13.6.22. Appl., 12.8.18.

A thermionically-active filament consists of a core of a ductile metal of the iron group coated with strontium and barium oxides. The activity is comparable with that of a platinum filament similarly treated.—J. S. G. T.

Peat and the like; Process for the distillation and coking of raw ——. A. J. H Haddan. From Torfverwertungsges. Pohl und Von Dewitz. E.P. 158,513, 24.1.21.

See G.P. 337,097 of 1920; J., 1921, 618 A.

Electric lamp bulbs or the like; Evacuation of ——. Patent-Treuhand-Ges. für Elektrische Glühlampen. E.P. 165,406, 22.6.21. Conv., 22.6.20.

See U.S.P. 1,410,665 of 1922; J., 1922, 363 A.

III.—TAR AND TAR PRODUCTS.

Hydrocarbons and fats; Solubility of —— *in liquid sulphur dioxide.* E. Zerner, H. Weiss, and H. Opalski. Z. angew. Chem., 1922, 35, 253—256.

Weighed quantities of the oils under investigation and liquid sulphur dioxide were heated in sealed hard glass tubes, placed in a bath, and the temperature at which turbidity was produced was observed. The commercial sulphur dioxide used contained 98·85% of sulphur dioxide, 0·56% of water, and 0·67% of oily residue. Toluol, *n*-tetradecane, *n*-pentatriacontane, decahydronaphthalene, tetrahydronaphthalene, and American kerosene were tested, also castor, rape, olive, and linseed oils and bone fat. The graphs in all cases show a maximum. Paraffins are the least soluble, naphthenes more so, and aromatic and unsaturated compounds are easily soluble. The solubility decreases with increase in molecular weight. Sulphur dioxide shows great solubility in hydrocarbons.—H. M.

Catalytic hydrogenations under pressure in the presence of nickel salts. I. Indene and acenaphthene. J. von Braun and G. Kirschbaum. Ber., 1922, 55, 1680—1686.

The method is essentially that due to Schroeter 1922, 133 A), hydrogenation being effected under a pressure of 10—15 atm. at a suitable temperature in an autoclave provided with stirring gear and in the presence of a nickel catalyst. At 200° C. indene is very readily transformed into hydrindene, b.p. 176° C., the yields being theoretical. At 210° C. technical acenaphthene, purified by a single crystallisation from alcohol, is rapidly and quantitatively reduced to tetrahydroacenaphthene (tetraphthene), b.p. 115° C. (12 mm.). The latter is distinguished from hydrindene and tetrahydronaphthalene by its ready susceptibility to oxidising agents. It is stable when preserved in closed vessels and becomes coloured merely pale yellow when exposed to air, but behaves towards permanganate as an unsaturated compound. (*Cf.* J.C.S., August.)
—H. W.

Isoquinoline and the Isoquinoline Reds. J. E. G. Harris and W. J. Pope. Chem. Soc. Trans., 1922, 121, 1029—1033.

Isoquinoline was extracted from the fraction of commercial coal-tar quinoline boiling at 230°—255° C. by taking advantage of its more powerful basic properties. 387 g. of the mixed bases was shaken with 600 c.c. of 4 *N* sulphuric acid, which left about 20% undissolved. The sulphuric acid solution was then treated with successive quantities of 4 *N* ammonia in sufficient amount to liberate about 20% of its content in base, which was removed by extraction with benzene. After eleven treatments about 6·9% of the original base remained in sulphuric acid solution, containing 20—30% of isoquinoline. This was then liberated with ammonia and purified by recrystallisation of the acid sulphate from alcohol. Pure isoquinoline hydrogen sulphate melts at 206·5°, and the pure base liberated therefrom boils at 242·5° C., somewhat higher than previously recorded in the literature. Isoquinoline Red was obtained in 70% yield and free from inorganic matter by heating isoquinoline, quinaldine, and benzotrichloride with aluminium chloride as condensing agent. It was purified by recrystallisation from boiling water. By substituting *p*-toluquinaldine or 6-ethylquinaldine for quinaldine in the above preparation 6′Methylisoquinoline Red, or 6′-Ethylisoquinoline Red was obtained.—G. F. M.

Patents.

Anthracene; Process of producing high-percentage pure ——. L. Weil. U.S.P. 1,419,186, 13.6.22. Appl., 21.12.21.

Crude anthracene is distilled with petroleum hydrocarbons of b.p. about 300° C., and the anthracene which crystallises from the distillate is separated from the residual oil.—L. A. C.

m-Hydroxybenzaldehyde; Production of ——. J. B. Slimm, Assr. to National Aniline and Chemical Co., Inc. U.S.P. 1,419,695, 13.6.22. Appl., 6.1.21.

A solution of a *m*-aminobenzaldehyde-bisulphite addition product is diazotised, and the solution of the diazonium compound is heated to remove nitrogen and sulphur dioxide simultaneously.
—L. A. C.

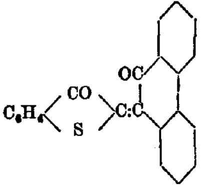
Phenylglycine bodies; Method of making ——. L. E. H. Cone, Assr. to Dow Chemical Co. U.S.P. 1,419,720, 13.6.22. Appl., 22.3.18.

A salt of chloroacetic acid is dissolved in a cold aqueous solution of aniline, and the solution added to a hot aqueous solution of aniline to form the aniline salt of phenylglycine. The freshly precipitated phenylglycine is washed with a cold aqueous solution of aniline.—L. A. C.

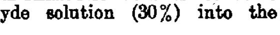
IV.—COLOURING MATTERS AND DYES.

Indigoid dyes of the phenanthrene and indene series. P. Friedländer, W. Herzog, and G. von Voss. Ber., 1922, 55, 1591—1596.

2-Thionaphthene-9′-phenanthreneindigo (annexed formula), dark violet, almost black crystals,

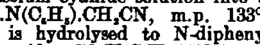


is readily prepared by the addition of a few drops of concentrated hydrochloric acid to a boiling solution of 3-hydroxythionaphthene and phenanthraquinone in acetic acid; it gives dull violet shades on the textile fibres from a yellow vat. It is remarkable for its resistance towards solutions of alkali hydroxides, being far more stable in this respect than thionaphtheneacenaphtheneindigo (Thioindigo Scarlet 2 G). β-Ketohydrindene condenses with one proportion of isatin chloride giving 2-indole-1′-indaneindigo, which is also produced from β-ketohydrindene and α-isatinanilide in the presence of acetic anhydride. The dyestuff is decomposed with great difficulty by solutions of alkali hydroxides; it gives very intense, dark bordeaux shades on wool from a pale yellow hydrosulphite vat. The similar dyestuff from β-ketohydrindene and dibromoisatin chloride is described. Thionaphthenequinone-2-anil and β-ketohydrindene give 2-thionaphthene-1′-indaneindigo,



$$C_6H_4<{}^{CO}_{S}>C:C<{}^{CO}_{C_6H_4}>CH_2$$

reddish violet needles, which dyes textile fibres from a yellow vat in redder shades than the corresponding indole dyestuff. Similarly, thionaphthenequinone-2-anil and αγ-indanedione yield 2-thionaphthene-2′-indoneindigo,

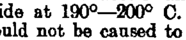


$$C_6H_4<{}^{CO}_{S}>C:C<{}^{CO}_{CO}>C_6H_4$$

slender, reddish-violet needles. (*Cf.* J.C.S., August.)—H. W.

NN′-Diphenylindigotin. P. Friedländer and K. Kunz. Ber., 1922, 55, 1597—1607.

N-Phenylanthranilic acid is converted by hot formaldehyde solution (30%) into the so-called formalide,



$$C_6H_4<{}^{CO-\!\!-O}_{N(C_6H_5).CH_2}$$

m.p. 89° C., which is transformed by cold concentrated potassium cyanide solution into the nitrile, $CO_2H.C_6H_4.N(C_6H_5).CH_2CN$, m.p. 133°—134° C. The latter is hydrolysed to N-diphenylglycine-*o*-carboxylic acid, $CO_2H.C_6H_4.N(C_6H_5).CH_2.CO_2H$, m.p. 160°—163° C. (decomp.), which is transformed by sodium acetate and acetic anhydride or by sodium hydroxide at 190°—200° C. into phenylindoxyl. This could not be caused to crystallise. It is oxidised by potassium ferricyanide in faintly alkaline solution to diphenylindigotin, almost black, lustrous plates, in which the presence of the phenyl groups attached to the nitrogen atoms so lessens the stability of the molecule that the substance has no value as a vat dyestuff. The shade is displaced markedly towards green but not to so great an extent as with the methyl derivative. The corresponding di-4-chlorophenylindigotin is scarcely distinguishable in shade and properties from the chlorine-free dyestuff. (*Cf.* J.C.S., August.)
—H. W.

Isohæmatein; Synthesis of ——. Synthesis of isobrazilein and certain related anhydropyranol salts. II. H. G. Crabtree and R. Robinson. Chem. Soc. Trans., 1922, 121, 1033—1041.

Isohæmatein was synthesised from veratrylidenegallacetophenone dimethyl ether by hydrogenation of this to its dihydro derivative, and boiling the latter with formic acid and anhydrous zinc chloride, whereby an isohæmatein tetramethyl ether salt was obtained, and isolated as its ferrichloride which was found to be identical with the ferrichloride obtained from hæmatein through pentamethyldihydrohæmateinol. The salt forms hæmatite-red needles with a green reflex, m.p. 191° C. (with decomp.). On demethylation by warming with concentrated sulphuric acid, and converting the sulphate into hydrochloride, isohæmatein hydrochloride was obtained as orange needles. The brownish-red shades given by the synthetic substance and that obtained from hæmatoxylin on aluminium-mordanted cloth were identical and behaved in the same way on soaping and on treatment with sodium hypochlorite solution.—G. F. M.

Dyestuffs from Purpura aperta and P. lapillus. P. Friedländer. Ber., 1922, 55, 1655—1658.

The dyestuff obtained from *Purpura aperta* appears to be identical with 6.6′-dibromoindigotin as far as elementary analysis, solubility, tinctorial properties, and absorption spectrum allow a judgment to be formed. The dyestuff from *P. lapillus* is probably also a dibromoindigotin.—H. W.

Anthocyanidins; Distribution of —— in the coloured organs of plants. St. Jonesco. Comptes rend., 1922, 174, 1635—1637.

The anthocyanidins, either as a coloured pigment or in the free state, do not exist in all coloured tissues which contain anthocyan. They appear to be characteristic of pure red organs, but are replaced by a very intense yellow pigment in the blue, violet, or reddish-purple organs, in which the anthocyanidins are entirely absent. This yellow pigment is not coloured by warming with 20% hydrochloric acid. Its presence has been detected in the violet-red leaves of beetroot, the violet flowers of *Gladiolus* and *Cobœa scandens*, the reddish-purple flowers of *Canna* and of a cultivated rose, and the blue flowers of *Centaurea cyanus*.—W. G.

Isoquinoline Reds. Harris and Pope. *See* III.

Stereoisomeric catechins. Freudenberg and others. *See* XV.

Reduction of flavanone. Freudenberg and Orthner. *See* XV.

Patents.

Colouring matter of the anthracene series; Production of a ——. A. H. Davies, R. F. Thomson, J. Thomas, and Scottish Dyes, Ltd. E.P. 181,304, 27.11.20.

A vat dyestuff which dyes cotton brilliant greenish-blue shades of excellent fastness to chlorine, acids, and alkalis, is obtained by treatment of the oxidation product of dibenzanthrone with dimethyl sulphate. *Example:* 10 pts. of anhydrous sodium carbonate and 10 pts. of dimethyl sulphate are added to 10 pts. of the dried oxidation product of dibenzanthrone suspended in 100 pts. of nitrobenzene, and the mixture is boiled for 3 hrs., afterwards cooled, then 10 pts. of sodium carbonate dissolved in 200 pts. of water is added and the nitrobenzene removed by steam distillation. The product is then filtered, whereby a bluish-green paste of the dyestuff is obtained. The dyestuff crystallised from nitrobenzene has the composition $C_{34}H_{14}O_2(OCH_3)_2$ and dissolves in sulphuric acid with a reddish-violet

colour. It forms a brown amorphous compound when treated with sulphuric acid of about 80%.
—A. J. H.

o-Hydroxyazo dyes. [*Vat*] *dyes.* (A) R. Haugwitz, (B) W. Herzberg and G. Hoppe, Assrs. to Akt.-Ges. für Anilin-Fabr. U.S.P. (A) 1,419,500 and (B) 1,419,502, 13.6.22. Appl., (A) 30.8.21 and (B) 7.12.21.

(A) Sulphonic acids of the azo dyes derived from diazotised aromatic *o*-hydroxyamino compounds and a monohydroxy derivative of quinoline yield bordeaux to violet-brown shades on chrome mordanted wool. (B) The condensation products obtained by heating a 1.4-quinonoid compound halogenated in the quinonoid nucleus with an oxazine yield vats which dye fibrous material yellow to orange shades fast to chlorine and washing.
—L. A. C.

Ortho[*hydr*]*oxyazo dyes.* W. Herzberg and O. Scharfenberg, Assrs. to A.-G. für Anilinfabr. U.S.P. 1,419,501, 13.6.22. Appl., 30.8.21.

See E.P. 168,681 of 1920; J., 1921, 731 A.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Oxycellulose. E. Heuser and F. Stöckigt. Cellulose-Chem., 1922, 3, 61—74.

The aldehyde character of oxycellulose has been well established for a long time. Of the other characteristics the property of yielding furfural has also been previously recorded. The yield of furfural, however, is not large and only becomes substantial in oxycellulose residues which have suffered large losses in the course of their preparation. Raw cotton had a furfural value of 0·9%, and this was reduced to 0·5%, and even down to 0·3%, by digestion under pressure with water or dilute sodium hydroxide. Oxycellulose preparations generally gave furfural values below 1%; a preparation made with bromine and calcium carbonate showed over 2% and the maximum values, ranging from 2·12% to 3·89% in a very extremely oxidised residue were afforded by oxycelluloses prepared by means of chromic acid. No formation of methylfurfural groups was detected as the result of oxidation. A further characteristic of oxycellulose, definitely established by the authors, is the production of carbon dioxide on distillation with 12% hydrochloric acid; this was determined by Lefèvre's method (*cf.* Meyer, Analyse u. Konstitution org. Verb., III., 587) for the estimation of glucuronic acid. The quantities of carbon dioxide obtained rarely exceeded 1%. Here again, the maximum value of 1·32% was afforded by the highly oxidised oxycellulose prepared by means of chromic acid, while oxycellulose prepared by Knecht's permanganate method yielded 1·04%. As a qualitative test for oxycellulose, Tollens' β-naphthoresorcinol test for glucuronic acid (J., 1908, 716) may be utilised. By digestion under pressure with 1% sulphuric acid, the major portion of the substance which yields furfural and carbon dioxide is split off by hydrolysis, and a barium salt was obtained which showed many of the reactions of glucuronic acid but was not identical with barium glucuronate. This substance is regarded as the "pure" oxycellulose which occurs only in small quantities in combination with a portion of the cellulose in the oxycellulose preparations. It is an aldehyde-carboxylic acid presumably formed by the oxidation of a terminal alcoholic group of a cellobiose residue or of an aldehyde group liberated by simultaneous hydrolysis.—J. F. B.

Paper pulp; Instrument for measuring the degree of beating of ——. E. W. L. Skark. Papierfabr., 1922, 20, 845—852. (*Cf.* J., 1922, 9 A.)

An instrument called a "stuff-spindle" has been devised for testing numerically the degree of beating of paper pulp during its treatment in the hollander. It consists of a hollow metal cylinder terminating at the top in a slender open tube and carrying at the bottom a wire sieve of plain No. 50 mesh with an area of 3·14 sq. cm. (2 cm. diam.). The sieve is easily removable and must be thoroughly cleaned after each operation; it is situated in a recessed chamber of sufficient size to accommodate the cake of thickened pulp which collects on the surface of the sieve. When the instrument is immersed, sieve downwards, in a glass cylinder containing diluted pulp, water enters the cylinder through the sieve at a rate depending on the degree of beating of the pulp and the time is noted during which the instrument sinks to a mark on the tubular stem owing to the percolation of water into the body. In another form of instrument the stem is graduated and the rate of sinking is measured in terms of c.c. of water passing into the float-body in one minute. The pulp is taken from the hollander in a tin measuring vessel, the dry contents of which are determined, and is diluted with sufficient water to give a concentration of 5 g. of fibre substance per 4 litres. If the pulp is loaded an allowance is made for the mineral matter so as to preserve the fibre-concentration constant. The instrument is immersed in the diluted pulp, previously adjusted to 15° C.; the influence of temperature is very important. The instrument is calibrated by substituting for the sieve a thin metal plate, immersing the cylinder in water and running in water from a burette through the tubular stem until the spindle floats at the mark; a volume of 60 c.c. of water is a useful standard for research purposes. For practical purposes the sinking equivalent to 60 c.c. may take too long. The graduated spindle is used in such cases and the distance from the zero point is noted after one minute. The "stuff degree" is defined as the number of c.c. of water passing through the sieve of 3·14 sq. cm. area in one minute at standard fibre-concentration and temperature.—J. F. B.

Sulphite process [*for the production of wood pulp*]; *Chemistry of the* ——. R. N. Miller and W. H. Swanson. Paper, Apr. 19, 1922, 96—104.

The changes that take place during the cooking of sulphite pulp and their relation to the character of the pulp produced have been investigated in a series of experimental cooks conducted under the same conditions of acid strength, temperature, and pressure, and blown at 9, 10, 11, 11½, 12, 12½, and 13½ hrs. respectively. An examination of the pulp and acid liquor at these intervals indicates that, to obtain the best pulp under given conditions of temperature, pressure, and acid strength, the digester should be blown when a sample of the acid liquor shows a maximum value for loosely combined SO_2 (*cf.* J., 1919, 38 A) and a low value for combined SO_2. The Sander reaction (J., 1915, 225; 1921, 256 A) is employed in the analysis of the acid liquor; 2 c.c. of the sample is diluted and titrated with $N/8$ sodium hydroxide using methyl orange as indicator, excess of saturated mercuric chloride solution is added and the solution again titrated to neutrality with $N/8$ alkali. The second titration is a measure of the total SO_2; the difference between the second and first is a measure of the combined SO_2, as shown in the following equations:—

(i) $H_2SO_3+NaOH=NaHSO_3+H_2O$, (ii) $Ca(HSO_3)_2+NaHSO_3+3HgCl_2=Ca(HgClSO_3)_2+NaHgClSO_3+3HCl$. The difference between the figure for total SO_2 determined as above and that obtained by titration with iodine gives an approximate value for loosely combined SO_2, sufficiently accurate, however, for the control of the cook. Determinations of the lignin content of the pulps show that the removal of lignin commences at temperatures little above 100° C. and proceeds with vigour through all intermediate temperatures up to the maximum attained.
—D. J. N.

Sulphite acid; Analysis of reclaimed ——. G. P. Genberg. Paper, Apr. 19, 1922, 122—123.

THE following scheme is suggested for the analysis of reclaimed sulphite acid:—*Total SO_2*: 20 c.c of the acid, withdrawn under pressure, is diluted to 500 c.c. and run from a burette into a known volume of $N/16$ iodine solution until in slight excess, more iodine solution is added to restore the yellow colour, and the end-point finally adjusted after addition of starch. *Sulphur trioxide*: 50 c.c. of acid is evaporated to dryness with an equal volume of hydrochloric acid and the residue boiled with 5 c.c. of hydrochloric acid and 100 c.c. of water, filtered hot, and precipitated with barium chloride. *Calcium sulphite*: to 50 c.c. of sulphite acid, 15 c.c. of 26% ammonia is added, drop by drop, with constant stirring, and, after standing for 10 mins., the precipitated calcium sulphite is filtered off and washed with three 25 c.c. lots of 14% ammonia; the precipitate is then washed into a 500 c.c. flask and, after addition of 5 c.c. of hydrochloric acid, is made up to the mark and titrated against $N/16$ iodine solution as described above. Total lime may be estimated as oxalate on 20 c.c. of the acid liquor after diluting and boiling with hydrochloric acid until free from sulphur dioxide. The lime thus obtained should agree within 2% with that required for the SO_2 and combined SO_2 determined above.
—D. J. N.

Sulphite pulp; Use of rotten and stained wood in the manufacture of ——. E. Sutermeister. Pulp and Paper Mag., 1922, **20**, 513—514.

COMPARATIVE boils using sound wood, wood thoroughly permeated with the threads of dry rot, but still quite hard and firm, and wood stained a greyish-brown colour (often found in spruce logs which have been stored in a very wet condition with the bark on), indicate that, if a high grade of pulp is required, wood affected by dry rot, or stained wood, should not be used, even in admixture with sound wood. The pulp from the rotten wood was found to be weak, poor in colour, and practically impossible to bleach; that from the stained wood was also poor in colour and required 15·5% of bleach as against 8·6% for best selected wood; in both cases the unbleached pulp was full of dark brown shives. Figures for yield show that, whereas rotten wood gives a lower yield of air-dry pulp per cord than does sound wood, staining does not materially affect the yield.—D. J. N.

Copper oxide-ammine-cellulose solutions. Traube. *See* VII.

PATENTS.

Textile fibres; Degumming or preparatory treatment of ——. M. Sabner. E.P. 178,570, 20.1.21.

A CONTINUOUS process is described for degumming textile fibres such as jute, ramie, flax, and the like. The apparatus consists of a series of hollow, disc-like chests arranged around, and in internal communication with, a central supply pipe. These chests are perforated on the underside so that liquid supplied through the central pipe is sprayed on to the fibres, which are laid in an open and straight condition in trays between the chests; the trays are provided with perforated bottoms and imperforate sides, so that the treating liquid continuously passes through the fibres. The whole apparatus is slipped into a digester, and the supply pipe connected by a flexible joint to an inlet pipe passing through the side of the digester; the fibres are then treated with the necessary degumming chemicals, supplied under pressure, steamed and washed without further handling. Liquid is drawn off at the bottom of the digester as required.—D. J. N.

Fibres; Method of protecting animal —— *from the injurious effect of alkaline liquids.* P. Goldberg, P. Onnertz, and A. Peters, Assrs. to Akt.-Ges. f. Anilin Fabr. U.S.P. 1,419,497, 13.6.22. Appl., 15.8.21.

THE addition of sulphite-cellulose waste liquors to alkaline liquids inhibits the injurious effect of the liquids on animal fibres.—L. A. C.

Paper; Method of manufacturing —— *[at high speeds].* W. P. Carpmael. From The Bagley and Sewall Co. E.P. 181,140, 16.3.21.

A STRONG and satisfactory web of paper may be made at high speeds, *e.g.* 1000 ft. per min., on a Fourdrinier or similar type machine, by feeding the water and stock on to the machine under pressure, and providing means whereby the stock, after passing under the slice, accumulates in a pool, through which the rate of flow of the stuff is approximately equal to the speed of the wire. The desired velocity is imparted to the stock by using more water than is usual, and suitably adjusting the pressure head in the flow box. The pool may be formed by extending the apron over the machine wire for a short distance or by placing the slice behind the axis of the breast roll. Difficulty may be experienced when running at high speeds in removing the water from the web; in such cases the suction box end of the wire should be raised to give the water more opportunity of draining away. The main feature of this process is that by maintaining a pool of stock above the wire the fibres become well mixed and give a well felted sheet.—D. J. N.

Cellulose; Treatment of crude ——. C. Harnist. E.P. 156,777, 7.1.21. Conv., 6.7.14.

SEE F.P. 477,895 of 1914; J., 1917, 132. By using potash, or the potassium salt of a weak acid, such as carbonic or sulphurous acid, in the alkaline digestion treatment, residual lyes containing potash, suitable for use as a fertiliser, are obtained.

Viscose silk; Manufacture of ——. E. Bronnert. U.S.P. 1,419,714, 13.6.22. Appl., 30.8.20.

SEE E.P. 170,024 of 1920; J., 1921, 843 A.

Carroting hairs; Process for ——. C. Pichard, Assr. to Pichard Frères. U.S.P. 1,419,754, 13.6.22. Appl., 3.5.21.

SEE E.P. 163,297 of 1921; J., 1922, 541 A.

Spinning artificial threads; Rotary pumps [of the gear type] for use in apparatus for ——. British Cellulose and Chemical Mfg. Co., Ltd., and H. R. A. Mallock. E.P. 181,085, 2.3.21.

Paper stock; Hollanders or similar machinery for cleaning ——. H. W. Southworth. E.P. 181,220, 13.5.21.

Mixtures of starch and sulphuric acid. E.P. 181,197–8. *See* XVII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Patents.

Mercerisation of yarns in hank form [; Machine for ——]. F. J. Copley. E.P. 180,739, 25.2.21.

Hanks of yarn are extended between bobbins permanently attached to a chain which passes continuously through tanks containing the mercerising and washing liquors. Arrangements are provided whereby the bobbins are rotated and the hanks are subjected to tension.—A. J. H.

Furs, feathers, hairs, skins, and the like material; Process for dyeing ——. A. G. Bloxam. From Akt.-Ges. f. Anilin-Fabr. E.P. 180,905, 7.6.21.

Furs and the like are dyed brown shades by treatment with a neutral or feebly alkaline solution of 1.4-diamino-2-chlorobenzene in the presence of oxidising agents. Skins, either unmordanted or prepared with chromium or iron mordants, on treatment at ordinary temperatures in a bath containing, *e.g.*, 2 g. of 1.4-diamino-2-chlorobenzene, 1 g. of ammonia, and 30 g. of hydrogen peroxide per l., are dyed reddish-brown shades; while skins prepared with a copper mordant are dyed an olive tint on similar treatment.—L. A. C.

Bleaching, dyeing, finishing and otherwise treating fabrics; Machines for ——. J. Thornber and A. B. Henshilwood. E.P. 181,552, 19.4.21. Addn. to 122,241.

The patent relates to a removable framework having guiding surfaces for the coiled fabrics, for use in connexion with machines of the type claimed in the chief patent (J., 1919, 132 A).

Dyeing hanks of yarn and the like; [Bearings for agitator spindles of] machines for ——. G. Lee and Sons, Ltd., and G. Pinder. E.P. 181,506, 19.3.21.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sulphuric acid; Modern methods of concentrating ——. P. S. Gilchrist. Chem. and Met. Eng., 1922, **26**, 1159—1162.

A plant consisting of a combination of an over-heat pan and packed tower, of which two 50-ton units have been in operation since 1916, is described. The weak acid is fed into a tower packed with checkered brickwork or quartz and flows thence into a long horizontal bath, about 9 in. deep, contained in the fire flue from an oil burner. A scrubbing tower packed with rings or quartz, and an electrical precipitator are also used. Owing to the effect of surface evaporation the acid leaves the apparatus at 50° F. (28° C.) below its boiling point, which in the case of sludge acid containing carbonaceous matter reduces the loss of acid by reduction, while the moderate tower temperature increases the life of the packing. The fuel consumption is 11 galls. of oil per ton of acid of 66° B. (sp. gr. 1·84) concentrated from 54° B. (sp. gr. 1·598). The outer walls of the towers are built of acid-proof shale brick and silicate cement, lined on the inside with several layers of 1-in. tiles. A variation of this apparatus specially intended for concentrating sludge acid has as its feature the blowing of flue gases at 1200° F. (650° C.) through the acid instead of simple concentration by top heat. The preheated acid is contained in a lead pan lined with acid-proof brick and the gases are blown in through acid-resisting iron pipes. The foaming which occurs through the decomposition of hydrocarbons when the density reaches about 55° B. is avoided by effecting the concentration in two stages in duplicate units. A series of cost estimates for different methods is given.—C. I.

Hydrocyanic acid; Formation of —— from nitrogen and hydrocarbons in the electric arc. A. Koenig and W. Hubbuch. Z. Elektrochem., 1922, **28**, 202—223.

When nitrogen mixed with acetylene, ethylene, or methane is passed through an arc rotating in an electro-magnetic field, hydrocyanic acid is produced. With a relatively slow rate of flow methane gives the largest yield of hydrocyanic acid, 40%, irrespective of its concentration within the limits 2—11%. With methane there is no deposition of carbon. Ethylene and acetylene mixed with hydrogen and nitrogen show definite maxima in the yields at the point where the deposition of carbon commences. Mixtures of acetylene and nitrogen give a maximum yield in the region where there is a heavy deposition of carbon. With more rapid rates of flow the best yields are obtained with acetylene. Very good utilisation of energy and yield of material are obtained when a mixture of 30% of hydrogen and 70% of nitrogen is mixed with 7—8% of acetylene and passed at the rate of 20 litres per hour through the arc, and there is no deposition of carbon. With a rate of flow up to 100 litres per hour the yield from mixtures of nitrogen, hydrogen, and acetylene containing a large excess of nitrogen reaches a maximum of 10—11 g. HCN per kw.-hr. (*Cf.* J.C.S., July.)—J. F. S.

Phosphoric acid; Manufacture of —— in the electric furnace by the condensation and electric precipitation method. T. Swann. J. Ind. Eng. Chem., 1922, **14**, 630—631.

Phosphatic rock, coke, sand, and iron borings are smelted in an electric furnace. A certain portion of the phosphorus which is liberated is absorbed by the iron and is tapped from the furnace as ferro-phosphorus containing 24—25% P. The lime and sand also leave the furnace in combination as a slag, and the remainder of the phosphorus passes through the charge with the furnace gases, which are oxidised by air and drawn out of the furnace into a condensing and precipitating apparatus. The acid as collected is light brown in colour and contains 90—95% H_3PO_4; it is treated for the removal of certain impurities. An exceptionally pure acid may be obtained by crystallisation. A high-grade concentrated acid and ferro-phosphorus are thus produced directly by the electric furnace process at a cost comparable with that of present methods.—G. F. M.

Nitric acid; Economic production of oxidation reactions in factories where —— is synthesised. Applications. C. Matignon. Bull. Soc. Chim., 1922, **31**, 555—561.

It is proposed to use the dilute nitric acid, such as is obtained in the fixation of atmospheric nitrogen or in the oxidation of ammonia, for processes in which the acid can be used as an oxidising agent, providing the consequent reduction of the nitric acid does not proceed beyond the stage of nitric oxide. The oxides of nitrogen can be reconverted into nitric acid by atmospheric oxygen and again absorbed in the towers. In this way there is practically no loss of nitric acid, and thus the expense of the oxidation process is very small. Suggested applications are the preparation of copper sulphate from copper by the combined action of sulphuric and nitric acids, and the oxidation of sugar or molasses to oxalic acid by the action of nitric acid. This latter process was satisfactorily carried through with a cargo of sugar damaged by sea water.—W. G.

Ammonia oxidation; Some economic aspects of ——. G. B. Taylor. Chem. and Met. Eng., 1922, **26**, 1217—1219.

The economic possibility of the oxidation of ammonia for the large-scale manufacture of concentrated nitric acid is discussed, and it is shown that if the costs of nitrogen in the forms of ammonia and of sodium nitrate are on a parity the use of the former is uneconomical, as the high cost of concentrating the relatively weak nitric acid produced offsets other savings. In this calculation the overall efficiency of ammonia oxidation is taken as 90%. In the case of processes requiring weak nitric acid, or merely oxides of nitrogen as in the lead chamber sulphuric acid process, the ammonia process has the advantage.—C. I.

Soda and hydrogen sulphide; Manufacture of —— *from sodium sulphate and coal.* J. Michler. Chem.-Zeit., 1922, **46**, 633—634.

Finely ground sodium sulphate is mixed with finely ground coal and the mixture briquetted. The briquettes are charged into a gas-tight furnace and heated with a mixture of producer-gas with a slight deficiency of air. The charge is kept at a bright red heat until a test shows that less than 1% of sodium sulphate remains undecomposed. The charge is allowed to cool to a dull red and a mixture of steam and carbon dioxide is passed in, whereby the sodium sulphide formed in the first stage is decomposed into carbonate with the evolution of hydrogen sulphide. The issuing gases contain about 30—40 vols. % of hydrogen sulphide and may be utilised for the production of sulphur by the Chance process. The residue contains less than 0·1% of sodium sulphide, and after leaching the solution contains 96% Na_2CO_3 calculated on the total solids. The process is preferably carried out in a series of furnaces, the spent gases from the first stage (which contain some hydrogen sulphide) being used in the second stage, so that by suitable working an economical recovery of sulphur is obtained in gases containing at least 30% of hydrogen sulphide, *e.g.*, by passing the carbon dioxide mixture through the series in such a manner that it first comes in contact with material poor in sulphur. The briquettes emerge from the process in the same shape as they went in and are conveniently porous for leaching.—A. R. P.

Chlorine and hypochlorous acid; Determination of —— *in concentrated salt solutions.* M. C. Taylor and C. A. Gammal. J. Ind. Eng. Chem., 1922, **14**, 632—635.

The determination of free chlorine and hypochlorous acid in concentrated salt solutions which may contain either sodium hypochlorite or hypochlorous acid, is usually carried out by a determination of total "available" chlorine, and then of free chlorine by an aeration process. The latter, however, is inaccurate owing to decomposition of hypochlorous acid or of hypochlorite during aeration. It is now shown that the rate of the removal of the free chlorine is a linear function of the amount present at any moment, whilst when all free chlorine has been removed the rate of removal varies directly as the square of the hypochlorous acid present. The curves obtained, therefore, by plotting the rate of the removal of chlorine against the total amount removed as measured by absorption in potassium iodide and titration with thiosulphate will be two lines having a point of intersection from which a vertical line to the horizontal axis shows the initial amount of free chlorine present. As the actual loss of available chlorine during aeration, due for example to the decomposition $HOCl \rightarrow HCl + O$, is equal to the increase in acidity measured in terms of thiosulphate by means of potassium iodide-iodate solution, a calculation can also be made of the amount of chlorine initially present as hypochlorite or as hypochlorous acid and hydrochloric acid. —G. F. M.

Ammonia; Reactivity of ——. E. C. C. Baly and H. M. Duncan. Chem. Soc. Trans., 1922, **121**, 1008—1014.

The decomposition of ammonia by means of a heated platinum wire gives constant values for the same amount of energy with an active form of the gas derived either by slow evaporation from a cylinder of compressed gas, or by gently heating the concentrated aqueous solution, the gas being dried by quicklime, or by evaporating isothermally at the boiling point the gas obtained by either of these methods. A second "inactive" type, obtained by rapid evaporation of the liquefied gas, gives much smaller decomposition values under the same conditions. On standing in contact with the liquefied gas, or by heating to 200° C. with a platinum wire, this type slowly becomes active. The ratio of the decomposition values obtained by a first and second exposure of the gas to the heated wire differs markedly in the two forms. Addition of water vapour increases the reactivity of ammonia proportionally to the amount of water present, an increase which is lost on drying with quicklime. Hence two different molecular phases of ammonia exist possessing different energy content and reactivities, that of lower energy content being identical with completely dry ammonia. The active and inactive forms of ammonia described differ in the relative amounts of these two phases which they contain. In order to observe these phenomena the platinum wire must be activated as for the Ostwald process for the catalytic oxidation of ammonia in air to nitric acid.—P. V. M.

Sulphuryl chloride; Researches on ——. *II. A new chlorinating agent. Preparation of polychloro-derivatives of benzene.* O. Silberrad. Chem. Soc. Trans., 1922, **121**, 1015—1022.

A solution of sulphur monochloride in sulphuryl chloride in contact with aluminium chloride is a vigorous chlorinating agent, capable of bringing about any degree of chlorination. For purposes of chlorination 250 pts. of sulphur monochloride is run into excess of sulphuryl chloride; 68·2 pts. of this mixture contains 1 g.-equiv. of active chlorine or 0·5 g.-mol. of sulphuryl chloride. The compound to be chlorinated, 1 to 2 mols., plus 5 to 10 g. of finely-ground anhydrous aluminium chloride, is treated with 5 to 10% excess of the chlorinating mixture in a vessel provided with an efficient reflux condenser, the upper end of which is connected with a second condenser loosely packed with asbestos; the two condensers are arranged so that the gases pass up the former and down the latter, the condensate from the second being returned through a trap to the reaction vessel, while the gases evolved are conducted through a valve to a vessel containing water. The reaction mixture is cooled or warmed according to the vigour of the reaction, which is completed by warming for a short time. The product is washed with water and purified by suitable means. The preparation of the polychloro-derivatives of benzene is described. —P. V. M.

Specific heat of gases for calculations concerned with technical heating. Sulphur dioxide. B. Neumann. Z. angew. Chem., 1922, **35**, 367.

The figures previously given (J., 1919, 618 A) for the true specific heat of sulphur dioxide at temperatures between 0° and 3000° C. and the mean specific heat between 0° and *t*° C. (calculated for 1 kg. of gas) are inaccurate. The heading to the second column on the above page of this Journal should be amended by deleting "SO_2" and a new column added giving the specific heat of sulphur dioxide at constant pressure calculated for 1 kg. of gas as follows:

t° C.	0°	100°	200°	300°	400°	500°	1000°	1500°	2000°	2500°	3000°
Sp. heat	0·139	0·148	0·158	0·168	0·177	0·184	0·204	0·2125	0·219	0·225	0·231.

—A. R. P.

Ammonium nitrate; Properties of ——. *II. Ammonium nitrate and water.* I. L. Millican, A. F. Joseph, and T. M. Lowry. Chem. Soc. Trans., 1922, 121, 959—963. (*Cf.* J., 1920, 105 A.)

The depression of the freezing point of ammonium nitrate by water has been determined from 170° to 6° C., from which, together with earlier data, the complete equilibrium diagram from 0 to 100% ammonium nitrate has been plotted. There is a sharp break in the curve at 125° C., but none at 84° C., indicating identical solubilities and temperature coefficients of the α and δ forms of the salt. The extension of the curve below the normal transition point, 32° C., through which the curve passes with only a very slight break, represents the freezing points of its metastable phase.—P. V. M.

Ammonium nitrate; Properties of ——. *III. Ammonium nitrate and sodium nitrate.* R. G. Early and T. M. Lowry. Chem. Soc. Trans., 1922, 121, 963—969.

The freezing point curve of ammonium nitrate and sodium nitrate from 9 to 49% of sodium nitrate consists of three rectilinear sections corresponding with the separation of the ε and δ forms of ammonium nitrate and one form of sodium nitrate. The crystallisation curve of ammonium nitrate prolonged backwards cuts the temperature axis at 156° C., a similar value being obtained from the freezing point curve of ammonium nitrate and silver nitrate, indicating that temperature as the melting point of the metastable δ-ammonium nitrate. The eutectic point for ammonium nitrate and sodium nitrate lies at 120·8° C., corresponding to 20·5% of sodium nitrate. No evidence of isomorphism has been observed.—P. V. M.

Gypsum; Conversion of —— *into ammonium sulphate.* C. Matignon and M. Fréjacques. Comptes rend., 1922, 175, 33—35.

The authors obtained a 96% yield of ammonium sulphate in the interaction of a commercial sample of gypsum with ammonium carbonate (*cf.* Neumann, J., 1921, 692 A). The curves giving the velocity of the reaction show the existence of two distinct phases, during the first of which the velocity is lower than in the second. The presence of ammonium sulphate in the original solution causes a diminution in the velocity of the reaction, but in all cases equilibrium is reached at the end of 2¼ hours.—W. G.

Potash felspar; Melting of ——. G. W. Morey and N. L. Bowen. Amer. J. Sci., 1922, 4, 1—21.

Pure synthetic crystals of potash felspar, prepared by crystallising a glass of the composition $KAlSi_3O_8$ in a bomb with water vapour, when rapidly heated appear to melt to a clear glass at about 1200° C. If kept at this temperature for some days, however, microscopical examination reveals the presence of a crystalline framework of leucite ($KAlSi_2O_6$), which, at higher temperatures, becomes more distinct, eventually melting at about 1530° C. The first appearance of this decomposition was noticed at 1170° C. Similar results are obtained with natural potash felspars, but the temperatures at which melting begins and finishes are modified by the presence of impurities. The petrogenic significance of the results is discussed with reference to the formation of the leucite-granite porphyry of Brazil and the syenite laccolith at Loch Borolan in Scotland.—A. R. P.

Sodium perborate; Electrolytic preparation of ——. K. Arndt and E. Hantge. Z. Elektrochem., 1922, 28, 263—273.

Sodium perborate is best prepared by the electrolysis of a solution of 120 g. of anhydrous sodium carbonate and 30 g. of borax per litre at 14°—16° C., using an anodic current density of 10—20 amp. per sq. dm. The yield is increased by the addition of 0·5 g. of sodium chromate and one drop of Turkey-red oil per litre. These substances eliminate cathodic reduction of the perborate. A bright platinum anode is used, and the cathode is a length of water-cooled tin tubing. The solution must be kept free from platinum or iron compounds, for these substances reduce the yield. Increase in temperature also decreases the yield. During the electrolysis there is a loss of carbon dioxide, and if this is not replaced the current yield becomes very poor. (*Cf.* J.C.S., Aug.)—J. F. S.

Chlorites; Oxidation and reduction reactions with ——. G. R. Levi. Atti R. Accad. Lincei, 1922, 31, I., 370—373.

In most of its reactions sodium chlorite exhibits oxidising properties, but towards ozone it acts as a reducing agent. (*Cf.* J.C.S., Aug.)—T. H. P.

Permutite; Dependence of the equilibrium of bases in —— *on the concentration of the surrounding solution.* A. Günther-Schulze. Z. Elektrochem., 1922, 28, 85—89.

The equilibrium between the solid permutite and the bases in the solution for the cases of silver-ammonium, copper-ammonium, and lanthanum-ammonium at 22° C. is in all probability in keeping with the law of mass action.—J. F. S.

Copper salts; Determination of complex formation in aqueous solutions of —— *by means of permutite.* A. Günther-Schulze. Z. Elektrochem., 1922, 28, 89—99.

The formation of complexes in solutions of copper chloride, acetate, formate, sulphate, chlorate, nitrate, and bromide has been investigated by shaking known concentrations of the salts with pure potassium-permutite. The complex cation CuR is present in practically all the solutions of copper salts examined even at the greatest dilution. The complex Cu_2R_2 is present only in the chloride and bromide solutions, whilst with the other salts probably a higher complex is formed, though not in great amount. The complexity of copper salt solutions increases at constant concentration with the strength of the acid and is greater with the salts of the halogen acids than with the salts of oxygen acids of equal strengths.—J. F. S.

Alkaline copper oxide solutions and copper oxide-ammine-cellulose solutions. II. W. Traube. Ber., 1922, 55, 1899—1912. (*Cf.* J., 1922, 97 A.)

The reaction between copper ethylenediamine-hydroxide and glycerol probably takes place in accordance with the following equation, where en = ethylenediamine:—

$$2CH_2(OH)\cdot CH(OH)\cdot CH_2(OH)+2[Cu(en)_2](OH)_2 = [Cu(en)_2](O\cdot CH_2\cdot CH(OH)\cdot CH_2O\cdot)_2Cu+4H_2O+2(en).$$

The isolation of the compound,

$$[Cu(en)_2](O\cdot CH_2\cdot CH(OH)\cdot CH_2O)_2Cu,$$

in an almost homogeneous condition is described. The conclusions thus reached in the studies with glycerol can be extended to other polyhydroxy substances, notably cellulose. The ability of copper oxide-ethylenediamine-cellulose solutions to dissolve further quantities of copper oxide depends on the liberation of the ethylenediamine; the behaviour of Schweizer's solution may be explained similarly. The difference between the behaviour towards polyhydroxy compounds of the copper bases and those of the metals, silver, cobalt, nickel, zinc, and cadminum is accounted for, since only the former is able to form complexes in which the metallic atom is fixed directly to the hydroxy group of the polyhydroxy compound. An uncertainty appears to exist in the case of cobalt, according to the literature, the precipitation of this metal from its solutions as hydroxide by means of alkali is hindered by the presence of glycerol in the same manner as is the precipitation of copper hydroxide from copper solutions; the exception is only apparent, however, since the cobalt hydroxide is present in the colloidal state (and not as the glycerate) and can be precipitated completely by barium sulphate.—H. W.

Copper sulphide; Structural formula for ——. W. Gluud. Ber., 1922, 55, 1760—1761. (*Cf.* J., 1922, 370 A.)

If hydrogen sulphide is passed into a 1·5% solution of copper sulphate in ammonia (10%) until only a faint blue colour remains, a variety of copper sulphide is precipitated which yields elementary sulphur on immediate oxidation with air, whereas after preservation for 4—5 hrs. it is oxidised to copper sulphate or thiosulphate. It is suggested that the formulæ, Cu:S and Cu$_2$S:S, are to be assigned to the two modifications. This conception is in harmony with the known tendency of copper sulphide to pass into cuprous sulphide. The modification which yields free sulphur does not give potassium thiocyanate when treated with potassium cyanide; this reaction is shown strongly by the other variety. The changes may be expressed as follows: (1) $2CuS+10KCN=K_6Cu_2C_8N_8+2K_2S+C_2N_2$, and $C_2N_2+H_2O=HCN+HCNO$. (2) $Cu_2S_2+8KCN=K_6Cu_2C_8N_8+K_2S_2$ and $K_2S_2+KCN=K_2S+KCNS$. —H. W.

[Chromic] oxides; Hydrous ——. H. B. Weiser. J. Phys. Chem., 1922, 26, 401—434. (*Cf.* J., 1920, 781 A.)

From a study of various hydrous chromic oxides prepared in different ways, it is concluded that no definite hydrates of chromic oxide are formed by precipitating a chromic salt with alkali. The evidence that Guignet's green is a definite hydrate is inconclusive. The respective properties of positively and negatively charged colloidal suspensions of hydrous chromous oxides, more especially the precipitating and peptising action of alkali salts, are discussed. (*Cf.* J.C.S., Aug.)—J. S. G. T.

Lead oxides; Effect of grinding upon the apparent density of ——. O. W. Brown, S. V. Cook, and J. C. Warner. J. Phys. Chem., 1922, 26, 477—480.

The apparent density of heavy crystalline lead oxide is diminished initially by grinding, the minimum value being attained by grinding for about 10 hrs. in a pebble mill making 50 revs. per min. Thereafter the apparent density increases, rapidly at first, to a constant value greater than the initial value. The initial decrease of apparent density is not shown by a light amorphous lead oxide. By fine grinding, oxides suitable for the manufacture of storage battery plates can be produced from oxides which in their original state are worthless for this purpose.—J. S. G. T.

Banded structures. Synthesis of banded minerals. S. S. Bhatnagar and K. K. Mathur. Kolloid-Zeits., 1922, 30, 368—371.

Banded structures in agates, sandstone, pisolithic and oolithic structures are produced in the same manner as the Liesegang rings in gels. Artificial agates may be prepared as follows: 12·5 g. of sodium silicate in 100 c.c. of water is treated with a 10% solution of ammonium acetate; within 10 secs. a transparent gel is produced. Before the addition of the acetate, the silicate solution is mixed with hydrogen sulphide, sodium phosphate, potassium ferrocyanide, or potassium iodide, depending on the colour of the bands desired. After the gel is formed a solution of ferric chloride or mercuric chloride is added and left to diffuse into the gel, when the banded structure is produced. The gel is then dehydrated by pressure and gentle heating and eventually reaches a hardness of 5, and is in every way similar to natural agate. Banded sandstone is produced by adding 10 c.c. of 2·27*M* sodium silicate solution and vigorously centrifuging the mixture. A weak solution of sodium carbonate and a 10% solution of ammonium acetate are added, and after 12 hrs. the sand has become cemented by the silicic acid gel. The mass is then placed in a 10% solution of cobalt nitrate and left for some time, when bands of cobalt carbonate are produced throughout the mass.—J. F. S.

Platinum; Recovery of —— from used contact mass at the Old Hickory Powder Plant. A. L. Kibler. J. Ind. Eng. Chem., 1922, 14, 636—641.

The contact mass consisted of fused grained magnesium sulphate impregnated with platinum. It was first treated with hot water to dissolve out the soluble portions, and after allowing to settle, the insoluble sludge, consisting of platinum together with iron rust, insoluble magnesium salts, sand, gelatinous silicic acid, etc., was separated by means of a Sharples supercentrifuge. The sludge was then concentrated by digestion with weak hydrochloric acid and again centrifuged, and the concentrated sludge extracted with *aqua regia* and the extract evaporated to dryness two or three times with hydrochloric acid. The platinic chloride formed was dissolved out of the dry residue by two or three treatments with dilute hydrochloric acid, and the platinum was precipitated from the clear solution as ammonium chloroplatinate. The mother liquor was siphoned off, the precipitate washed several times with alcohol, and finally centrifuged and dried. The dry salt was then converted, by roasting in crucibles in a muffle furnace to a temperature of 1300° F. (700° C.), into platinum sponge. The platinum from the waste acid and alcohol liquors was recovered by precipitation with zinc, solution in *aqua regia*, and subsequent purification as above. In all 8812 oz. troy of platinum sponge of about 94% purity was recovered from 343,241 lb. of contact mass.—G. F. M.

Amorphous precipitates and crystalline sols. F. Haber. Ber., 1922, 55, 1717—1733.

Crystalline or amorphous solid masses are obtained by supersaturation processes which may be considered to occur in two distinct phases, the formation of aggregates and the re-arrangement of such aggregates, with loss of free energy, into ordered lattice formations. These considerations, if applied to the production of very sparingly soluble substances, show that if the rate of aggregation is high and as far as possible in excess of that of arrangement, amorphous precipitates are to be expected which gradually, particularly on warming, pass into the crystalline condition. If, however, the rate of aggregation is depressed by only slightly exceeding the solubility limit, the rate of arrangement may be sufficiently high to cause the orderly formation of crystals before visible particles have separated. This, however, involves an alteration in the rate of aggregation due to electrical phenomena at the boundary of the molecules and liquid, the net result of which is that the growth of the aggregates is greatly impeded and sols are produced. These theoretical predictions are confirmed by the behaviour of the precipitates and sols of aluminium and ferric hydroxides, which, however, are to be regarded as furnishing the ideal case from which deviations may be expected in two directions. If the rate of arrangement is greater, it will not be possible to obtain the precipitates in the amorphous condition and to retain the latter during the Röntgen exposure. The rate of arrangement may be expected to be at its maximum in binary, heteropolar compounds in which the dipolar character is most marked (illustrated by the cases of the silver halides and the sulphides of mercury, zinc and cadmium). On the other hand, with molecules in which the dipolar character is not strongly accentuated, the tendency towards the formation of amorphous sols and precipitates must be more marked; this is illustrated experimentally by the cases of the hydroxides of zirconium and thorium and of arsenic sulphide.—H. W.

Hydrogen desorbed from platinum and palladium; Some properties of ——. P. Anderson. Chem. Soc. Trans., 1922, **121**, 1153—1161.

Experiments were undertaken with a view of determining whether activated hydrogen instantaneously lost its activity on desorption or whether it had a finite period of decay. It was found that the temperature of incipient reduction of both copper oxide and sulphur was distinctly lower with highly purified hydrogen which had passed through a catalytic mass of palladium previous to coming into contact with the material, than with the same hydrogen which had not traversed the palladium. The first formation of water from the oxide was detected by means of the fall in resistance of a granule of calcium chloride placed in the unknown gap of a Wheatstone bridge, and occurred at temperatures between 103° and 115° C. with several runs with ordinary hydrogen, and at 81°—87° C. with activated hydrogen. Similarly the first formation of hydrogen sulphide occurred at 112°—118° C. in the former case and 80°—83° C. in the latter. The freshly desorbed gas was also found to be ionised to some extent, as it accelerated the rate of discharge of a gold leaf electroscope. It is improbable that the slight ionisation can be the cause of the increased activity of the element, and theories of atomic hydrogen or triatomic hydrogen are also rejected on experimental grounds. The author inclines to the view that the activation is due to an increase in the internal energy of the hydrogen molecules themselves.—G. F. M.

Potassium sulphate, aluminium sulphate, water at 25° C.; The system ——. H. T. S. Britton. Chem. Soc. Trans., 1922, **121**, 982—986.

The isothermal diagram of the system potassium sulphate, aluminium sulphate, water shows three branches, each branch representing saturated solutions in equilibrium with potassium sulphate, alum, and hydrated aluminium sulphate respectively. The range of composition of solutes of saturated solutions in equilibrium with alum diminishes considerably with rise of temperature.—P. V. M.

Sulphite acid. Genberg. *See* V.

Adsorption of iron by manganese dioxide. Geloso. *See* XXIII.

Patents.

Phosphoric acid; Production of ——. A. Kelly. E.P. 181,255, 15.7.21.

Mineral phosphate is pulverised and roasted at such a temperature that all the organic matter contained therein is destroyed, and active decolorising carbon remains evenly distributed through the mass. On withdrawal from the furnace the product is reduced to powder and then treated in the known manner with sulphuric acid for the direct production of colourless phosphoric acid.—H. R. D.

Prussic [hydrocyanic] acid; Manufacture of ——. Deutsche Gold- u. Silber-Scheide-Anstalt vorm. Roessler, and O. Liebknecht. E.P. 181,058, 7.2.21.

A gas mixture containing carbon, nitrogen, and hydrogen, *e.g.*, a mixture of 5% of carbon monoxide, 18% of methane, 34% of hydrogen, and 43% of nitrogen, is heated in a high-tension arc at pressures above atmospheric, whereby an increased yield of hydrocyanic acid is obtained.—C. I.

Pulverous material [e.g., for fixing nitrogen]; Process for agglomerating ——. C. T. Thorssell and O. Troell. E.P. 181,413, 2.2.21.

A mixture which is required in a granular form, *e.g.*, the mixture of alkali carbonate and carbon for the synthesis of cyanide from atmospheric nitrogen, is wetted and then passed through three series of rotating cylinders. In the first it is dried by fire gases to a moisture content necessary for agglomeration, emerging as soft irregular masses; in the second the granulation is completed, the moisture being kept constant by admission of steam; in the last the granules are dried. The steam and dust from the last-mentioned apparatus are returned to the one before. The fire gases travel in the same direction as the material in order to avoid combustion of the carbon.—C. I.

Ammonia; Method for the catalytic oxidation of —— *with oxygen.* I. W. Cederberg and H. M. Bäckström. E.P. 181,486, 15.3.21.

The oxidation of ammonia gas by oxygen in mixtures containing up to 35—40% of ammonia is carried out without overheating or risk of explosion by the use of a series of catalytic masses in which the concentration of the catalyst (*e.g.*, platinum) successively increases. These masses, *e.g.*, plates of pumice, are separated from each other by nettings of nickel or other inactive material held within nickel rings, which serve to dissipate the heat of reaction.—C. I.

Bicarbonate of soda and ammonium chloride; Processes for production of ——. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des. Proc. G. Claude. E.P. 160,172, 15.3.21. Conv., 17.3.20.

The object of this invention is to avoid certain drawbacks of the processes described in E.P. 131,870 (J., 1920, 266 A). The process now described, which is characterised by the presence of ammonium carbonate in excess in the liquids throughout the series of operations, comprises the following successive steps: The mother liquor, from which sodium bicarbonate has been precipitated, and containing ammonium carbonate in excess, is cooled to 5° C. to remove ammonium chloride. Sodium chloride and gaseous ammonia are then added to the liquor in quantities corresponding to the amount of sodium bicarbonate it is desired to produce and precipitate. Sufficient carbon dioxide is passed into the solution to transform the sodium chloride and free ammonia into equivalent amounts of ammonium chloride and sodium bicarbonate. The bicarbonate is separated, thus leaving a mother liquor which is cooled to 5° C. for the removal of ammonium chloride. The cycle of operations is then repeated.—H. R. D.

Ammonia; Synthesis of ——. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des. Proc. G. Claude. E.P. 161,195, 6.4.21. Conv., 7.4.20.

When catalyst tubes for ammonia synthesis are cooled, *e.g.*, by a bath of molten lead as described in E.P. 155,302 (J., 1922, 371 A), they are liable to burst owing to the internal strains set up. It is proposed therefore to insulate the tubes, *e.g.*, by asbestos or enamel, in such a way as to maintain the walls at a uniform temperature, and this end is further secured by an electrical heating resistance in the insulation. Progressive mixing of cold gases with the hot gases from a heat exchanger takes place in the catalyst chamber, or the entering gases are allowed to circulate around the insulated catalyst tube, in such a way that the walls of the chamber are kept as cool as possible and the gases reach the tube at the minimum reaction temperature. The gases leave the catalyst tube at a temperature which may exceed 400° C. and the reaction can thus be maintained almost up to the end of the column.—C. I.

Caustic alkali; Eliminating colour from ——. T. C. Meadows and H. D. Ruhm, Assrs. to Eastern Potash Corp. U.S.P. 1,415,186, 9.5.22. Appl., 25.1.19.

Fluid concentrated caustic alkali is subjected to the bleaching action of an electric current.—T. H. Bu.

Earthy minerals that in native deposits are stained by colouring matters that render them useless for industrial purposes; Process for bleaching ——. A. J. Stubbs. E.P. 181,132, 12.3.21.

The finely divided mineral, *e.g.*, kaolin, barytes, felspar, bauxite, is placed in a vessel filled with water, together with pieces of iron, platinum, or, preferably, zinc, and the water is then saturated with sulphur dioxide. The sulphurous acid is reduced to "hyposulphurous acid," with liberation of oxygen which alters the degree of oxidation of the colouring substances and renders them soluble, leaving the mineral of a pure white colour.
—H. R. D.

Calcium hypochlorite; Process for rendering —— *stable.* Chem. Fabr. Griesheim-Elektron, and H. Reitz. E.P. 181,153, 23.3.21.

Calcium hypochlorite is mixed with purified sodium chloride, free from magnesium chloride, both substances being in a dry, finely ground state, and the proportions being such that 100 pts. of the mixture contains at least 10 pts. of active chlorine. The mixture can be moulded by slight pressure and made into permanent preparations.—H. R. D.

Carbon; Manufacture of pure retort ——. I. Szarvasy. E.P. 159,823, 28.2.21. Conv., 29.1.18.

See U.S.P. 1,392,266 of 1921; J., 1921, 816 A.

Hydrogen. E.P. 181,062. *See* IIA.

VIII.—GLASS; CERAMICS.

Clays; Influence of small additions of electrolytes on the stability of clay suspensions, and the use of these in the purification of ——. H. Kohl. Ber. Deuts. Keram. Ges., 1922, **3**, 64—77.

To Zettlitz kaolin, freed from salts by washing, and suspended in water, was added *N*/10 sodium carbonate or *N*/10 sodium silicate, and the whole well mixed by shaking. Photographs of the suspensions, after 3 weeks, showed that, with increasing amounts of electrolyte, the amount of suspended material increased up to a definite maximum, after which further additions of electrolyte caused clarification. Very small percentages of calcium sulphate in the clay reduce the stability of the suspension. Sodium silicate is more efficient than sodium carbonate, and an excess of it is less harmful. The presence of soluble or colloidal silica is unnecessary when the clay contains a protective colloid such as humic acid. Clays containing soluble salts—particularly those of magnesium and calcium—are not suitable for purification by the addition of electrolytes unless these salts are first removed or rendered insoluble. Any clay, provided it does not contain too much soluble salts, shows an optimum degree of suspension, with a definite electrolyte at a definite concentration. Whether the separation of the particles of clay from the water in which they are suspended should be effected by means of electro-osmosis or by filtration or other means is a purely economic matter; it does not in any way affect the quality of the product. Quartz particles are usually too large to remain in suspension, but the smallest ones are capable of being suspended with the aid of an electrolyte, the optimum results being obtained with 0·208% Na_2CO_3 or 0·5%Na_2SiO_3. Hence, the finest particles of quartz are electro-negative, and behave like clay. A cataphoresis test showed that these particles pass to the anode, like clay, and cannot be separated from it by osmosis. Felspar behaves in a similar manner. Mica, when sufficiently finely divided, behaves with electrolytes like clay. A mixture of 70% of kaolin and 30% of mica, when treated with the optimum proportion of sodium carbonate, produced a suspension containing 80% of kaolin and 20% of mica, showing that most of the mica is retained in suspension with the clay. A cataphoresis test showed that finely divided mica passed wholly to the anode, precisely like clay, so that the finest particles of mica cannot be separated from clay, either by sedimentation or by electro-osmosis. Pyrite can, to a large extent, be separated from clay by elutriation or washing. Extremely minute particles of pyrite which remained in suspension in distilled water for 1½ days were flocculated by sodium carbonate and silicate, and also by sulphuric acid. A mixture of kaolin and these fine particles of pyrite settled in 2 hrs., and a suspension of kaolin, to which 0·5 g. of pure ferrous sulphate was added, in solution, flocculated and settled in 6 hrs. A cataphoresis test of a mixture of 80 g. of kaolin and 7 g. of pyrite effected no separation. It appears to be impossible to separate the most finely divided pyrite from clay. The occurrence of such finely divided pyrite is, however, improbable; it would rapidly be oxidised to sulphate. Ferric oxide, when sufficiently finely divided, is completely absorbed by the clay suspension, and, on electro-osmosis, it is deposited, along with the clay, on the anode. Only relatively coarse particles of silica, mica, and iron compounds can be separated from clay. No electrolyte is necessary for this separation, but its use is convenient, as it facilitates the suspension of the clay, and so makes the subsequent treatment easier. In the so-called purification of clay by electro-osmosis, the whole of the "purification" occurs in the preliminary settling tanks. The electrical treatment does not effect any further purification. At the same time, the smaller amount of space and water required when an osmosis machine is used (as compared with a filter-press) is noteworthy.—A. B. S.

Rational analysis [of ceramic materials] as a method of works control. R. Rieke. Ber. Deuts. Keram. Ges., 1922, **3**, 24—30.

Although the rational analysis of ceramic materials is not suitable for scientific investigations on account of its uncertainty, it is useful as a means of control of manufacturing processes. Some of the published methods of estimating the "clay substance" are critically reviewed. Clay substance is decomposed by heating it to 575° C., with evolution of water, forming free silica and alumina. The latter is readily soluble in hydrochloric acid if the calcining temperature has not exceeded 800° C. The amount of clay may be estimated from the water evolved on ignition or from the amount of soluble alumina formed. This method assumes that "clay substance" from all sources corresponds exactly to $Al_2O_3,2SiO_2,2H_2O$, which is not strictly the case, though the results of determinations of loss on ignition made on samples dried at 110° C. are sufficiently accurate for technical purposes, especially if checked by a determination of the alumina soluble in acid. The only source of error is the presence of organic matter, which is included in the loss on ignition. For repeated tests on clay from the same source, this error is practically constant; it is not affected by an estimation of the clay substance from the soluble alumina. As a rapid method, the author recommends Kallauner and Matejka's method: 2 g. of the sample is ignited for one hour at 750° C. in an electric furnace, and the product is heated in a water bath with 100—150 c.c. of sulphuric acid (1:1) for 3 hrs. So little of the silica enters into solution that it may be neglected and the alumina and traces of iron oxide are precipitated with ammonia, filtered off, ignited, and weighed. If a properly dried sample is available, an estimation can be completed in 6—7 hrs. Calculations of the clay substance based on (*a*) loss on ignition, (*b*) silica in ignited material soluble in 5% caustic soda solution, and (*c*) alumina in ignited material soluble in acid, showed that (*a*) and (*c*) agreed well, but (*b*) gave only about half the quantity, from which the author concludes that only one molecule of silica is liberated on ignition, and that, possibly, the clay substance is decomposed into Al_2O_3,SiO_2+SiO_2.—A. B. S.

irebricks; Determination of the compressive strength of —— at high temperatures. E. Sieurin, F. Carlsson, and B. Kjellgren. Ber. Deuts. Keram. Ges., 1922, 3, 53—64.

AN ordinary refractoriness test and chemical analysis are not sufficient to determine the value of firebricks, particularly those made largely of grog. A normal mixture of 1 pt. of blue clay and 4 pts. of fireclay was ground with water in a ball mill until it passed completely through a 250-mesh sieve. Part of the powder was burned at cone 14, crushed, and separated into grog between 4- and 20-mesh, and grog finer than 7-mesh. Equal parts of grog and the fine raw clay were mixed, made into cubes of 30 mm. side, and fired at cone 14. The cubes were ground accurately to shape, and the "refractoriness under load" determined. This was defined as the temperature at which the cube contracted 0·3% after heating for 2 hrs. under a pressure of 2 kg. per sq. cm. (28 lb. per sq. in.). Similar cubes, but containing varying percentages of silica, alumina, ferric oxide, lime, and magnesia, were also examined. On increasing the silica the minimum refractoriness under load occurred with 60—70% of silica, whereas the minimum refractoriness without load occurred with 90% of silica. On increasing the alumina the refractoriness under load increased steadily up to 80% of alumina, when the test-pieces failed suddenly, probably because there was not sufficient binding clay present. An increase of only 0·64% in the iron oxide (original content of Fe_2O_3 0·89%) reduced the refractoriness under load by 50° C.; with further increase of iron oxide the refractoriness diminished more slowly and remained almost constant between 6 and 12% of iron oxide, after which a further increase caused a further rapid loss of refractoriness. An increase in the lime-content showed a steady and rather rapid loss of refractoriness under load, an increase of only 0·11% of lime (original content of CaO 0·68%) reducing this refractoriness by 25° C. The effect is less noticeable with coarse grog. Magnesia behaves similarly to lime, but the effect of very small percentages of magnesia is greater.—A. B. S.

Refractory materials; Determination of the softening temperature of —— under load. W. Steger. Ber. Deuts. Keram. Ges., 1922, 3, 1—4.

THE test-piece, in the form of a small cylinder, is supported on a refractory cylinder of electrode carbon, 6 cm. diam., and heated in a vertical cylindrical electric resistance furnace, 8 cm. diam., internally, with an e.m.f. of 100—120 volts. A second (hollow) carbon cylinder stands on the test-piece and is provided at its upper end with a plate to which the pressure from a scale-pan carrying weights of 20—100 kg. is transmitted through a simple system of levers. The small movement of the last lever in the series is marked on a rotating drum by means of a light index, about 1 m. in length, which magnifies it 20 times. The hollow carbon cylinder enables the top of the test-piece to be inspected and its temperature to be measured by an optical pyrometer or a thermo-electric couple.
—A. B. S.

Porcelain; Testing of ——. R. Rieke and M. Gary. Ber. Deuts. Keram. Ges., 1922, 3, 5—23.

A CONSIDERATION of the various methods of determining the compressive, tensile, and transverse strengths of materials showed that the following modifications are desirable in applying them to porcelain: Tensile strength.—Instead of the usual flat 8-shaped test-piece, a circular one, 3 in. (7·5 cm.) long and 20 mm. diam. at the middle, corresponding to a cross-sectional area of 3 sq. cm. at the breaking point, is used. The test-pieces are roughly moulded and dried to a black-hard condition, after which they are turned accurately to shape, and burned. They are tested in an ordinary tensile test machine, but the clips are placed at right-angles to each other and are lined with thin copper plates to allow for any irregularities in the test-piece and to ensure its breaking at the centre. Compressive strength is determined in a Gary press in which a disc 10 cm. diam. and 1 cm. thick is supported on a steel ball, 31·7 mm. diam., and pressure applied to it through a second similar ball. The results are calculated to correspond to a disc 1 mm. thick. Transverse strength is determined on a cylindrical test-piece, 120 mm. long and 16 mm. diam., made by extrusion, burnt whilst hanging in a vertical position, and afterwards sawn to the correct length. The test is made in a Frühling-Michaelis apparatus, the test-piece being supported on steel knife edges exactly 10 cm. apart, and loaded centrally. The load is increased at the rate of 1 kg. per sec. Brittleness or resistance to shock is determined in Rudeloff's apparatus, fitted with a Schopper's pendulum impact device, consisting of a pendulum mounted on ball bearings and fitted at its upper end with an indicator to show the angle through which it rotates before its lower end strikes the test-piece. The latter is a rod 120 mm. in length and 16 mm. in diam. The pendulum is raised to a pre-arranged height, and, in falling, it breaks the test-piece and swings forward. The tensile and compressive tests show the most characteristic results, the latter giving figures proportional to, but much larger, than the transverse and brittleness tests. For the determination of porosity an aqueous solution of Brilliant Green is recommended. The sealed pores are estimated by comparing the apparent density of the pieces weighing about 20 g. and the sp. gr. of the finely powdered material. This method ignores the microscopic sealed pores in the minute particles of powder. No relationship between the percentage of sealed pores and the results of other tests could be established. Microscopical examination is used to detect variations in the proportion of unaltered quartz, in the size of the quartz grains and of the pores. The relationship of micro-structure and physical properties needs further investigation, and possibly a microscopical examination may render the other and more tedious tests unnecessary. The results of tests on eight samples of German porcelain (composition not stated) are tabulated. —A. B. S.

Porcelain; Translucency of ——. W. Steger. Ber. Deuts. Keram. Ges., 1922, 3, 50—53.

Hard porcelains of normal composition, made of materials of normal fineness, with low clay-content (40%), and burned at a high temperature (cone 15), vary greatly in translucency, as measured by a photometer. Those containing Norwegian quartz are three times as translucent as those with quartz sand or Taunus geyserite. With a rather higher clay-content (50%) the porcelains containing Norwegian sand are twice as translucent as those with quartz sand, and four times as translucent as those with Taunus geyserite.—A. B. S.

Ceramic tiles; Cold glazes [on cement] and comparison of Kerament slabs with ——. C. Tostmann. Ber. Deuts. Keram. Ges., 1922, 3, 31—41.

Kerament slabs are composed of concrete covered with a glaze by Friedrich's process (G.P. 298,378; *cf.* E.P. 154,236; J., 1919, 47 A). Comparison of purchased slabs of Kerament (each 15×15×1 cm.) with white earthenware tiles (each 14·5×14·5×0·8 cm.) with a transparent glaze, showed that the glaze on the tiles was much harder than the Kerament "glaze"; the latter could easily be scratched with a finger-nail. The porosity after soaking in boiling water was 6·7% for Kerament slabs, and 0·08% for tiles. The samples saturated with water, were exposed 15 times to frost (–15° C.) for 4 hrs., and raised to room temperature after each exposure. All the samples passed this test perfectly. The average transverse strength of the Kerament slabs was 50 kg., that of the earthenware tiles 117 kg., equivalent to a modulus of rupture of 65 and 187 respectively. The samples were laid on a bed of sand and a weight of 0·5 kg. dropped on them from various heights up to 30 cm.; the average resistance was 0·14 m.-kg. for the Kerament slabs, and 0·09 m.-kg. for the tiles. The Kerament slabs were only feebly resistant to acids and were completely destroyed by dilute mineral acids, and attacked by dilute acetic acid, and hence would not be weather-proof. The Kerament "glaze" was too soft to resist any ordinary abrasion, and the surface was not only rough enough to allow any kind of writing upon it, but such writing could be removed. The glazed earthenware tiles, on the contrary, could not be written on, except in a few instances, and, in these, the writing was easily obliterated. The surface of the Kerament slabs could easily be removed by an ordinary wet scrubbing brush, whilst the earthenware tiles were unaffected by such treatment. Kerament slabs are only suitable for situations in which they are protected from all chance of injury, and even then they are far less durable than tiles. Moreover, patina gradually forms on them, and renders them unsightly. The so-called cold glazes may form a substitute for paint, but they cannot in any way replace the glaze on ceramic wares. —A. B. S.

[Opaque] glazes; Zirconium fluoride ——. F. Kraze. Ber. Deuts. Keram. Ges., 1922, 3, 157—161.

Low-temperature glazes, free from lead and boron, rendered opaque by zirconium fluoride, are particularly suitable for fireclays and other porous bodies low in lime. Zirconium compounds do not produce a good opaque white glaze in the absence of fluorides, except at inconveniently high temperatures. The glaze recommended is made from a mixture of sodium silicofluoride, cryolite, soda ash, orthoclase, felspar, quartz, barium peroxide, and zircon, in proportions corresponding to the following formula:—(0·323 Na_2O, 0·412 Na_2F_2, 0·214 K_2O, 0·051 BaO) 0·412SiF_4, 0·234 Al_2O_3, (3·029 SiO_2, 0·184 ZrO_2). In the formula the maximum permissible proportion of zircon is used; part of this may be replaced by cryolite, if desired. In each case, a portion of the kaolin (0·02 mol.) is added after the other materials have been fritted and ground. The fritting must be continued until no more gas is evolved, after which the frit is run into a tank, and allowed to cool slowly; it is then mixed with the reserved amount of clay and ground in a ball-mill. The glazed ware must be placed in the kiln in such a manner that any vapours evolved may readily escape, or the glaze will be soluble in water. The optimum glazing temperature is cone 05a (1000° C.). As enamels on iron, these zircon fluoride glazes are particularly useful, on account of their great elasticity and the rapidity with which they may be fired and cooled.—A. B. S.

Ceramic colours; Constitution of some ——. R. Rieke and W. Paetsch. Ber. Deuts. Keram Ges., 1922, 3, 147—156.

Mixtures of various metallic oxides, in the proportions $1RO:1R'_2O_3$ to $4RO:1R'_2O_3$, were heated for an hour to 600°, 700°, 800° and 1350° C., respectively. The unaltered oxides were separated, and the residual products analysed. It was found that in each case definite compounds of the formula RO, R'_2O_3 were formed, many of them having a characteristic colour, and being very suitable for use as under-glaze colours. Chromites are very stable under glaze, but aluminates and ferrites are dissolved by the molten glaze. With the chromite colours, a glaze with a high alumina content is advantageous, but a high lead content is harmful, causing a partial formation of chromate.—A. B. S.

Patents.

Kilns for clayware; Appliance for the regular and certain firing of top-fired continuous and chamber —— by mechanical means. J. Procter. E.P. 181,090, 3.3.21.

Small coal is fed into the kiln through two or more feed-holes at a time from a central hopper provided with the requisite number of pipes, each pipe containing a screw-conveyor. The hopper is provided with two vertical screw-conveyors, which propel the coal downward through apertures controlled by slides. The rate at which the coal enters the kiln is regulated by adjusting the slides.—A. B. S.

Glass tubes, rods or like bodies; Continuous manufacture of —— [by imparting a rotary movement to the glass during its flow]. Naaml. Vennoots. Philips' Gloeilampenfabrieken. E.P. 172,289, 9.11.21. Conv., 2.12.20.

Glass manufacture [; Press moulding machines for ——]. E. A. Hailwood. E.P. 181,434, 5.3.21.

Bleaching earthy minerals. E.P. 181,132. *See* VII.

IX.—BUILDING MATERIALS.

Concrete pavements; Use of pit-run gravel and excess sand in ——. R. W. Crum. Amer. Soc. Testing Materials, June, 1922. [Preprint.] 10 pp.

Tables of sieving results and graphical representations of numerous tests (compression, transverse and "wear") show that concrete made from pit-run gravel gives results which on the average are closely comparable with those for concrete of the less varied proportions arbitrarily used. As advantages for pit-run mixtures it is claimed that (1) the use of certain coarse aggregates, otherwise unsuitable, is possible; (2) By basing cement required on maximum sand content a factor of safety is provided when sand content drops. Sieve analyses show that lack of uniformity in concrete is no worse with pit-run than with screened aggregates.—J. B. P.

Patent.

Magnesite; Method of treating —— [*for manufacture of oxychloride cements*]. R. D. Pike. E.P. 180,837, 6.4.21.

The free or water-soluble lime in magnesite is reduced to 3% or less by calcining the magnesite, preferably in a rotary kiln, at 800°—950° C., then passing it into a cooler, in which its temperature is reduced to 500°. The product is then treated with a gas (such as lime-kiln gas or flue gases) containing carbon dioxide and a little moisture, which re-carbonates the lime, and renders it insoluble. By this means, a magnesite which would be useless for the production of oxychloride cements (as free lime is injurious) is made capable of producing such cements of first-class quality.—A. B. S.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Blast furnace practice; Little known difficulties occurring through "sulphur-misery" in ——. A. Killing. Stahl u. Eisen, 1921, 42, 968—971.

A furnace yielding an iron with 0·02% of sulphur suddenly began giving an iron with 0·2%. Tough masses of material appeared in front of the tuyères, but were worked away with the aid of bars. After a large number of such difficulties occurring and after changing the tuyères and blowing in sand with the blast and finally removing all deleterious materials such as briquettes, cinders, etc. from the charge, the furnace hearth became clear. Two samples of the slag which had worked into the tuyères gave 5·14% and 4·76% sulphur respectively on analysis. Other tests showed 4—5% of sulphur and the slag remained infusible until the sulphur was lowered below 3%. It is therefore stated that the highest sulphur content permissible in the slag should be 2·5—2·8%. The sulphur in the charge should not exceed 4%.—J. W. D.

Blast furnaces; Processes in gas producers and ——. H. von Jüptner. Z. physik. Chem., 1922, 100, 231—237.

The direct reduction of iron oxide by carbon in the blast furnace is advantageous, for it involves a reduction in the amount of fuel used, but the process is slow. In the electric blast furnace better results are obtained with porous wood charcoal than with the denser coke, and also the fluid condition of the charge accelerates the reduction.—J. F. S.

Cementite; Transformation of —— *at* 210° *C.* G. Tammann. Stahl u. Eisen, 1922, 42, 772—775.

The lines representing the heat content, electrical resistance, and coercivity of steel with different percentages of carbon show a change in direction at the eutectic point. This might be due either to differences in crystal type between pearlitic and primary cementite or differences in grain size. As the magnetic transformation of cementite always takes place at 210° C. and the magnitude of the change increases linearly with the carbon content, the former explanation cannot be the true one. The differences in heat content of pearlitic and primary cementite can only be explained by differences in grain size. Compressing cementite increased the magnitude of the change on loss of magnetisation. On cooling cementite through 210° C. no heat of transformation was detected but a diminution of volume of 0·071 cub. mm. for 1 g. of material. Hence at ordinary temperatures cementite does not interlock closely with the ferrite groundmass. It is possible that by suitable additions the change point could be depressed below ordinary temperature and close interlocking thus produced.—T. H. Bu.

Steels; High-temperature tests on special ——. H. Edert. Stahl u. Eisen, 1922, 42, 961—968.

The tests were carried out on two nickel-chrome steels containing, respectively, C 0·31%, Ni 1·90%, Cr 1·53%, and C 0·21%, Ni 4·03%, Cr 1·69%, a nickel-chrome vanadium steel containing C 4·37%, Cr 2·38%, V 0·58%, and two nickel-chrome steels containing C 0·12%, Ni 1·49%, Cr 15·8% and C 0·28%, Ni 5·76%, Cr 20·6% respectively. The first three were oil-hardened and tempered, the fourth oil-hardened from 900° C. and oil-tempered from 650° C., and the fifth oil-hardened from 1200° C. before testing. Tensile tests were carried out up to 700° C., Brinell hardness tests to 300° C., bending tests to 800° C., and notched bar tests to 700° C. The product of tensile strength and elongation gave high values for all the steels. The increased tensile strength observed in carbon steels between 200° and 300° C. was not noted in these steels. A rapid falling off in strength occurred in the first three steels (pearlitic steels) between 300° and 500° C., but in the higher chromium steels only above 500° C. The higher chromium steels were still bright but slightly yellow after the testing at 700° C. The first three steels possessed a considerable resistance to continued reversal of stress (bending tests) and also to single heavy blows (notched bar tests); they worked easily, especially the first two, and could be used up to 500° C., especially in high-speed machine parts where lightness is essential. The properties of the fourth steel were very similar, and this steel also had great resistance to oxidation and chemical action. It could be used at temperatures up to 600° C. The fifth steel possessed the above properties to a lesser degree, was easily polished, and resisted wear well. At a bright red heat it could be worked similarly to a tool steel and in the cold it could be pressed and drawn fairly well.—J. W. D.

Iron and steel; Influence of molecular concentration on immersion tests on the corrosion of ——. D. M. Strickland. Chem. and Met. Eng., 1922, 26, 1165—1169.

In actual service conditions the corroding medium is generally in excess of the ferrous metal and the molecular concentration remains more uniform than in long period experimental tests. Experiment shows that in a long period test the corrosion of a comparatively resistant metal may approach equality with that of a less resistant metal, owing to the exhaustion of the attacking medium by the latter. Figures are given showing the corrosion rates of iron and steel in various solutions, the solutions being renewed at varying periods. The weight losses were found to be absolutely dependent on the solution strength, and in conducting corrosion experiments it is recommended that all the test-pieces be immersed in one tank of ample capacity, so that the reacting chemical will be present in excess of the ferrous metals. Circulation of the liquor should be provided for, and the results obtained from short period immersions are considered more in line with actual service conditions than are the results from more protracted experiments. Although the experiments primarily show the effect of molecular concentration of the corroding solution, commercially pure iron appears more resistant to corrosion than steel or coppered steel.—C. A. K.

Vanadium; Analytical chemistry of —— with special reference to the investigation of steel works materials. H. Briefs. Stahl u. Eisen, 1922, 42, 775—778.

A process for the separation of chromates and vanadates is described, consisting in the precipitation of vanadium from a boiling solution by means of zinc oxide, the chromate in solution not being affected. The best results were obtained by a double precipitation with zinc oxide. The determination of chromium and vanadium takes 1¼ hr. The method of precipitating quinquevalent vanadium with cupferron (nitrosophenylhydroxylamineammonium) was carefully investigated and accurate determinations of vanadium were made. Cupferron was applied to the analysis of ferrovanadium, and is specially suitable for the separation of quinquevalent vanadium from chromic salts, only one precipitation being necessary. The procedure for the analysis of a chrome-vanadium-tungsten steel is given, involving the use of either the ether process or the barium carbonate process and subsequently separating the chromium and vanadium either by zinc oxide or cupferron.—T. H. Bu.

Chromium in steels; Determination of ——. L. Losana and E. Carozzi. Giorn. Chim. Ind. Appl., 1922, 4, 197—200.

For the determination of chromium in steels good results are obtained by gravimetric methods, but these are too lengthy for industrial use; the employment of colorimetric methods is not recommended. Satisfactory results are yielded by Stead's volumetric method, if certain precautions are taken. In this method the metal is attacked with dilute sulphuric acid (not exceeding 30% in strength) and the solution oxidised with a little nitric acid, boiled until red vapour disappears, diluted to about 500 c.c and boiled for 20 minutes with a large excess of potassium permanganate, the excess of the latter being reduced by addition of a few pieces of filter paper; the paper is found to exert no reducing action on the chromic acid. The liquid is filtered through either asbestos or an alundum crucible under pressure and the chromic acid treated with ferrous sulphate, the excess of the latter being titrated with permanganate. The following modification of the ammonium persulphate method renders it exact and very rapid. The metal is dissolved in nitric acid of sp. gr. 1·2, or, if the content of chromium is high, in 20% sulphuric acid, and the solution diluted and oxidised by means of 20 c.c. of 6% ammonium persulphate solution in presence of silver nitrate, the liquid being boiled until it becomes yellow; if this operation is slow it may be hastened by introduction of a few pieces of filter paper into the liquid. The cold solution is mixed with 25 c.c. of concentrated nitric acid and excess of standard arsenite solution, the excess of arsenite being then estimated by titration with permanganate solution.—T. H. P.

Vanadium in steel; Colorimetric determination of ——. **A. Kropf. Z. angew. Chem., 1922, 35, 366—367.**

A solution of 0·2 g. of a steel containing less than 0·5% V, or 0·1 g. of one containing more, in 3—5 c.c. of a mixture of 9 vols. of sulphuric acid (1:5) and 1 vol. of phosphoric acid (sp. gr. 1·2), is oxidised with 1 c.c. of nitric acid (1:1), boiled, cooled, boiled again after addition of 1 c.c. of 10% ammonium persulphate solution, cooled once more, and transferred to a Nessler tube. 1 c.c. of 3% hydrogen peroxide solution is added and the liquid diluted to 20 c.c. The colour is compared with that obtained by adding known amounts of a standard vanadium solution to a synthetic steel solution of approximately the same content in chromium and nickel as the test, and made by dissolving 0·2 or 0·1 g. of plain carbon steel in the above manner and adding the requisite amounts of standard chromium and nickel sulphate solutions. The vanadium standard is made by dissolving the commercial oxide in caustic potash, acidifying with sulphuric acid, determining the vanadium content of the solution volumetrically and diluting it until 1 c.c. = 0·00005 g. V.—A. R. P.

Dephosphorisation slags; The accessory elements of ——. A. Demolon. Comptes rend., 1922, 174, 1703—1706.

Determinations have been made on a number of slags of the amounts of calcium soluble in different solvents. The solvents used were distilled water, 5% sugar solution before and after calcining the slag, 2% phenol, a neutral solution of ammonium humate, cold solutions of ammonium chloride of different strengths, a saturated solution of carbon dioxide, and mineral acids. The amount of free lime in the slags was small, varying from 1 to 3%. In all the solvents the amount of calcium going into solution increased at first very rapidly with the time of shaking and then only very slowly over a long period of time. This is considered to be due to the presence of calcium silicates which react slowly with the solvents. The amount of magnesium oxide present in the slags varied from 3 to 15%, with an average of 8·9%. The amount of manganese was fairly constant at about 4—5%, which was easily soluble in 2% citric acid.—W. G.

Copper-silicon-aluminium alloys; Physical properties of some —— when sand-cast. E. H. Dix, jun., and A. J. Lyon. Amer. Soc. Testing Materials, June, 1922. [Preprint.] 17 pp.

Tensile tests and micrographic examination were made on a series of aluminium alloys containing 2, 4, and 6% Cu, together with 3, 6, and 9% Si, and also on alloys containing 1% Mn, 2% Cu, and 3, 6, and 9% Si, and the results are reproduced in a series of graphs and photomicrographs. The best physical condition is obtained if the alloys contain from 3 to 5% each of copper and silicon; the lower the copper between these limits the better is the elongation, while if the copper is near 5% and the silicon about 3% the machining qualities are improved. Manganese increases the tensile strength but reduces the elongation, without increasing the tensile strength at high temperatures; with the plain copper-silicon-aluminium alloys the tensile strength decreases very little up to 600° F. (315° C.). The microstructures of these alloys show eutectics of $CuAl_2$ and aluminium and of aluminium and silicon. The iron impurity appears to be present in two forms, as light grey needles of $FeAl_3$ and as irregular grey masses of the so-called "X" constituent. A sixth constituent consisting of bluish-grey cubes has also been noticed in these alloys.—A. R. P.

Lead; Determination of —— in metallic lead by the permanganate method. Y. Odajima. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, **25**, 270—271.

The sample (2·5 g.) is dissolved in 20 c.c. of dilute nitric acid (1:4); silver, if present, is removed by adding dilute ammonium chloride. The solution is diluted to 200 c.c., filtered, and made up to 500 c.c., to 50 c.c. of which 20 c.c. of saturated oxalic acid or ammonium oxalate solution is added, and then 10 c.c. of acetic acid, with vigorous shaking. After a few hours the lead oxalate is filtered off, washed, and decomposed with dilute sulphuric acid (1:4), the solution diluted to about 200 c.c., heated to 70°—80° C., and the liberated oxalic acid titrated with standard permanganate solution.—K. K.

Metals; Effect of temperature on some of the properties of ——. F. C. Lea. Inst. Mech. Eng., 15.6.22. Engineering, 1922, **113**, 829—832.

In view of the extended use of metals under conditions where they are exposed to high temperatures, *e.g.*, in high-pressure boilers and internal combustion engines, the effect of this treatment on the physical properties of some important metals and alloys has been determined. In the case of "Armco" iron (0·02% C, 0·013% P, 0·043% Mn, and 0·03% S) the ultimate strength falls from 24 tons per sq. in. at −40° C. to a minimum of 19 tons at 0°, then rises in a straight line to a maximum of 39 tons at 220° C., after which it falls to below 2 tons at 850° C. and rises again to 3 tons at 950° C. The elongation decreases from 27% at −50° C. to 13% between 100° and 220° C., then rises to maxima at 400°, 675°, and 800° C., falling to minima at 600°, 730°, and 900° C., at which latter points the metal is very brittle. It is important, therefore, to forge this material at as near 800° C. as possible. The critical points of the metal are at 767° C. and between 880° and 900° C., corresponding with increased brittleness. The elastic limit remains constant to 200° C., then rapidly falls to about one-third of its former value, while the modulus of elasticity decreases regularly with increasing temperature. Carbon steels containing up to 1% C show a similar increase in tensile strength up to a maximum between 220° and 300° C., depending on the carbon content. Similar tests on various steel alloys show that temperatures below 250° C. have no deleterious effects on their tensile properties, but above 350° C. a serious falling off in the elastic properties takes place. Copper-aluminium alloys, on the other hand, while nearly as strong as steel at ordinary temperatures, are considerably less so at 250° C.
—A. R. P.

Metals; Preparation of some special —— by Goldschmidt's aluminothermic process. I. T. Fujibayashi. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, **25**, 499—511.

An intimate mixture of dried trimanganic tetroxide with 15—20% of its weight of manganese dioxide or sesquioxide, and 90% of the theoretical amount of powdered aluminium was used for the preparation of pure carbon-free manganese. A yield of 85—90% or more of the theoretical was obtained of a purity of 95—97%, the remainder being aluminium, iron, and silicon. For the preparation of pure carbon-free chromium a mixture of chromium sesquioxide with 10—15% of its weight of calcium chromate, and 90% of the theoretical amount of powdered aluminium was heated at 300°—400° C. and reduced as usual. The yield was 85—92% and the purity of the product 95—97%, the remainder being aluminium. Ferrochromium containing about 60% Cr was prepared from a mixture of green chromium oxide with 10—15% of its weight of calcium chromate, the theoretical quantity of black iron oxide, and 85—90% of the theoretical weight of powdered aluminium. The yield was 85—90% of the theoretical, and the product contained 5—8% Al. All the materials for the process should be dried at 200°—300° C., used while still hot, and thoroughly mixed.—K. K.

Metals; Phenomena of diffusion of solid —— and cementation of non-ferrous metals. II. Cementation of copper by means of chromomanganese. G. Sirovich and A. Cartoceti. Gazz. Chim. Ital., 1922, **52**, I., 436—442.

The cementation of copper by chromomanganese containing 30·4% Cr and 63·8% Mn has been studied by means of the arrangement previously used (*cf.* J., 1922, 17 A). The chromium does not penetrate the copper, but it influences the migration of the manganese to a much greater extent than the iron of ferromanganese does. (*Cf.* J.C.S., August.)—T. H. P.

Tellurium-lead and tellurium-antimony-lead alloys. M. Dreifuss. Z. Elektrochem., 1922, **28**, 100—101, 224.

When lead is added to molten tellurium in small quantities, a little of the tellurium alloys with the lead, but a large portion forms a slag containing both elements. Tellurium has a deoxidising action on lead, so that the alloy may be heated to redness without the surface losing its brightness. Tellurium and antimony form a continuous series of mixed crystals, and alloys containing tellurium and lead may be prepared by mixing tellurium with molten antimony, and adding to the molten alloy thus obtained first small quantities of antimony-lead alloy and eventually pure lead. A stiff pasty mass is obtained which on heating to 700° C. melts and does not readily lose its bright surface. In the same way small quantities of tin and copper alloy with the antimony-tellurium alloy. The addition of 2% of tellurium to lead-antimony alloys has no marked effect on the hardness. The addition of 5—6% of tin to antimony-lead alloys produces much more desirable properties than does tellurium.—J. F. S.

Uranium; Qualitative test for ——. H. D. Buell. J. Ind. Eng. Chem., 1922, **14**, 593.

Uranium may be detected in slags or ores by preparing a nitric acid solution of the material, too great an excess being avoided, and adding an excess of granulated zinc. When the reaction with the acid has subsided a yellow deposit will appear on the zinc if uranium is present. Gold, platinum, thorium, lead, tungsten, titanium, chromium, mercury, and copper do not interfere with the test. Iron and vanadium interfere only when present in large quantities, and in that case the spent liquid is removed and the zinc and the deposit are again treated with nitric acid. The deposit dissolves, but reappears when the acid is again exhausted, and vanadium and iron remain in solution. The test is not applicable in the presence of sulphuric or hydrochloric acids. The yellow deposit is apparently the hydrated trioxide $VO_3,2H_2O$.—G. F. M.

Bismuth and cadmium; Solubility in the solid state of —— in lead. C. Di Capua. Atti R. Accad. Lincei, 1922, **31**, I., 162—164.

The solid solubility of lead in bismuth is 4% and that of bismuth in lead 34%. For lead in cadmium or cadmium in lead the solid solubility is practically zero.—T. H. P.

Minerals; Heavy liquids for the separation of ——. E. Clerici. Atti R. Accad. Lincei, 1922, 31, I., 116—118.

For the mechanical separation of minerals of different densities, the following colourless liquids, which may be diluted and are recoverable, are recommended: Aqueous barium bromomercurate solution, sp. gr. 3·11 at 11° C., 3·14 at 18° C.; saturated aqueous thallium formate solution, sp. gr. 3·31, 3·40, and 4·10 at 10°, 20°, and 50° C. respectively; aqueous solution of thallium formate and thallium malonate in equal proportions, sp. gr. 4·0, 4·7, and above 5 at 10°, 50°, and about 100° C., respectively. Fused thallium formate, either alone or mixed with fused thallium malonate, may also be used. A solution of powdered thallium carbonate in fused thallium formate has sp. gr. above 5.—T. H. P.

Patents.

Copper alloys; Process of manufacture of ——. O. von Rosthorn, Assee. of A. Heller. E.P. 158,882, 4.2.21. Conv., 4.2.20.

A more uniform quality of bronze for electrical purposes is produced by the use of an intermediate alloy containing about 1 pt. of tin, 3 pts. of cadmium, and 2 pts. of copper. Final adjustment of the composition is obtained by the addition of an auxiliary alloy consisting of equal parts of tin and aluminium, or of tin and magnesium (or cadmium). —C. A. K.

Non-ferrous metal articles having an electrically insulating and mechanically adhesive coating. Producing an electrically insulating and mechanically adherent coating on metal articles. F. Krupp A.-G. E.P. (a) 168,592, 11.8.21, and (b) 172,620, 25.11.21. Conv., (a) 3.9.20, (b) 13.12.20.

(a) Non-ferrous metal articles are pickled by treatment with a 5—10% solution of mineral acid or 10% solution of iron chloride, and then immersed in a bath, heated to 80°—100° C., composed of an aqueous solution of potassium permanganate acidified with sulphuric acid, and containing in addition a small amount of iron, lead, silver, or similar metallic salts. These latter may likewise be added to the pickling solution. (b) In the production of the adherent coating in accordance with (a), the loose layer simultaneously produced is not removed, but saturated with a drying oil, *e.g.*, linseed oil or resin solutions. If desired, the thickness of the loose layer deposited may be increased by adding a soluble organic compound, *e.g.*, sugar, to the pickling solution.—J. S. G. T.

Magnetic separators. H. H. Thompson and A. E. Davies. E.P. 178,587, 27.1.21.

One or more arcuate or segmental stationary armature pieces are arranged partially to surround a drum or ring and concentric therewith. The armature pieces can be adjusted radially so as to vary the air gap formed with the drum or ring, and also adjusted circumferentially according to the material under treatment. The material may be fed on to the separating drum or ring through slots in the armature pieces.—T. H. Bu.

Metallurgical furnaces; Gas-fired ——. South Metropolitan Gas Co., and D. Chandler. E.P. 178,722, 22.4.21.

The furnace is of the reverberatory type, the products of combustion being led in through the roof and tangentially to the hearth. After flowing over the hearth in one direction they flow back in the opposite direction over a sloping floor leading to the hearth and thence to a flue passing beneath the floor, but stopping short of the hearth.—T. H. Bu.

Shaft furnaces, especially blast furnaces; Process for the working of ——. E. Diepschlag. E.P. 180,395, 11.2.21.

Dust-like fuel, ores, mouth-dust and the like, are supplied to the smelting zone of the furnace through drop-feed pipes leading to the air nozzles. The height of the column of material in the feed pipes is such that the pressure exceeds that in the furnace. The operation of the furnace can be simply controlled by variation of the air supply and adjustment of slide-valves or the like in the feed pipes.—J. W. D.

Shaft-furnaces, gas producers, and the like; Feeding of fine materials to ——. E. Diepschlag. E.P. 180,396, 11.2.21.

Fine substances, *e.g.*, fuel, or ore and fuel, are introduced into the mouth of the furnace as part of a charge and are carried away by the furnace gases to a collector, where they are dried by the heat of the furnace or by heat from an outside source such as a hot current of waste gases from metallurgical furnaces or gas engines. The dryer, in the form of a tube with a revolving screw conveyor, or a revolving drum, may be inserted in the waste gas flue of the furnace.—J. W. D.

Blast furnace operations; Process for conveying the mouth-dust and other fine ores in ——. E. Diepschlag. E.P. 180,397, 11.2.21.

Air or gas under pressure is used to transport the materials, which are of such a degree of fineness that the gas forces a passage through and loosens the mass, and carries the material forward. The apparatus consists of a closed receptacle, a delivery pipe having an inlet adjacent to the bottom of the receptacle, and an outlet at the point of discharge, and means for introducing a gas under pressure into the receptacle. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 132,523 and 135,842.)—J. W. D.

Open-hearth furnace device. A. Arthur. U.S.P. 1,414,451, 2.5.22. Appl., 7.2.21.

A gas slag pocket and an air slag pocket are separated by a partition provided with a series of tortuous paths, from which an air passage leads to openings on each side of a gas port. The paths may be used alternately.—T. H. Bu.

Metals from their compounds; Methods of extraction of ——. P. Freedman and E. Greetham. E.P. 180,384, 26.1.21.

The compounds are fused and reduced in a direct current arc furnace in an atmosphere of inert gas or gases, such as argon or helium. The furnace is so constructed that it can be exhausted to a high degree of vacuum before introducing the inert gas. The compound to be reduced, *e.g.*, the oxide of zirconium, cerium, uranium, or other rare metal, is contained in a crucible of refractory conducting material, *e.g.*, tungsten, which serves as anode, and the compound under treatment is rendered conductive by being heated in an arc formed between the wall of the crucible and the cathode (a rod or block of tungsten or other suitable material), or between an auxiliary anode and the cathode. The inert gaseous atmosphere in the furnace is continually changed, the gases being drawn out of the furnace into an external reservoir and returned to the furnace after passing through purifying devices to remove active gaseous impurities.—J. W. D.

Ores or metallurgical products; Preparatory treatment of ——. O. Imray. From Jackson and Co. E.P. 180,968, 27.4.21. Addn. to 172,356 (J., 1922, 107 a).

After the nitrate roast, as described in the chief patent, the hot ore is sprayed with a solution of, or mixed with, a solid, metal halide, *e.g.*, sodium chloride, and the roasting is continued for a further short period.—A. R. P.

Lead-bearing mattes and the like; Treatment of ——. F. E. Elmore, and The Chemical and Metallurgical Corp., Ltd. E.P. 181,239, 11.6.21.

Lead-bearing mattes or products consisting essentially of metallic sulphides are pulverised and treated with a hot concentrated chloride solution (*e.g.*, sodium chloride), which has been acidified with hydrochloric or sulphuric acid, or with an alkali bisulphate. The filtered solution contains all the lead and a proportion of the silver present, which are recovered by known methods. The method is particularly applicable to "leady-copper mattes."—C. A. K.

Metallic values from slag; Recovery of ——. H. V. Welch, Assr. to International Precipitation Co. U.S.P. 1,414,491, 2.5.22. Appl., 7.9.20.

The slag is brought into contact with a halidising agent in the presence of an oxidising atmosphere at a sufficiently high temperature to cause the metals in the slag to vaporise in the form of halide compounds.—T. H. Bu.

[*Zinc*] *ore briquette.* D. B. Jones. U.S.P. 1,415,094, 9.5.22. Appl., 3.6.18.

The briquette is composed of zinc ore, a reducing agent, and bauxite as binder.—T. H. Bu.

Metallurgical apparatus. J. Lund. U.S.P. 1,415,183, 9.5.22. Appl., 8.8.18.

A molten bath of metal is maintained in a chamber to which heat can be applied both from above and below. Solid material and molten slag are fed simultaneously into the chamber, and the protective coating of molten slag may be supplied, maintained, or withdrawn as desired.—T. H. Bu.

Metal scavenging alloy; Process of making and using ——. H. G. C. Thofehrn (D. H. McLean, administrator), Assr. to Light Metals Co. U.S.P. 1,415,733, 9.5.22. Appl., 2.2.20.

Ferro-uranium and aluminium are melted together, and the molten material separated from the slag and allowed to cool.—T. H. Bu.

Iron and steel; Process for rust-proofing articles of ——. E. P. Andrews. E.P. 181,399, 2.12.20.

See U.S.P. 1,362,213 of 1920; J., 1921, 88 A. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 862 of 1876, 94 of 1897, 15,852 of 1912, and 129,831.)

Iron or steel; Process of making ——. L. P. Basset. U.S.P. 1,419,801, 13.6.22. Appl., 4.6.19.

See E.P. 130,610 of 1918; J., 1921, 588 A.

Molybdenum metal or iron molybdenum alloys; Process for the manufacture of ——. Ampère-Ges.m.b.H., F. Rothe and O. Diefenthäler. E.P. 160,143, 12.3.21. Conv., 12.3.20.

See G.P. 337,961 of 1920; J., 1921, 663 A.

Electric furnaces. E.P. 170,848. *See* XI.

XI.—ELECTRO-CHEMISTRY.

Graphite; Electrical conductivity of compressed ——. E. Ryschkewitsch. Z. Elektrochem., 1922, 28, 289—298.

Bavarian graphite has the highest electrical conductivity of all varieties of graphite. The specific conductivity of graphite increases with increasing pressure according to a hyperbolic law. All varieties of graphite approach a common value of 0·0075 ohm for the specific resistance with increasing pressure. The relation between the specific resistance, y, and the pressure, x, is expressed by the formula, $y = a/x + 0{\cdot}0075$, where a is a constant. —J. F. S.

Alkali chloride; Model apparatus for the electrolysis of —— *with mercury cathodes.* A. von Antropoff. Z. Elektrochem., 1922, 28, 298—300.

A glass apparatus, for demonstrating the electrolysis of solutions of alkali chlorides, is described. —J. F. S.

Carbon monoxide-oxygen cell with glass as electrolyte. H. Kallmann. Z. Elektrochem., 1922, 28, 81—85.

The emf of cells containing various mixtures of carbon monoxide, carbon dioxide, and oxygen on one side of a glass wall and air on the other, have been determined at 717° C. and under pressures of 800—920 mm. The values obtained agree to 0·9% with the theoretical values calculated from the equation

$$E = 1{\cdot}118 - 0{\cdot}0707 \log p_{CO_2}/p_{CO}\cdot p_{O_2}^{\frac{1}{2}}$$

—J. F. S.

Electrochemical oxidation of organic compounds. E. Müller. Z. Elektrochem., 1922, 28, 101—106.

The assertion of Fichter (J., 1922, 20 A) that his views on electrochemical oxidation and those of the author are in agreement is not true. Whilst the author assumes the discharge of anions, Fichter supports the primary formation of oxygen and the accompanying purely chemical oxidation. He also assumes the intermediate formation of peroxides or per-acids, but does not explain how they are formed and decomposed. Such per-compounds may be prepared chemically, but their decomposition is to some extent different from what would be expected if they are formed at the anode and form the products of electrolysis. The author accepts the formation, by the discharge of anions, of intermediate hydroxy-compounds, which decompose in a manner in keeping with facts, and which present a mechanism for both chemical and electro-chemical oxidation.—J. F. S.

Phosphoric acid. Swann. *See* VII.

Sodium perborate. Arndt and Hantge. *See* VII.

Hydrocyanic acid. Koenig and Hubbuch. *See* VII.

Lead oxides. Brown and others. *See* VII.

Rapid electrolysis. Edgar and Purdum. *See* XXIII.

Patents.

Electric furnaces. Det Norske Aktieselskab for Elektrokem. Ind. Norsk Ind.-Hypotekbank. E.P. 170,848, 24.10.21. Conv., 1.11.20.

An electric furnace is provided with a continuous electrode, either hollow or channelled longitudinally, manufactured according to E.P. 116,853 and 137,811 (J., 1918, 429 A; 1920, 374 A). Conducting material is fed into the furnace through the electrode, and current passing between the material and the electrode is employed to bake the electrode. The internal cross-sectional dimensions of the furnace are small compared with the diameter of the hollow electrode. The funnel or crater at the lower end of the electrode forms a roof over the region of great heat development. Coke, or similar material, and ore to be treated are charged round the electrode, and air or other oxidising gas blown into the charge at a suitable height, the resulting carbon monoxide being used to preheat a further charge.—J. S. G. T.

Electrolyte; Storage battery ——. F. de W. Cheney. E.P. 181,630, 26.7.21.

An electrolyte for use in storage batteries is prepared by dissolving 4 oz. of sodium phosphate in 1 quart of water, and adding 1 quart of chemically pure sulphuric acid.—J. S. G. T.

See also pages (A) 576, *Electrical precipitation* (E.P. 170,601); *Electrical gas purifiers* (E.P. 181,284). 589, *Hydrocyanic acid* (E.P. 181,058). 590, *Eliminating colour from caustic alkali* (U.S.P. 1,415,186). 596, *Insulating coatings on metals* (E.P. 168,592 and 172,620).

XII.—FATS; OILS; WAXES.

Alligator and crocodile oils. S. Kobayashi. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, 25, 691—703.

The oil obtained from a north African alligator (*Alligator mississipiencis*) by boiling was a light yellow liquid having a peculiar fishy odour and deposited a large quantity of stearine on standing. Its characters were: Sp. gr. (15°/4° C.) 0·9285; iodine value (Wijs) 159·1; acid value 1·2; saponification value 189·2; n^{20}=1·4795; unsaponifiable matter 0·73%. The fatty acid bromide from the saponified oil yielded 20% of solid acid on distillation by Grün and Janko's method; 25·1% of highly unsaturated acid (iodine value 367·6) was obtained by Tsujimoto's lithium salt acetone method. The debrominated acid from the ether-insoluble polybromide (12%) appeared to consist of a mixture of arachidonic and clupanodonic acids. The debrominated acid (iodine value 308·0, neutral. value 165·7, n^{20} 1·4888) from the petroleum ether-insoluble bromide (7%) had the composition $C_{22}H_{34}O_2$, and gave on hydrogenation an acid of m.p. 76°—76·5° C. and neutral. value 165·1. The lower unsaturated acids consist mainly of oleic and palmitic acids with small quantity of lower fatty acids. The unsaponifiable matter (0·7%) is mainly cholesterol. Crocodile oil from an African crocodile (*Crocodilus niloticus*) was a solid fat at room temperature, having sp. gr. (40°/4° C.) 0·8989; m.p. 30°—33° C.; acid value 2·1; saponification value 195·4; iodine value 60·3; n^{40} 1·4602; and unsaponifiable matter 0·97%. The lead salt ether method yielded about equal quantities of a liquid acid (iodine value 92·6) and a solid acid (m.p. 52·5°—53° C., iodine value 6·1), the former consisting mainly of oleic acid and the latter of palmitic and stearic acids. A small quantity of highly unsaturated acid was also present.—K. K.

Shark, ray, and chimæras liver oils. M. Tsujimoto. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, 25, 252—270.

The specific gravities (15°/4° C.), saponification, iodine (Wijs), and acid values, refractive indices at 20° C., quantity of unsaponifiable matter, melting points of fatty acids, quantity of fatty acid polybromides, and bromine contents of polybromides have been determined on the liver oils from the following sharks, rays, and chimæras. *Sharks:* Tobi-mizuwani, *Carcharias owstoni* (Garman); Kiku-zame, *Echinorhinus brucus* (Bonnaterre); Koma-mizuwani, *Carcharias ferox* (Risso); Itachi-zame, *Galeocerdo tigrinus* (M. and H.); Mejiro-zame, *Carcharias gangeticus* (M. and H.)?; a shark the name of which has not yet been determined, probably a species of Abura-zame; Shimaneko-zame (striped cat-shark), *Heterodontus zebra* (Gray); Tsumari-tsuno-zame, *Squalus mitsukurii* (Jordan and Snyder); Shiro-zame, *Cynias griseus* (Pietschmann); Kirinoto-buka, *Orectolobus japonicus* (Regan); Eiraku-buka, *Galeorhinus japonicus* (M. and H.); Ushimi-zuwani, *Carcharias taurus* (Rafinesque); and Koro-zame, *Squatina nebulosa* (Regan). *Rays:* Yamato-shibire-ei (great torpedo-fish), *Narcacion tokionis* (Tanaka); Nitari-ei, a species (?) of *Dasyatis;* Komon-sakata-zame, *Rhinibatus polyphthalmus* (Bleeker); and Tongari, *Rhyncobatus djiddensis* (Forskal). *Chimæra:* Owston-ginzame, *Chimæra owstoni* (Tanaka). Squalene was detected in Tobi-mizuwani (65·9%), Kiku-zame (53·5%), and Koma mizuwani (35·6%), but not in the other oils.
—K. K.

Arachis oil; Catalytic decomposition of ——. A. Mailhe. Bull. Soc. Chim., 1922, 31, 567—570.

When arachis oil is passed over an alumina-copper catalyst at 600° C. and the product freed from acids and then hydrogenated over nickel at 180°—200° C. hydrocarbons of the methane and benzene series are obtained. Amongst the aromatic hydrocarbons benzene, toluene, and *m*-xylene were identified.
—W. G.

Erucic acid and its anhydride. III. D. Holde and C. Wilke. Z. angew. Chem., 1922, 35, 289—291. (*Cf.* J., 1922, 260 A.)

A detailed account is given of the methods tried and that finally adopted for the preparation of pure erucic acid from rape oil. The fractional distillation of the esters obtained by the methylation of the oil gave a methyl erucate from which an erucic acid was prepared having the correct m.p., 34° C., and the correct molecular weight by titration, but an iodine value of 71—72, indicating the presence of about 5% of saturated acids. Attempts to separate these saturated acids by extraction of the lead salt with ether, light petroleum, or chloroform failed, the whole of the salt passing into solution. Neither could the iodine value of the impure erucic acid be raised by fractional precipitation of a preparation (previously partially purified through the methyl ester and crystallisation from alcohol) with lead or magnesium acetate. The pure acid with an iodine value of 75 was eventually obtained by recrystallising crude erucic acid from alcohol, first at temperatures below 0° C. to remove the liquid unsaturated acids, and then above 0° C. to remove the greater part of the saturated acids, and finally fractionally precipitating this product with a saturated alcoholic solution of lithium acetate, whereby the saturated acids were precipitated first. The pure acid had m.p. 33·5° C. Erucic anhydride was prepared by heating the acid with acetic anhydride at 170° C. under pressure for 7 hrs. After purification it formed a white crystalline substance, m.p. 46° C. It is decomposed by boiling water, boiling alcohol, and cold alcoholic alkali hydroxide solution, but is stable towards cold aqueous alkali and dilute hydrochloric acid.—G. F. M.

Pine needles; A variety of wax from —— and certain abietic esters. H. P. Kaufmann and M. Friedebach. Ber., 1922, 55, 1508—1517.

The dried residue left after the distillation of pine needles with steam is extracted with ether, benzene, and carbon bisulphide, thereby giving a dark green viscous mass, the weight of which does not exceed 8—10% of that of the crude material and varies greatly with the season of the year. This residue is extracted with cold acetone in which the wax does not dissolve; the undissolved portion is distilled under diminished pressure and the distillate is crystallised repeatedly from alcohol or acetic acid. The chief components of the wax (m.p. 64°—65° C.) thus isolated are cetyl, ceryl, and myricyl alcohols, which are mainly esterified with stearic and palmitic acids; in addition, the presence of hydroxypalmitic and abietic acids has been established, the latter being in the form of an ester. The fat-like product which is dissolved by cold acetone (see

above) contains mainly phytosterol and oleic acid. Cetyl abietate is a wax-like substance, m.p. 40° C., whereas myricyl abietate is a dark brown, brittle product closely resembling shellac. The difficulties involved in the separation and the small yields of the wax render the technical utilisation of pine needle residues in this manner unpromising.
—H. W.

Soap solutions; Studies of the constitution of ——. Sodium behenate and sodium nonoate. O. J. Flecker and M. Taylor. Chem. Soc. Trans., 1922, **121**, 1101—1109.

Sodium behenate solutions exhibit the same type of dissociation as the palmitate and stearate (*cf.* McBain, Laing, and Taylor, J., 1922, 424 A). Although in very high concentrations of any of the soaps there is but little difference in the amounts of neutral colloid and ionic micelle, which constitute almost the whole of the solution, these persist in much more dilute solutions in the case of the behenate. The nonoate, as typical of fatty acids with an uneven number of carbon atoms, exhibits properties intermediate between those of the adjacent members with an even number of carbon atoms.—G. F. M.

Water-in-oil type emulsion; Formation of a —— by the concentration of the oil phase. R. P. Sanyal and S. S. Joshi. J. Phys. Chem., 1922, **26**, 481—486.

The authors have confirmed the result that emulsions of the water-in-oil type can be formed by shaking large quantities of a viscous oil (olive oil, castor oil) with soap solutions. When the concentration of the emulsifying agent exceeds about 1% oil-in-water emulsions only are stable. In the case of light oils (kerosene, benzene) the water-in-oil type emulsion is unstable.—J. S. G. T.

Solubility of fats in liquid sulphur dioxide. Zerner and others. *See* III.

Sugars etc. as emulsifying agents. Clark and Mann. *See* XVII.

Fat formation by yeast. Maclean. *See* XVIII.

Volatile fatty acids. Wiegner and Magasanik. *See* XIXA.

Patents.

Oil presses and the like. Utrechtsche Machinefabriek opgericht door F. Smulders. E.P. 156,593, 6.1.21. Conv., 8.4.19.

A cage press having a floating press chamber is provided with a filling drum and a pressing block, these being adapted to be alternately moved laterally into the space between the piston and the press chamber. The press has a telescopic outer piston transmitting its pressure to the inner piston. The pressing block, which has a smaller cross-sectional area than the inner space of the press chamber, is placed on the inner piston, and the filling drum fits between the press chamber and the outer piston, the length of stroke and the diameter of the latter being such that after the removal of the filling drum the outer piston can rise until it abuts against the press chamber. One or more removable distance pieces fit between the wall of the press chamber and the head of the press, and there is an independently removable counter-pressure block.—H. C. R.

Oils; Process or method of refining ——. M. Reynolds. U.S.P. 1,419,760, 13.6.22. Appl., 4.3.20.

Discoloured oils are brought to a desired standard of colour by alternately refining, by a process including saponification, and bleaching the oil.
—L. A. C.

Detergent compound and method of making the same. F. H. Guernsey, Assr. to The Electric Smelting and Aluminum Co. U.S.P. 1,419,625, 13.6.22. Appl., 18.2.21.

A hydrated detergent contains 1 mol. of alumina, x mols. of silica, and $x-1$ mols. of an alkali metal oxide (where x is greater than 7), together with an alkali metal salt of a weak acid, an emulsifying agent, and a further quantity of an alkali metal oxide sufficient to replace that consumed during the cleaning process, but small enough to enable the product to remain solid at summer temperatures.
—L. A. C.

Oils; Method for deodorising blown or polymerised vegetable or animal ——. E. I. du Pont de Nemours and Co., Assees. of J. E. Booge. E.P. 157,401, 10.1.21. Conv., 13.6.18.

See U.S.P. 1,337,339 of 1920; J., 1920, 459 A.

Glycerides; Process for removing free acids from ——. W. Gleitz. E.P. 181,509, 23.3.21.

See U.S.P. 1,408,804 of 1922; J., 1922, 334 A.

Oil presses; Cage forming and cage loading mechanism for ——. The Murray Co., Assees. of N. B. Henry. E.P. 164,015, 31.5.21. Conv., 1.6.20.

Edible fats. E.P. 181,077. *See* XIXA.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Yield value and mobility of paints; Relation of —— to their so-called consistency. J. E. Booge, E. C. Bingham, and H. D. Bruce. Amer. Soc. Testing Materials, June, 1922. [Preprint.] 40 pp.

Fifty-two samples of 13 commercial paints were examined in the plastometer designed by Bingham and Green (J., 1920, 495 A), and the results compared with the average values awarded by a committee of seven paint experts acting as five independent observers, in an empirical notation of units of consistency, *i.e.*, "consistencies" on the thick side being represented by the units 1, 2, 3, etc., and on the thin side by −1, −2, −3, etc., the best painting consistency being designated as zero. The plastometer used differed from that described in the later papers of Bingham and his collaborators in the use of a simpler pressure stabiliser, and in the direct weighing of the material exuded from the capillary, in place of either the drop counting method or the flowmeter reading. The accuracy of the plastometer in furnishing reproducible results is confirmed, and the non-dependence of yield value on the dimensions of the capillary used is noted. Comparison of the average of the "consistency" values with the two factors of mobility (reciprocal of viscosity in dynes per cm.), and yield value (expressed in g. per sq. cm.) showed no simple relationship, but complete correlation was shown in the two sets of figures except in one case. The clearest and most simple relationship, however, was obtained by plotting the ratio of the quotient of mobility into yield value (f/μ) against consistency, when 12 out of the 13 paints examined lay fairly close to a smooth curve, the exceptional case being represented by an enamel containing a vehicle with abnormally low fluidity.—A. de W.

Paints; Physical properties of ——. P. H. Walker and J. G. Thompson. Amer. Soc. for Testing Materials, June, 1922. [Preprint.] 19 pp.

Uniform films for tests are obtained by flowing an excess of the paint under examination on to the centre of the finely-ground face of a circular glass plate 25 cm. in diam. and 1 cm. thick, mounted horizontally on a vertical spindle rotating at *e.g.*, 300 r.p.m. Distribution is complete, and all excess thrown off the plates after 3 minutes' rotation, a film of practically uniform thickness being obtained excepting for a small pyramid in the centre in the case of paints or enamels. This procedure permits of paint mixtures being made and so diluted with volatile solvents, that films of uniform and similar thickness are obtainable by the usual methods of brushing etc., it being assumed that mixtures which give films of similar thickness when whirled as described will also give similar films when brushed on test panels. The mobility of mixtures of linseed oil and turpentine was found not to be a linear function of the composition, and this result was confirmed by experimental determinations of viscosities of mixtures of linseed oil and turpentine in varying proportions, a hyperbolic curve being obtained. On application of a paint obtained by freshly mixing new or old white lead ground in oil with raw linseed oil, spots or pits consisting of small areas from which pigment is repelled appear on the surface. The trouble is obviated by storage for a period of 24 hours before use, by substitution of boiled linseed oil in place of raw oil, or by the use as a thinner of a raw linseed oil previously treated with white lead. The trouble does not occur when other pigments are substituted for white lead or when other oils are used for thinning; it is not due to faulty incorporation, presence or absence of driers or thinners, presence of free fatty or mineral acids or water, and the authors assume that the governing factor consists in a reaction between basic carbonate white lead and some unidentified portion of the oil.—A. de W.

Paints; Accelerated weathering of —— on wood and metal surfaces. H. A. Nelson. Amer. Soc. for Testing Materials, June, 1922. [Preprint.] 15 pp.

Accelerated weathering tests for paint films have been carried out in a wooden exposure tank surrounded by an insulated air space and lined with galvanised iron. Effects of sunlight, rain, and mist have been simulated by a quartz mercury arc lamp of 30 in. effective lighting length, a revolving spray, and a water atomiser respectively, a variable speed electric fan serving to cool the arc and maintain a uniform temperature. A cycle of exposure for 24 hours to the rays of the arc at a temperature of 50°—60° C., followed by cooling and exposure to the water spray for a further 24 hrs. at 5°—10° C. was chosen as representing actual service conditions. Exposures were made at a distance of 28 in. from the source of the rays, investigation proving that the useful rays of destructive effect had a wave-length in the neighbourhood of 3000 A.U. On an average, comparable results were obtained in as many days in the apparatus as in months under service conditions. The following results were obtained on a series of paints, the figures referring to the number of days necessary for the complete loss of gloss, and initial chalking, respectively: 100% lead-free zinc oxide, 14, 16; 100% leaded (35%) zinc oxide, 9, 12; 100% light-resistant lithopone, 4, 6; 100% basic lead carbonate, 3, 5; 100% "Titanox," 2, 4; 40% zinc oxide, 40% lithopone, 20% whiting, 9, 11. The effect of periodic saturation and maintenance of a saturated atmosphere during exposure is to accelerate both complete loss of gloss and initial chalking by 50%, a fact attributed to the activity of dissolved oxygen in an ionised condition. Freezing of a saturated film materially promotes the formation of removable "chalk," most probably due to the formation of ice within the film. Neither flaking nor "checking" has been reproduced in any of the tests. Cracking, rapidly followed by scaling and peeling, is produced by periodic exposures to temperatures considerably below freezing-point, and is reproducible by exposures of equal alternate intervals to light, low temperature, and water-spray for a period of 100 days, equivalent to 14—15 months' exposure to the weather. Lack of adherence is a fault more strictly connected with the method of application of the paint, but can be reproduced by exposure at 50°—60° C. to the mercury arc. Of commercial paints intended for use as protective coatings for iron, both the combination of 83% Fe_2O_3 with 15% ZnO, and a 100% red lead paint showed outstanding merit in maintaining gloss and inhibiting the formation of rust as compared both with iron oxide paints reduced with various fillers, and a reduced ZnO/sublimed lead paint. Whilst a certain light-resistant lithopone maintained its whiteness over a period of 3 years on exterior exposure, the effect of the ultra-violet radiations was to discolour both this product and white lead in a short time.—A. de W.

White pigments; Determination of tinting strength of —— by the Pfund colorimeter. J. H. Calbeck and C. P. Olander. Amer. Soc. Testing Materials. June, 1922. [Preprint.] 8 pp.

A given amount of lampblack is ground with a definite quantity of white pigment, glycerin being used as a medium, and the resulting loss in brightness is measured on a Pfund or other colorimeter. The reading obtained is then referred to that amount of stainer necessary to produce the same brightness with the standard white pigment, such readings being previously plotted on a chart correlating decreasing brightness of the standard with increasing additions of stainer. The true strength measurement, however, is obtained by a modified treatment wherein a correction for the differing initial brightness of the sample is allowed for by similar reference to the standard strength curve. Since the standard strength curve is not a straight line but indicates that the greatest loss in brightness takes place with the initial additions of stainer, the maximum sensitiveness of the determination will be obtained by the addition of relatively small proportions of stainer.—A. de W.

Wax from pine needles, and abietic esters. Kaufmann and Friedebach. *See* XII.

Patents.

Lead sulphate water paste; Conversion of —— into oil paste. D. Whyte. U.S.P. 1,419,655, 13.6.22. Appl., 27.6.21.

Lead sulphate water pastes are dried to express the "free water" and then churned with oil in just sufficient amount to "break out the waters of crystallisation" from the lead sulphate particles and to be taken up by these particles to form a stiff paste.—A. de W.

Pigment colours [green lakes]; Manufacture of ——. J. Y. Johnson. From Badische Anilin und Soda Fabrik. E.P. 181,584, 20.5.21.

Nitroso-β-naphthol, preferably in the form of the bisulphite compound, is caused to react with ferric or ferrous salts, in which latter case (with the exception of pyroligneous iron liquor) the iron is employed in less than the theoretical amount of two mols. of nitroso-β-naphthol to each atom of iron. The reaction is preferably carried out in the presence of Turkey-red oil or similarly acting substance, *e.g.*, sodium di-isopropylnaphthalenesulphonate, and the mixture should be kept alkaline either from the beginning or at the end of the reaction.—A. de W.

Artificial resin products; Manufacture of ——. H. Dreyfus. E.P. 181,575, 12.5.21.

Cyclohexanone or one of its homologues is condensed with acetaldehyde in the presence of either alkaline or acid condensing agents. The ratio of acetaldehyde to cyclohexanone may vary from one to several mols., whilst the temperature of reaction and dilution by means of solvents may also vary within wide limits; *e.g.*, 100 pts. by weight of cyclohexanone is diluted with 100 pts. by weight of alcohol, and 1 pt. by wt. of caustic soda as a 50% solution added whilst cooling. The mixture is heated to 80°—90° C., about 250 pts. by wt. of 25% acetaldehyde added, and the mixture heated for 3—4 hrs. The alcohol is then distilled off, the residue washed with water and allowed to solidify by standing.—A. de W.

Bleaching earthy minerals. E.P. 181,132. *See* VII.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber; Tests on plantation —— with zinc oxide and litharge mixings. H. P. Stevens. Bull. Rubber Growers' Assoc., 1922, 4, 275—281.

Samples of rubber prepared in slab form using varying proportions of acetic acid, sulphuric acid, and alum as coagulants, were vulcanised for 3 hrs. at 138° C. with sulphur alone (proportions 90:10) or with the additional presence of zinc oxide (proportions 90:10:5) or of litharge (proportions 100:6:7). For each sample of rubber the elongation measured at 0·6 kg. per sq. mm. for the simple mixture stood in an approximately constant ratio to that of the mixture with zinc oxide but not to that of the litharge mixture; constant relationship, however, did not extend to the corresponding vulcanisation coefficients, the zinc oxide and litharge mixtures exhibiting relatively higher values for the more slowly vulcanising rubbers.
—D. F. T.

Accelerating effect of dimethyldithiocarbamate of dimethylamine and of diethyldithiocarbamate of diethylamine; Note on the comparative ——. P. Schidrowitz, J. M. S. de Gouvea, and F. G. Osborne. Indiarubber J., 1922, 64, 75—77.

The vulcanisation of mixtures of rubber (100) and sulphur (8) with and without the addition of zinc oxide (10) at 286° F. (141° C.) showed that dimethylamine dithiocarbamate (0·25) and its diethylamine analogue are of comparable effectiveness in the absence of zinc oxide. In the presence of zinc oxide the dimethylamine compound is distinctly the more active. An iodine derivative of the dimethylamine compound proved distinctly less active than either. (*Cf.* Twiss, Brazier, and Thomas, J., 1922, 81 T.)—D. F. T.

Rubber goods; Accelerated ageing tests on ——. W. W. Evans. Amer. Soc. Testing Materials, June, 1922. [Preprint.] 10 pp.

In accelerated ageing tests at 160° F. (91° C.) in circulating fresh air the samples do not harden as in natural ageing but become definitely weaker; the stress-strain curves undergo little alteration in form but become shortened and also gradually fall lower on account of increasing resistance to extension. Sulphur changes are noticeable but are unimportant. The results are best interpreted by comparison of the curves showing the progress of the ageing effect in samples of similar type. The curves for the accelerated and natural life tests are not exactly parallel, the former test being somewhat the more severe, even when interpreted on the basis that one day of accelerated ageing is equivalent to six months' natural life. In the vast majority of cases too rapid deterioration is due to over- or under-vulcanisation, chiefly the former. (*Cf.* Geer and Evans, J., 1921, 479 A.)—D. F. T.

Vulcanisation; Mercaptothiazoles as accelerators of ——. G. Bruni and E. Romani. Atti R. Accad. Lincei, 1922, 31, I., 86—88. (*Cf.* J., 1921, 553 A.)

When added to a mixture of rubber and sulphur containing oxide of zinc, lead, magnesium, calcium, mercury, etc., 1—3% of 5-methyl-2-mercaptothiazole greatly accelerates vulcanisation, which is effected in 5 minutes at 120° C. The cadmium, lead, mercuric, and especially the zinc salts of the thiazole exhibit similar accelerating action.
—T. H. P.

XV.—LEATHER; BONE; HORN; GLUE.

Tannins and similar compounds. IX. Stereoisomeric catechins. II. K. Freudenberg, O. Böhme, and L. Purrmann. Ber., 1922, 55, 1734—1747.

A further step in the elucidation of the constitution of the catechins (*cf.* J., 1921, 520 A, 781 A) has been made through the observation that *r*-catechin is transformed into *r*-epicatechin under conditions which causes the racemisation of *l*-catechin. It follows that catechin must contain two asymmetric carbon atoms, which is possible only if the unlocated hydroxy group replaces the hydrogen of a methylene group. Acacia (Pegu) catechu contains a mixture of *r*- and *l*-catechins and *r*- and *l*-epicatechins. The catechin from Chinese rhubarb is pure *d*-catechin; that from mahogany contains *r*- and *d*-catechins and probably also *d*-epicatechin, but only steamed wood in which the original catechins had suffered alteration was available for the examination; the catechin from *Paullinia cupana* is similar to that from mahogany. (*Cf.* J.C.S., August.)—H. W.

Flavanone; Reduction of ——. K. Freudenberg and L. Orthner. Ber., 1922, 55, 1748—1751.

Flavanol (4-hydroxyflavan), a possible parent substance of catechin (Freudenberg, Böhme and Purrmann, *cf. supra*), has been prepared by the reduction of flavanone with aluminium amalgam in neutral alcoholic solution. It gives a decided reddish-violet coloration with concentrated sulphuric acid; this is much more intense than the yellowish-red shade given by tetramethylcatechin which, however, gradually becomes darker when the mixture is preserved. (*Cf.* J.C.S., August.)—H. W.

Catechin. K. Freudenberg. Ber., 1922, 55, 1938—1942. (*Cf.* Nierenstein, J., 1922, 184 A, 407 A.)

The author maintains his contention that the tannins are condensation products of catechin-like substances. Attempts to prepare catechincarboxylic acid according to Nierenstein's directions were unsuccessful, the catechin appearing to be decomposed completely during the action. Similar observations were made with hydroxycatechin. The catechincarboxylic acid from *Paullinia* tannin is optically active and resolvable; its conversion by loss of carbon dioxide into *d*-catechin (gambier catechin) is therefore inexplicable. Demethylation of tetramethylcatechin cannot be effected by acetic anhydride and acetyl chloride, whilst penta-acetylcatechin cannot be hydrolysed by sulphuric acid to catechin as claimed by Nierenstein. The identity of the methylated reduction product of catechin, m.p. 87°—88° C., with pentamethoxy-$\alpha\gamma$-diphenylpropane has been confirmed; Nierenstein's synthesis of acacatechin is therefore difficult to understand, since his compounds belong to the $\alpha\alpha$-diphenylpropane group.—H. W.

Glue; Action of alum on animal ——. A. Gutbier, E. Sauer, and F. Schelling. Kolloid-Zeits., 1922, 30, 376—395.

Alum strongly increases the viscosity of glue and at higher temperatures, in slightly acid solutions, causes precipitation. The addition of alum to both bone and leather glue immediately reduces the colour. The sensitiveness of glue to alum varies with the different varieties; thus the viscosity of leather glue is increased by very small concentrations of alum, whilst very large concentrations are necessary to give a noteworthy increase of viscosity with bone glue. At higher temperatures, in the case of leather glue, there is a continuous decrease in the viscosity depending on the concentration of the alum and the time during which the two substances have been in contact. Bone glue is much more stable than leather glue to alum and to high temperatures. When glue jellies mixed with alum are dialysed the aluminium is retained quantitatively, but the other constituents of the alum are removed. The precipitates produced during the clarification of glue by alum and phosphoric acid contain both glue and aluminium in varying proportions and are adsorption compounds; they have a considerable surface energy and consequently possess a great clarifying power. The more rapidly the precipitate forms the greater is the clarifying power. After proper clarification the glue contains only small quantities of aluminium, but it contains the whole of the acid added. The clarification of glue is always accompanied by a deterioration, as shown by the decrease in viscosity. This is not due directly to the clarification process but to secondary reactions. The acid added and the prolonged heating bring about hydrolysis which yields substances that are not glue-like. Leather glue is more sensitive than bone glue in this respect.—J. F. S.

Patents.

Tanning materials; Manufacture of new —— and process of tanning therewith. Chem. Fabr. und Asphaltwerke A.-G. E.P. 156,254, 4.1.21. Conv., 1.9.16.

Tanning materials prepared by condensing organic compounds with formaldehyde are neutralised with compounds of aluminium or chromium, or both. —D. W.

Tanning of skins and hides. J. Hell. E.P. 180,758, 1.3.21.

Hides are unhaired and then treated with soluble magnesium salts and soluble carbonic acid salts of other bases in the presence of water, which may be followed by a treatment with other tanning materials.—D. W.

Tanning. T. B. Carmichael and W. H. Ockleston. E.P. 181,067, 24.2.21.

Hides are treated with an acidified green chrome liquor and then with a vegetable tanning liquor, or they are treated with a combined tanning liquor consisting of equal parts of an acidified green chrome liquor of about 20° Bkr. and a vegetable tanning liquor of about 30°—40° Bkr., which may be followed by further treatment in vegetable tan liquors. The acidified green chrome liquor is prepared by adding acetic acid to a commercial chrome tanning liquor.—D. W.

Glue; Process of, and apparatus for, extracting —— from glue-yielding raw materials by means of water. K. Niessen. E.P. 156,645, 6.1.21. Conv., 8.12.19.

The raw material is heated with water under reduced pressure in a series of extractors, which are charged in turn. The water freshly introduced into an extractor passes through all but one of the extractors in series in such an order that the liquor is enriched and concentrated in each by contact with fresher material and by partial evaporation of the water. The water in regular circulation passes from the bottom of one extractor to the top of the next vessel, wherein it is preferably discharged through a sprinkler. Each extractor is provided with automatic valve controlling gear by means of which the passage of liquor through the system is controlled.—J. R.

Casein; Manufacture of plastic material from ——. E. Krause and H. Blücher. E.P. 162,657, 29.4.21. Conv., 3.5.20.

Casein, which may be ground to pass a 2000-mesh sieve, is treated with formaldehyde, dried so as to remove any free formaldehyde, and compressed hot into the desired shape.—D. W.

XVI.—SOILS; FERTILISERS.

Nitrogenous metabolism of the higher plants; Investigations on the ——. II. Distribution of nitrogen in the leaves of the runner bean. A. C. Chibnall. Biochem. J., 1922, **16**, 344—362.

Numerous determinations have been made of the nitrogen content of the leaves of the runner bean, particularly to determine seasonal and diurnal variations and the results of starvation. The results indicate the synthesis of protein from nitric-nitrogen through monoamino-nitrogen, and then the degradation of protein to non-protein nitrogen, followed by translocation from the leaf.—W. O. K.

Fungi; Chemistry of the higher ——. XV. Chemical relations between the higher fungi and their substratum. II. R. Hasenöhrl and J. Zellner. Monatsh., 1922, **43**, 21—41.

The physical and chemical characteristics of the higher fungi resemble closely those of the heterotropic phanerogams (*cf.* Monatsh., 1919, **40**, 311). They contain a considerably higher proportion of water than green plants, and more water than the host on which they are parasitic. The composition of the mineral matter in the fleshy fungi resembles that in phanerogams, potassium and phosphorus being high and calcium low. In some of the more woody or leathery fungi, however, calcium sulphate is exceptionally high. In general the fungi contain a high proportion of soluble salts, which are necessary to maintain the high osmotic pressure required in plants of such high water content. The osmotic pressure in the fungus is shown experimentally to be higher than in the substratum. Attempts to detect cellulose- and lignin-splitting enzymes in a number of fungi were unsuccessful. A specimen of oak on which *Polyporus igniarius* had been parasitic was found to have lost 74% of its weight, the sp. gr. being reduced from 0·740 to 0·191. Its analysis, however, showed little difference in composition from that of healthy oak, except that starch, tannin, and sugar had disappeared. The material of the wood appears, therefore, to be absorbed equally by the fungus. (*Cf.* J.C.S., August.)—E. H. R.

Catalase of seeds. J. de Vilmorin and Cazaubon. Comptes rend., 1922, **175**, 50—51. (*Cf.* Němec and Duchon, J., 1921, 899 A; 1922, 264 A.)

In the case of the seeds of pines and larches the authors find no correlation between the amount of catalase present and the vitality of the seed as shown by its germinative capacity.—W. G.

Patents.

Fertilisers; Manufacture of artificial nitrogenous ——. K. Niedenzu. E.P. 166,887, 9.7.21. Conv., 23.7.20.

A mixture of calcium sulphate and carbonaceous material is heated at 1000°—1300° C., and gases containing nitrogen (producer-gas etc.) are passed through the mixture. Calcium cyanide and cyanamide are formed, and the product is ground to a powder. Halogen compounds, oxides, carbonates, and salts of the alkaline-earth metals containing oxygen may be added as accelerators.—A. G. P.

Refuse; Plant for the aerobic fermentation of —— and the production of manure therefrom. Soc. Anon. Brevetti Beccari. E.P. 175,586, 28.2.21. Conv., 16.2.21.

Putrescible refuse is stacked on the perforated floor of a chamber through which a current of air is drawn. Volatile products are trapped by bubbling the escaping air through water. The period of treatment is 30—35 days.—A. G. P.

Fertiliser; Method of conditioning ——. C. A. Butt. U.S.P. 1,418,618, 6.6.22. Appl., 17.6.21.

Nascent hydrogen is generated in a fertiliser material containing a nitrogen compound capable of reacting with nascent hydrogen to produce ammonia. The ammonia formed combines with any free acid present.

Fertilisers. D. Lo Monaco. E.P. 159,481, 25.2.21. Conv., 26.2.20.

See U.S.P. 1,402,368 of 1922; J., 1922, 151 A. The process is intended more particularly for the treatment of humus.

XVII.—SUGARS; STARCHES; GUMS.

Sucrose; Inversion of —— in alkaline copper solution. E. Canals. Bull. Soc. Chim., 1922, 31, 583—588.

Results indicate that sucrose is slowly hydrolysed during the estimation of reducing sugars in its presence by means of Fehling's solution. The actual amount of sucrose hydrolysed increases with the concentration of the sucrose, with the time of heating, and with the temperature at which the liquid is kept. It is essential, therefore, to make a blank estimation, and it is advisable to heat by immersion in a water-bath.—W. G.

Sucrose lost in the carbonatation scums of the beet sugar factory; Determination of the ——. H. Claassen. Centr. Zuckerind., 1922, 30, 703.

In factories in which the carbonatation scums are not dried but are washed into a screw conveyor and pumped away to waste, the loss of sugar may be determined by taking an average sample from the mixing tank placed before the pump, calculating the weight from the volume and density, and determining the sucrose in a portion in the usual manner. The results given by this method, owing to the greater accuracy in sampling which it permits, are nearer the truth than those found by the procedure generally followed, in which the weight is found directly by weighing and the sugar determined in a portion abstracted from the cakes by means of a trier.—J. P. O.

Sucrose; Spectral study of the triboluminescence of ——. H. Longchambon. Comptes rend., 1922, 174, 1633—1634.

The spectrum of triboluminescence of sucrose shows almost all the constituents of the second positive band spectrum of nitrogen and no others. The triboluminescence of sugar is, therefore, due to a discharge in the air between two solid particles which have been suddenly separated and are electrically charged.—W. G.

Artificial honey; Determination of the dry matter in —— by means of the refractometer. F. Auerbach and G. Borres. Z. Unters. Nahr. Genussm., 1922, 43, 297—311.

The Abbe refractometer was used. The artificial honey was warmed until all crystals had melted and thoroughly mixed before drops were removed for testing. Preliminary experiments carried out to determine the variation of refractive index with temperature gave 0·00025 as the mean fall per degree rise in temperature between 20° and 50° C. Readings were taken after the temperature had remained constant for 5 mins. in the neighbourhood of 40° C. and corrected to that temperature. The results obtained for a large number of samples were compared with the percentage of dry matter as obtained by density determinations. The refractive index increases as a linear function of the percentage of dry matter. The maximum variation in the percentage as given by the refractometer as compared with that given by density determinations is $\pm 0·2\%$, except for artificial honeys prepared with starch syrup, where the variation reached $0·3\%$. Pure starch syrups showed variations up to $2·36\%$. —H. C. R.

Adsorption in solution and at interfaces of sugars, dextrin, starch, gum arabic, and egg albumin; Quantitative study of the —— and the mechanism of their action as emulsifying agents. G. L. Clark and W. A. Mann. J. Biol. Chem., 1922, 52, 157—182.

Measurements were made of the surface tension and viscosity of solutions of the above substances for a large number of concentrations both with and without the addition of electrolytes. The interfacial tension between each solution and benzene was also measured, and the efficiency of the emulsifying agent with respect to both benzene and kerosene estimated. The factors of predominating importance in an emulsifying agent appear to be viscosity and ability to lower interfacial tension. In the case of sugar, viscosity is the more important, whilst with egg albumin, which gave the best emulsions, film formation is of primary importance. Two types of agglomeration are distinguished, namely, that accompanied by an increase in viscosity, in which coalescence of the particles is accompanied by enclosure of water, and that producing a decrease in viscosity, in which there is a decrease both in surface and amount of bound water. Dextrin and starch, considered separately, provide examples of the former type. When these substances are considered in relation to one another, however, it is found that the viscosity curves run parallel, thus resembling the viscosity curves of sulphur sols of different degrees of dispersion (Z. physik. Chem., 1912, 80, 709). This is considered to be evidence that starch and dextrin differ merely in the degree of agglomeration (second type) of the particles, and thus to furnish experimental proof of the view put forward by Herzfeld and Klinger (J., 1921, 784 A).—E. S.

Inulin. Constitution of polysaccharides. IV. J. C. Irvine, E. S. Steele and M. I. Shannon. Chem. Soc. Trans., 1922, 121, 1060—1078.

The formation of dimethylinulin as the main product of the methylation of inulin with methyl sulphate and sodium hydroxide was confirmed. The varying solubility in ether of the compound from different preparations is ascribed to partial depolymerisation. The physical properties of trimethylinulin also vary in marked degree according to the experimental procedure adopted in preparing the compound, the physical state varying from an amorphous solid to an extremely viscous syrup, the latter being dextro- and the former lævo-rotatory.

All forms, however, have the same composition and on hydrolysis give the same form of trimethyl-γ-fructose, the lævo-varieties only undergoing a change of sign during hydrolysis. The occurrence of these varieties of trimethylinulin can only be ascribed to variations in molecular magnitude, the cause of which it is at present impossible definitely to determine. Dimethylinulin, which has always been obtained as a lævo-rotatory compound, shows a change of sign on hydrolysis, giving *d*-dimethyl-γ-fructose, which is valuable confirmatory evidence of the form of fructose of which inulin is a derivative.—G. F. M.

Digestibility of starches. Langworthy and Deuel, jun. *See* XIXA.

PATENTS.

Syrups and molasses in storage; Preservation of ——. W. L. Owen, Assr. to Penick and Ford, Ltd. U.S.P. 1,418,457, 6.6.22. Appl., 31.7.19.

THE syrup or molasses is subjected to carbon dioxide under pressure in suitable reservoirs in order substantially to displace the surrounding and entrained air, and is then stored in an atmosphere of carbon dioxide under a pressure of at least 45 lb. per sq. in.—J. P. O.

Starch and starchy matter and sulphuric acid; Manufacture of compounds or mixtures of —— [*for use in the manufacture of viscose silk, etc.*]. Courtaulds, Ltd., and (A) W. H. Stokes, (B) J. A. Lloyd. E.P. (A) 181,197, (B) 181,198, 23.4.21.

(A) HOMOGENEOUS mixtures of starch and 60% sulphuric acid are made by mixing finely-divided starch or starchy material with water, or preferably dilute sulphuric acid, and adding rapidly, with stirring and cooling, to the paste so obtained sufficient concentrated acid to bring the mixture to the desired concentration: *e.g.*, 14 pts. of starch is made into a paste with 15 pts. of 28% sulphuric acid at about 28°—30° C.; 14 pts. of 77% sulphuric acid is then added rapidly, with continuous stirring and cooling, until after a few hours a clear, homogeneous liquid is obtained, which may be used in the preparation of setting baths for viscose etc. (B) Starch or starchy material, *e.g.*, ground rice or tapioca, not necessarily in a finely-divided state, is added in successive small quantities to 50—65% sulphuric acid at temperatures of 35°—75° C. (the higher the temperature the darker will be the colour of the resulting liquid): *e.g.*, 56 pts of maize starch is added over a period of about 3½ hrs. to 116 pts. of 52% sulphuric acid, maintained at 40° C. The liquid is stirred for another 2 hrs., keeping the temperature at 40° C., when a light-coloured, mobile liquid is obtained.—D. J. N.

Starch products; Method of making soluble ——. A. W. H. Lenders and H. F. Bauer, Assrs. to Penick and Ford, Ltd. U.S.P. 1,418,311, 6.6.22. Appl., 2.7.17.

AN aqueous solution of modified or thin boiling starch, made by the usual process of acid hydrolysis, is subjected without the addition of any reagent to a temperature which instantaneously evaporates the water and further modifies the starch.—J. P. O.

Filter for sugar liquors. E.P. 180,935. *See* I.

XVIII.—FERMENTATION INDUSTRIES.

Yeast; Nitrogen nutrition of ——. F. K. Swoboda. J. Biol. Chem., 1922, **52**, 91—109.

THE effect of various substances on the nitrogen nutrition of yeast was studied, the special feature of the experiments being the addition to the synthetic media employed of a constant quantity of growth-promoting vitamin ("bios"). In media containing asparagine, succinamide, succinimide, or aspartic acid, the growth is better in the presence than in the absence of ammonium sulphate. Of the nitrogen contained in asparagine, the α-amino group appears to stimulate nitrogen assimilation; the amide group, however, in the presence of ammonium sulphate, also stimulates cell reproduction. The nutrient value of edestin is increased by mild acid hydrolysis, but is decreased by continued acid hydrolysis and by alkaline hydrolysis. In the latter case subsequent acid hydrolysis again improves the nutrient value. The effect of various amino-acids, both in the presence and absence of hydrolysed edestin, was also studied.—E. S.

Wines; [Detection of] dépiquage of [addition of a neutralising agent to] sour ——. L. Ferré. Ann. Falsif., 1922, **15**, 139—146.

FOR the detection of the addition to sour wines of a substance capable of improving their taste, the author recommends the estimation of the free and combined volatile acids by the following procedure: 10 c.c. of the wine is extracted with three successive 10 c.c. portions of ether. The ether extracts the free volatile acids together with a certain amount of the free fixed acids. The ether is distilled off at a low temperature, and the volatile acids in the residue are estimated by Mathieu's method of successive distillations. The wine left after the extraction is used for the estimation of the combined volatile acids by a similar method after acidification with 0·5 c.c. of sulphuric acid. In the case of a wine containing a considerable amount of free tartaric acid it is almost impossible to discover the addition of a neutralising agent, unless some of the untreated wine is available for comparison. In the case of a wine containing little or no free tartaric acid, however, it is possible not only to detect the addition of a neutralising agent, but also to ascertain the nature of the substance added. —W. G.

Yeast; Flocculation of ——. H. Lüers and K. Geys. Kolloid-Zeits., 1922, **30**, 372—376.

YEAST is normally positively charged or amphoteric, but in the process of fermentation a negative charge appears when vigorous budding sets in. Towards the end of the fermentation the charge again becomes positive at the same time as flocculation commences. These changes are very indistinct with powdery yeast. The change from yeast exhibiting a good "break" to powdery yeast often observed in practice is due to hunger, degradation of albumin, and reduction of the hydrogen ion concentration.—J. F. S.

Fat; Conditions influencing the formation of —— *by the yeast cell.* I. S. Maclean. Biochem. J., 1922, **16**, 370—379.

ETHER extracts considerably more fat from yeast if the latter be first boiled with *N*/1 hydrochloric acid for two hours. This is because a large part of the fat is in some form of combination in the plasma of the cell. Yeast grown under unfavourable conditions shows a large increase in fat content (up to 9%). Aeration, and a non-nitrogenous medium rich in carbohydrate, likewise cause an increased fat content, the increase being in the combined fat.—W. O. K.

Amylase of Aspergillus niger; Influence of hydrogen ion concentration on the action of ——. G. L. Funke. Proc. K. Akad. Wetensch., 1922, **25**, 6—8.

THE maximum hydrolytic action of the amylase from *Aspergillus niger* is observed at a hydrogen ion concentration p_H 3·5—5·5, and from this it follows that the enzyme is to be regarded as an ampholyte of which $k = 6·3 \times 10^{-7}$ and $k_b = 2·884 \times 10^{-13}$. Malt amylase has the values $k_a = 6·3 \times 10^{-7}$ and $k_b = 5·76 \times 10^{-11}$, where k_a and k_b are the dissociation constants of the acid and base respectively. (*Cf.* J.C.S., Aug.)—J. F. S.

Cider-making; Microbiology of ——. B. T. P. Barker. J. Inst. Brew., 1922, 28, 517—534.

The freshly expressed apple juice used for cider-making is invariably charged not only with a variety of naturally occurring wild yeasts and torulæ, but also with a heterogeneous collection of undesirable fungi and bacteria. The three possible general methods of fermenting this crude juice are spontaneous or natural fermentation (still the most important industrial process), by dominant fermentation, to attain which the addition of a culture of selected yeast to freshly expressed juice is necessary, and by pure fermentation, which involves preliminary sterilisation, followed by the addition of a pure yeast culture. For pure fermentations the juice may be either pasteurised by heating to 140°—160° F. (60°—71° C.) or sterilised by chemical or physical means, and then fermented. Sulphur dioxide, ozone, and ultra-violet rays have been suggested for sterilising the juice but have not met with any great practical success. Another reagent which offers more promise of success (although experiments are only in the preliminary stage) is formaldehyde. There is naturally present in apple juice a substance or a group of related substances which slowly combine with formaldehyde in the cold to produce an insoluble compound, so that sterilisation of the juice can be combined with the automatic removal of the excess formaldehyde. Pasteurisation sometimes affects the flavour of the cider. During cider making there is a continuous struggle in progress between the yeast capable of producing a sound type of alcoholic fermentation and undesirable yeasts and bacteria. Provided there is sufficient good yeast active to keep the liquor nearly saturated with carbon dioxide, the risk of serious deterioration from bacterial development is not great. Other factors, however, besides the presence of carbon dioxide are involved in the preservative action, so far at least as some of the bacterial disorders are concerned (*e.g.*, cider sickness). This disorder is characterised by the sudden decomposition of the residual sugar, alcohol being formed in addition to various aldehydes, including formaldehyde.—J. R.

Alcohol still; Plate efficiency of a continuous ——. C. S. Robinson. J. Ind. Eng. Chem., 1922, 14, 480—481.

Three tests were carried out on a modern Barbet plant using mixtures of ethyl alcohol and water, with a view to determine the plate efficiency of the plant. Observations were made of the alcohol fed, water fed, cooling water used, water in distillate, and temperature rise in the various condensers. From the data the plate efficiencies were calculated, using the formulæ given by W. K. Lewis (*cf.* p. 573 a). When the reflux ratio (ratio of reflux to product) was 4·06 a plate efficiency of 40% was found; with a reflux ratio of 3·04 the plate efficiency was 24%, and a plate efficiency of 56% was obtained when the reflux ratio was 2·75. In each case it was assumed that the alcohol present in the waste liquor was 0·0001. Another test by another experimenter on the same plant gave a plate efficiency of 70%, and, applying this result to the first of the above tests, it is found that waste should be 0·000002 mol. fraction of alcohol instead of 0·0001 as assumed. It is pointed out that for an accurate determination of plate efficiency it would be necessary to obtain samples of liquid containing a measurable amount of alcohol.
—S. G. U.

Pressed yeast; Regulation of the nutrient liquid for the manufacture of —— *on a chemical basis.* F. Wendel. Z. Spiritusind., 1922, 45, 160, 166—167, 171—172.

The food requirements of yeast made by the aeration process as regards sugar, nitrogen, and phosphoric acid are considered, and the proportions of different cereals and inorganic materials which must be used to satisfy these requirements and yield yeast of good baking and keeping qualities estimated.—T. H. P.

Polypeptidases, carbohydrases, and esterases; Influence of substances obtained from yeast cells and organs on the time course of the fission of substrates by ——. E. Abderhalden and E. Wertheimer. Fermentforsch., 1922, 6, 1—26.

Substances extracted from yeast in various ways, and also certain optones, accelerate the fission of dipeptides by pancreas extract, but diastatic action is not appreciably affected by this means. The action of sucrase (invertase) is retarded by the substances extracted from yeast by treatment with alcohol. (*Cf.* J.C.S., Aug.)—T. H. P.

Bacteria; Culture of —— *on media with a basis of pyruvic acid. Degradation of pyruvic acid.* R. Cambier and E. Aubel. Comptes rend., 1922, 175, 71—73.

The authors have found it possible to grow *B. pyocyaneus*, *B. fluorescens*, and *B. coli* on a mineral medium containing sodium pyruvate as its sole source of carbon. Among the products of degradation of the pyruvic acid they have identified acetic, glycollic, and lactic acids.—W. G.

Trypsin. Kai. *See* XXIII.

Patents.

Yeast; Process of drying pressed ——. E. Klein. E.P. 175,623, 10.2.22. Conv., 15.2.21.

Yeast is dried by air currents until the water content is reduced to 50—60%. Starch or flour is then added to bring down the percentage of water to 30%, followed by substances protecting the fermentative activity of the yeast, *e.g.*, potassium phosphate, sugar, etc. Common salt is added during the drying process to facilitate the removal of water from the yeast cells.—A. G. P.

Yeast; Method for treating and preparing ——. C. A. Jensen. From R. L. Corby. E.P. (a) 181,076 and (b) 181,293, 28.2.21.

(a) Pressed yeast is frozen at about –4° C., to remove water from the cells, and then allowed to regain normal temperature. Corn (maize) meal is added and/or a suitable oil, and the whole thoroughly mixed. A small amount of water, *e.g.*, 35%, is added, and the whole desiccated, *e.g.*, in a current of air. (b) Previous to drying, yeast is treated with a solution of sugar (40—100 lb.), ammonium tartrate (1—3 lb.), calcium phosphate (½—2 lb.), and lactic acid (½ lb.), in water (200 gallons). This quantity is suitable for treating 100 lb. of yeast.—A. G. P.

Filter for wines. E.P. 180,935. *See* I.

XIXa.—FOODS.

Milk as a source of water-soluble vitamin. III. T. B. Osborne and L. B. Mendel. Biochem. J., 1922, 16, 363—367.

Cow's milk shows great variations in its content of vitamin B, apparently scarcely to be accounted for by differences in the diet of the cows, and in no case has a sample been found with a content

of vitamin B approaching that found by Hopkins in his original experiments. Human milk is not essentially richer than cow's milk in this vitamin.
—W. O. K.

Meats; Pickling of —— in brines containing potassium nitrate and sodium nitrite. L. Pollak. Z. angew. Chem., 1922, **35**, 229—232.

WHEN potassium nitrate is used in the pickling solution the process proceeds irregularly, and considerable quantities of nitrite are formed, whilst when sodium nitrite is added to the solution the pickling process progresses regularly, the nitrite content of the solution decreases gradually, and only small quantities are present at the end of the operation. Meat pickled with nitrite never contained more than 15 mg. of sodium nitrite per 100 g., but this quantity was usually exceeded when nitrate had been used.—W. P. S.

Meat; Use of potassium nitrate and sodium nitrite in the pickling of ——. F. Auerbach and G. Riess. Z. angew. Chem., 1922, **35**, 232—233.

THE authors consider that the formation of nitrite when nitrate is used in pickling meat, as recorded by Pollak (preceding abstract), is due to the temperature having been too high during Pollak's experiments. They find that at 4° C. the quantity of nitrite formed is very small. Further, when nitrite is employed, the quantity found in the finished meat varies proportionately with the amount in the brine solution.—W. P. S.

Lupin seeds; Removal of bitter substances from ——. [Determination of the efficiency of the treatment]. E. Beckmann and F. Lehmann. Chem.-Zeit., 1922, **46**, 473—474.

FIVE g. of the crushed seeds is digested for 20 mins. with 50 c.c. of water at 60° C.; the liquid is filtered, the filtrate cooled, and a small quantity treated with a few drops of iodine solution. If the seeds are free from bitter substances the mixture remains perfectly clear. The aqueous extract from untreated lupin seeds, or that from seeds from which the bitter substances have not been removed completely, gives a precipitate or turbidity when tested with iodine solution.—W. P. S.

Fat-soluble factor; Relation of —— to rickets and growth in pigs. II. J. Golding, S. S. Zilva, J. C. Drummond, and K. H. Coward. Biochem. J., 1922, **16**, 394—402.

PIGS fed on a diet deficient in vitamin A, or in calcium, or in both, show no definite picture of rickets, though they exhibit signs of diminished vitality.—W. O. K.

Antiscorbutic vitamin. I. A study of its solubility from desiccated orange juice. E. B. Hart, H. Steenbock, and S. Lepkovsky. J. Biol. Chem., 1922, **52**, 241—250.

THE antiscorbutic vitamin is soluble in 80%, 95%, and absolute alcohol, and also in methyl alcohol, but is insoluble in butyl alcohol, benzene, petroleum ether, acetone, ether, chloroform, and ethyl acetate. Its solubility is greater in dilute than in absolute alcohol.—E. S.

Muscle; Effect of cold storage on the carnosine content of ——. W. M. Clifford. Biochem. J., 1922, **16**, 341—343.

USING the colorimetric method previously described (J., 1921, 672 A), it has been found that the carnosine content of meat decreases during cold storage.
—W. O. K.

Coconut oil meal; Relative growth-promoting value of the protein of —— and of combinations of it with protein from various other feeding stuffs. L. A. Maynard and F. M. Fronda. Cornell Univ. Agr. Exp. Stat. Mem. 50, Dec., 1921, 621—633.

WHITE rats were fed on a diet, containing coconut oil meal, so arranged that the total amount of protein present was insufficient for normal growth, even when the diet was fed *ad libitum*. Comparison was made of various diets on the basis of gain per gram of protein eaten. The protein of coconut oil meal was superior to that of corn (maize) meal. Rice bran and wheat middlings were found to be efficient supplements to coconut oil meal. Results were not very satisfactory when coconut oil meal was supplemented with alfalfa (lucerne), and the addition of kaffir corn resulted in no improvement in the quality of the protein.
—A. G. P.

Volatile fatty acids [in silage]; Estimation of ——. G. Wiegner and J. Magasanik. Mitt. Geb. Lebensmittelunters. Hyg., 1919, **10**, 156—174. Biedermann's Zentr., 1922, **51**, 140—145.

FROM an equation showing the relationship between the relative amounts of water and acid in a distillation residue at the beginning and end of a distillation interval, a method is developed for the estimation of volatile fatty acids in aqueous extracts of silage. (*Cf.* J.C.S., July.)—G. W. R.

Starches; Digestibility of raw rice, arrowroot, canna, cassava, taro, tree-fern, and potato ——. C. F. Langworthy and H. J. Deuel, jun. J. Biol. Chem., 1922, **52**, 251—261.

THE digestibility of raw starches eaten, in some cases, in amounts as large as 250 g. a day was studied. Cassava, rice, and taro root starches were digested completely, tree-fern and arrowroot (*Maranta arundinacea*) starches nearly completely, and commercial arrowroot (*Zamia floridana*), potato, and canna starches incompletely. There appears to be a direct relationship between the size of the starch granules and its digestibility, the smaller granules being more readily digested.
—E. S.

Egg albumin, sugars, etc., as emulsifying agents. Clark and Mann. *See* XVII.

Trypsin. Kai. *See* XXIII.

PATENTS.

Dehydrators for fruits, vegetables and other foods. R. Rea. E.P. 180,806, 21.3.21.

THE material is conveyed in a series of trays on rollers through a drying tunnel, through which hot air is drawn by means of fans. Temperature and air supply are controlled by means of dampers. Trays are introduced at the cool end of the tunnel and withdrawn at the hot end. If necessary a pan of sulphur is placed at the air inlet to minimise oxidation and blackening of the material during drying.—A. G. P.

Fats; Treatment of edible ——. W. Douglas and Sons, Ltd., and J. S. Nicol. E.P. 181,077, 1.3.21.

THE colour, grain, and texture of lard or lard compounds are improved by forcing the fat in a tortuous path through a series of perforations and grooves in and spaces between two or more concentric hollow cylinders from the exterior of the outermost cylinder to the interior of the innermost cylinder, or *vice versâ*. One of the cylinders may be rotated to increase the rubbing effect on the fat. The cylinders may be provided with circumferential grooves, with which some of the perforations communicate, and the edges of some of the grooves may be serrated. The apparatus is provided with a by-pass controlled by a cock in such a way that when the fat is not being collected it is returned to the pump from the casing enclosing the cylinders without passing through the latter.—H. C. R.

*Bread; **Manufacture of** ——.* W. Watson, D. W. Kent-Jones, and Woodlands, Ltd. E.P. 181,397, 3.5.20.

A small quantity of a harmless hypochlorite or "chloro-hypochlorite" such as the sodium salt (*e.g.*, 0·005 to 0·01 pt. per 100 pts. of flour) or the calcium salt (*e.g.*, 0·045 pt. of bleaching powder per 100 pts. of flour) is incorporated with flour, and the treated flour made into a dough, which is baked. —J. R.

Yeast. E.P. 175,623, 181,076, and 181,293. *See* XVIII.

XIXb.—WATER PURIFICATION; SANITATION.

Equilibrium of bases in permutite. Günther-Schulze. *See* VII.

Patents.

Filtration of liquids. [*Sand filters.*] B. Bramwell. E.P. 181,044, 6.1.21.

The sand is removed layer by layer from a foul filter bed, cleansed, and re-deposited in a neighbouring bed by means of a suction apparatus which automatically travels in both horizontal directions. A reverse current wash may be applied to the foul bed while this is being discharged.—B. M. V.

Garbage reducer and distillator. P. L. Goodman. U.S.P. 1,419,135, 13.6.22. Appl., 6.11.20.

Refuse is distilled in a series of detachable retorts, having removable dome-shaped heads, from which the distillate is carried away to condensers. The carbonaceous residues can be used as fuel in the furnace.—A. G. P.

Metaldehyde; Burner for burning ——. Elektrizitätswerk Lonza, and A. Busch. E.P. 181,512, 23.3.21.

Metaldehyde moulded into the form of a candle is placed in a vertical cylindrical container and fed upwards as it burns by means of a spring under compression at the bottom of the holder. A guard is placed over the top of the material to prevent its ejection from the burner, and the top of the holder is manufactured from non-conducting material. —A. G.

Trade effluent and the like; Apparatus for separating the solid matter from ——. T. Waite and T. Boldy. E.P. 181,071, 26.2.21.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Toads; Poisonous substance of ——. H. Wieland and R. Alles. Ber., 1922, **55**, 1789—1798.

Further attempts to isolate the poisonous material from the skin of the toad have led to an unexpected result, since a more careful repetition of methods that were previously successful (Wieland and Weil, Ber., 1913, **46**, 3315) did not lead to the isolation of bufotalin. It appears that this is not present as such but is a product of the decomposition of the actual poison, bufotoxin, $C_{46}H_{62}O_{11}N_4$, m.p. 204°—205° C. The isolation of the latter from the extract of the skins and the secretions of the glands is described in detail. Bufotoxin is hydrolysed by dilute acids to bufotalein, $C_{24}H_{30}O_3$, and suberylarginine. (*Cf.* J.C.S., August.)—H. W.

Secale cornutum and so-called ergot substitutes. A. Tschirch. Schweiz. Apoth. Zeit., 1922, **60**, 1—6. Chem. Zentr., 1922, **93**, I., 1341.

The action of ergot substitutes, such as *Capsella*, is attributable to protein decomposition products. Since proteinogenous amines can be expected particularly in the extracts of fungi which are rich in protein, it is very probable that *Capsella* which has been attacked by the fungus *Cyclopus candidus* would be particularly active. Until, however, the conditions for the inception and course of the protein decomposition can be controlled, the extracts of all ergot substitutes are at best uncertain in their action and sometimes quite inert. The colouring matters of *Secale cornutum*, scleroxanthin and scelerythrin, have spectroscopically a certain relationship with red bacterial colouring matters, and in addition a third colouring matter is present which after extraction of the surface layer with alcoholic hydrogen chloride, alcoholic ammonia, and alcoholic sodium hydroxide is dissolved by concentrated sulphuric acid to a red solution, which shows a broad, faint band between $\lambda=540$ and $\lambda=570$. The solution in alcohol is yellow and shows only end absorption.—G. F. M.

Capsularin, a glucoside from jute leaf. H. Saha and K. N. Choudhury. Chem. Soc. Trans., 1922, 121, 1044—1046.

Matured leaves of *Corchorus capsularis* were extracted with boiling water, the extract clarified with lead acetate and concentrated to a small bulk. The glucoside was precipitated with tannic acid, and after liberation with barium hydroxide and recrystallisation it formed needle-shaped crystals, m.p. 175°—176° C. This glucoside, capsularin, is not identical with corchorin isolated by Kobert from the seeds of the same plant. It has the molecular formula $C_{22}H_{36}O_8$, $[\alpha]_D = -23{\cdot}6°$, and its penta-acetyl derivative melts at 194° C. It is very bitter to the taste, develops a red coloration with sulphuric acid, and on hydrolysis gives a mixture of *d*- and *l*-glucose. The second product of hydrolysis forms small needles, m.p. 185°, and gives with acetic anhydride, chloroform, and sulphuric acid a violet colour changing to green, a reaction characteristic of the alcohols of the $C_nH_{2n-6}O_4$ series.—G. F. M.

Castelin, a new glucoside from Castela Nicholsoni. L. P. Bosman. Chem. Soc. Trans., 1922, **121**, 969—972.

The active principle of *Castela Nicholsoni* (N.O. *Simarubaceæ*) is a hygroscopic, optically active glucoside, castelin, $C_{15}H_{22}O_8.3H_2O$, associated with a bitter principle, castelmarin. Castelin, white needles from water, m.p. 205° C. (anhydrous), $[\alpha]_D = +62{\cdot}9$ in aqueous solution, is soluble in water (1 in 85 pts. at room temperature, 1 in 25 pts. at 100° C.), ethyl alcohol, and cold concentrated hydrochloric acid, and gives a violet coloration with concentrated sulphuric acid. Castelagenin, $C_9H_{12}O_3$, its product of hydrolysis, m.p. 240°—241° C., $[\alpha]_D = +59°$ C., gives no coloration with sulphuric acid, and is lactonic in nature. The osazone of the sugar constituent is identical in appearance with glucosazone, and melts at 207°—209° C.—P. V. M.

Glucosides; New ——. R. de Fazi. Gazz. Chim. Ital., 1922, 52, I., 429—431.

The glucosides of 2-hydroxybenzylideneindene, 2-hydroxybenzylidenefluorene, and 2-hydroxybenzylideneacenaphthenone, prepared by condensation of helicin with indene, fluorene, and acenaphthenone, respectively, in presence of sodium ethoxide, are described. (*Cf.* J.C.S., Aug.)—T. H. P.

Amyrols; Isomeric ——. V. Paolini. Atti R. Accad. Lincei, 1922, 31, I., 374—377. (*Cf.* von Soden, J., 1900, 464; 1901, 64.)

Amyrol, the alcoholic terpene compound occurring in the essential oil of *Amyris balsamifera,* may be separated into *d*-amyrol, b.p. 302°, sp. gr. 0·982 at 15° C., $[\alpha]_D = +74°16'$, and *l*-amyrol, b.p. 295°, sp. gr. 0·980 at 15° C., $[\alpha]_D = -1°59'$. Both compounds are dense, oily liquids of unpleasant odour. (*Cf.* J.C.S., Aug.)—T. H. P.

Sulphonimides of the naphthoic acids; Isomeric —— : a contribution to the theory of dulcigenic groups. H. P. Kaufmann and H. Zobel. Ber., 1922, 55, 1499—1508.

The preparation of 2-naphthoic acid 1-sulphonimide, 1-naphthoic acid 2-sulphonimide, 2-naphthoic acid 3-sulphonimide and 1-naphthoic acid 8-sulphonimide is described. The constitution of these compounds is closely analagous to that of saccharin from which they differ by having the benzene nucleus of the latter replaced by naphthalene. In their chemical characteristics they are very nearly allied to saccharin, whereas they are distinguished physiologically by having a pronouncedly bitter taste, which is still more marked in their freely soluble sodium salts.—H. W.

Constitution and pharmacological action; Relationship between —— in the case of benzoic and tropic esters of alkylamines. J. von Braun, O. Braunsdorf, and K. Räth. Ber., 1922, 55, 1666—1680.

A series of alkylamines of the types,

$$R_2N\cdot[CH_2]_2\cdot OH,\ R_2N\cdot[CH_2]_3\cdot OH,$$
$$R{:}N\cdot[CH_2]_2\cdot OH \text{ and } R{:}N\cdot[CH_2]_3\cdot OH$$

have been prepared and the hydrogen atom of the hydroxy group has been replaced by the benzoyl and tropoyl residues. The benzoates of the γ-alkylamines are generally more active physiologically than those of the β-hydroxy bases, whereas the reverse is the case with the tropates. With regard to the influence of the number of the members of the nitrogen ring, it is shown that the six-membered ring is the most active both with respect to the anæsthetising action of the benzoates and the mydriatic and cardiac action of the tropates. The linking of carbon chains to the nitrogen ring increases the physiological action but only to a remarkably slight degree. The union of an aromatic ring with the monocyclic nitrogen ring diminishes the physiological action but an exact comparison is difficult in these cases and the effect is not very marked. (*Cf.* J.C.S., August.)—H. W.

Cholesterol; Some new colour reactions of ——. L. Kahlenberg. J. Biol. Chem., 1922, 52, 217—225.

Cholesterol dissolves in arsenic trichloride to a pink solution changing to cherry-red; isocholesterol yields a cobalt-blue solution changing through violet, purple, and dark red to dark green; phytosterol, however, dissolves to a colourless solution. The colours are discharged by the addition of solvents such as benzene, toluene, and chloroform. The colour reactions are also obtained with hot solutions of arsenious oxide in concentrated hydrochloric acid, but are not so permanent as with the anhydrous chloride. Coloured solutions, which are not, however, sufficiently characteristic to be used for distinguishing between the sterols, are also obtained with certain other acid chlorides. —E. S.

Proteins; The natural ——. *I. Behaviour of chlorine dioxide towards organic substances.* E. Schmidt and K. Braunsdorf. Ber., 1922, 55, 1529—1534.

The behaviour of substances closely allied to the natural proteins towards chlorine dioxide has been investigated by the method described previously (J., 1921, 764 A), except that the final addition of reagents to the solution under investigation is made in the sequence, 2*N* sulphuric acid (3 c.c.), 2*N* aqueous potassium iodide solution (1·5 c.c.), water (2—3 c.c.). The substances are considered as stable towards the reagent when the chlorine dioxide content of the solution is not diminished by more than 2% after periods of 24, 48, or 72 hours in the different instances. The following are stable:—Amino-acids and their derivatives (urethane, glycine, glycine hydrochloride, ethyl aminoacetate hydrochloride, aminoacetonitrile sulphate, glycineamide hydrochloride, phenylaminoacetic acid, hippuric acid, betaine, creatine, alanine, phenylalanine, valine, leucine, aspartic acid, asparagine, glutamic acid, serine, hydroxyproline, taurine, glycylglycine hydrochloride, leucylglycine, triglycine); amines and their derivatives (tetra- and penta-methylenediamine hydrochlorides, α-aminopropane-β-ol oxalate, guanidine hydrochloride, tetramethylammonium chloride, choline hydrochloride); amides and their derivatives (acetamide, chloroacetamide, propionamide, phenylacetamide, δ-dimethyloxamide, urea, biuret, hydantoin); imides (glutarimide, phthalimide); polyhydroxy alcohols (glycol, glycerol, mannitol, carbohydrates, inositol); mono- and poly-basic acids (acetic, chloroacetic, stearic, benzoic, oxalic, and adipic acids, trilaurin, tristearin, α-crotonic acid, maleic acid and its anhydride, fumaric acid); hydroxyacids, esters (ethyl lactate, tartaric, citric, and quinic acids); nitriles (acetonitrile, benzonitrile, ethylene dicyanide); cyclic compounds (benzene, naphthalene, cyclohexane, pyridine sulphate, quinoline hydrochloride, piperidine hydrochloride, β-nitroanethol). The following substances are attacked by chlorine dioxide:—Amino-acids and their derivatives (tyrosine, N-benzoyltyrosine, 3.4-dihydroxyphenylalanine, tryptophan, histidine hydrochloride, cystine); mono- and poly-hydroxyphenols; unsaturated carbon compounds (cyclohexene, allyl alcohol, anethol, cinnamyl alcohol, cinnamaldehyde, oleic acid, triolein, uric acid, furfural, indole, β-methylindole); carbon sulphur compounds (mercaptans, dialkyl disulphides, compounds such as thiourea). Histologically, a solution of chlorine dioxide in acetic acid is very useful for the removal of stains due to melanins from tissues, without in the least affecting their anatomical features.—H. W.

Neoarsphenamine [neosalvarsan]; Estimation of sulphate in ——. E. Elvove. J. Ind. Eng. Chem., 1922, 14, 624—626.

About 200 c.c. of distilled water is boiled down to about 150 c.c. and to the hot solution 0·2 g. of the sample is added, followed immediately by 10 c.c. of *N*/1 hydrochloric acid, or sufficient completely to dissolve the precipitate which first forms. The liquid is then boiled down to 50 c.c., diluted with water to 150 c.c., heated to boiling, and the sulphate precipitated by the addition of 15 c.c. of

0·05 molar barium chloride. The results obtained by this direct method are lower than the amounts found by the method of Raiziss and Falkov (J., 1921, 320 A), but it is considered that the latter are too high owing to oxidation occurring during the precipitation and filtration of the formaldehyde-sulphoxylic acid derivative which is involved in this method. The amounts of sulphate found calculated as Na_2SO_4 varied, in 34 samples from 10 different manufacturers, from 1·4 to 17·6%, averaging 1·76 to 5·82% for each series.—G. F. M.

Alcohol for use in the preparation of perfumes and cosmetics; Substances for denaturing ——. Reichsmonopolamt für Branntwein. Chem.-Zeit., 1922, **46**, 476.

The use of the following substances is allowed for the purpose of denaturing alcohol: diethyl phthalate, 2 l., turpentine oil, 1 l., or thymol, 1 kg., per 100 l. of alcohol.—W. P. S.

Allyl alcohol. Conversion to glyceryl chloro- and bromo-hydrins. J. Read and E. Hurst. Chem. Soc. Trans., 1922, **121**, 989—999.

GLYCERYL-β-MONOHALOGENO- and β-dihalogenohydrins, the former in predominating amount, are formed by the action of cold chlorine water and bromine water respectively on allyl alcohol. The monobromo-derivative is obtained in 60% yield by passing a current of air laden with bromine vapour into a mechanically stirred solution of allyl alcohol in water, neutralising the product with sodium carbonate, saturating with anhydrous sodium sulphate, and extracting with ether. The β-dibromohydrin is isolated simultaneously, representing about 44% of the final product, and is only separated by prolonged fractional distillation. A preferential formation of dibromohydrin amounting to 72·9% of a mixture representing 88% of total bromhydrin obtainable, is produced by treating allyl alcohol in its own weight of water with liquid bromine under the same conditions. The action between allyl alcohol and chlorine water is much more vigorous and hence more difficult to control. Only 11·2 and 10·8% of mono- and dichlorohydrins respectively can be isolated.—P. V. M.

Tertiary ethylenic alcohols (linalool type); Conversion of —— into primary ethylenic alcohols (geraniol type). R. Locquin and S. Wouseng. Comptes rend., 1922, **174**, 1711—1713.

DIALKYLVINYLCARBINOLS of the general type, $HO.CRR'.CH{:}CH_2$, readily undergo isomerisation when heated with glacial acetic acid at 100°—115° C. for 15 hours, giving $\gamma\gamma$-dialkylallyl alcohols of the type, $CRR'{:}CH.CH_2OH$, which by controlled oxidation give the corresponding $\beta\beta$-dialkylacraldehydes and on further oxidation the ketones R.CO.R'. (*Cf.* J.C.S., Aug.)—W. G.

Lactic acid; Method for the estimation of small amounts of ——. S. W. Clausen. J. Biol. Chem., 1922, **52**, 263—280.

The method of Von Fürth and Charnass (J., 1910, 903) is slightly modified. Lactic acid is decomposed either by acid permanganate at 95° C. or by 50% sulphuric acid at 140° C., the aldehyde produced being carried by a current of air into excess of sodium bisulphite. The excess bisulphite is removed by addition of iodine, the end-point being adjusted to a definite blue to starch. Saturated sodium bicarbonate is then added until the blue coloration is just discharged, and the sulphite of the aldehyde-bisulphite compound titrated with saturated iodine, the end-point being determined by a blank control. The errors which arise when the method is applied to blood or urine may be reduced, but not entirely eliminated, by first extracting the lactic acid from the protein-free filtrate by ether, using a special extraction apparatus.—E. S.

Oxalic acid; Oxidation of —— [by permanganate] in the absence of other acids. J. C. Witt. J. Phys. Chem., 1922, **26**, 435—446.

OXALIC acid may be titrated with potassium permanganate without the addition of another acid, the oxalic acid functioning both as reducing agent and acid,

$$2KMnO_4+8H_2C_2O_4 \rightarrow K_2C_2O_4+2MnC_2O_4+8H_2O+10CO_2.$$

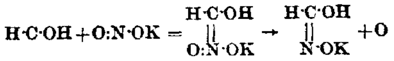
The end-point is marked by the appearance of a turbidity, followed by a slight permanent precipitate, and is affected by the temperature of titration, the concentration, and the presence of electrolytes. (*Cf.* J.C.S., Aug.)—J. S. G. T.

Acetic anhydride; Analysis of ——. C. E. Sage. Perf. Essent. Oil Rec., 1922, **13**, 172.

In the method described by Reclaire (J., 1922, 519 A) for the estimation of acetic anhydride the phenolphthalein used as indicator seems with certain samples to be peculiarly insensitive. The actual cause of this is obscure, but the peculiarity seems to run parallel with the development of the iodoform reaction when the sample in question is tested with sodium hydroxide and iodine. The unknown impurity giving this reaction may be traced back to the original acetic acid from which the anhydride was prepared, and it seems to be associated with faults in odour which sometimes develop in products prepared from the anhydride, *e.g.*, aspirin and synthetic "acetyl" perfumes. This insensitiveness of phenolphthalein may be overcome and a sharp end-point obtained if the titration is made by adding an excess of *N*/2 potassium hydroxide, allowing to stand for some time in the cold, until hydrolysis is complete, then adding a known quantity of *N*/2 acid and finishing off the titration with more *N*/2 potassium hydroxide. By this procedure errors due to heating under a reflux condenser will also be eliminated.—G. F. M.

Photocatalysis. II. Photosynthesis of nitrogen compounds from nitrates and carbon dioxide. E. C. C. Baly, I. M. Heilbron and D. P. Hudson. Chem. Soc. Trans., 1922, **121**, 1078—1088.

ACTIVATED formaldehyde, such as is photosynthetically produced from carbon dioxide and water under the influence of ultraviolet light or visible light in presence of a photocatalyst, reacts rapidly with nitrites with the formation of formhydroxamic acid, the reaction taking precedence to the polymerisation of the formaldehyde to reducing sugars. Photochemically activated formaldehyde possibly has the constitution H.C.OH, and its union with potassium nitrite would take place as follows:—



$$H\cdot C\cdot OH+O{:}N\cdot OK = \begin{array}{c}H\cdot C\cdot OH\\ \|\\ O{:}N\cdot OK\end{array} \rightarrow \begin{array}{c}H\cdot C\cdot OH\\ \|\\ N\cdot OK\end{array} +O$$

Formhydroxamic acid marks the first step in synthesis of the nitrogen compounds found in the plant, and it reacts further in various ways with activated formaldehyde to give α-amino acids and nitrogen bases, these condensations taking second order of preference, all excess of activated formaldehyde polymerising to hexoses. The photosynthesis of the nitrogenous compounds from formhydroxamic acid is extraordinarily rapid and soon goes far beyond the formation of simple compounds, the amino acids, pyrrol and pyridine derivatives condensing further to xanthine bases and substances of an alkaloidal nature. Two different alkaloids were isolated in this way, one a volatile oil with an odour resembling tobacco, and the other a solid of low melting point and an odour of burnt feathers. Both formed crystalline salts and gave positive tests with alkaloidal reagents. Positive evidence was also obtained of the formation of at least one substituted amino acid resembling histidine in its reactions. The photosynthesis of proteins would represent one stage further in the process, although positive evidence of their formation *in vitro* has not been obtained.—G. F. M.

Urea; Synthesis of —— from ammonia and carbon dioxide. N. W. Krase and V. L. Gaddy. J. Ind. Eng. Chem., 1922, 14, 611—616.

Experiments were made on the synthesis of urea from ammonia and carbon dioxide using a small experimental plant. The process finally developed consisted in preparing an initial charge of ammonium carbamate by condensing a mixture of ammonia, carbon dioxide, and about 1% of water vapour in a condenser maintained at about 25° C. and provided with a rotating scraping blade. The carbamate charge is formed by pressure into briquettes of such size as to fit easily into the autoclave, which is kept continuously at 150° C. The density of packing of the charge in the autoclave was found to influence greatly the percentage conversion into urea, a density of 0·3—0·5 g. per c.c. being suitable. High temperatures also favourably influence the yield, but the great pressure generated sets a limit to the temperature which can in practice be employed; 150° C. involving pressures of 1200—1800 lb. per sq. inch, is therefore as high as can conveniently be utilised. Heating is continued for 4 hours. The liquid converted charge containing about 40% of urea is slowly released into a still, and the unconverted ammonium carbamate distilled off at about 55° C. in a current of carbon dioxide, and recondensed together with additional ammonia to form a new charge of carbamate.—G. F. M.

Water, alcohol, and ether; Specific gravities and refractive indices at 15° C. of mixtures of ——. A. Sanfourche and A. M. Boutin. Bull. Soc. Chim., 1922, 31, 546—551.

The specific gravities and refractive indices at 15° C. of a large number of mixtures of water, alcohol, and ether in varying proportions are tabulated and the results are also shown in triangular diagrams.—W. G.

Spirit of camphor; The system camphor-alcohol-water in relation to the titration of ——. K. Scheringa. Pharm. Weekblad, 1922, 59, 389—395.

From the results of tests in which solutions of camphor in alcohol were treated with water until a permanent separation occurred, and the increase of weight determined, it is shown that many different mixtures can be prepared to satisfy the requirements of the Dutch Pharmacopœia, and that in analysing camphor spirit as recommended by titration with water, the temperature must be kept between 20° and 25° C., and the amount of camphor which can be added and held in solution at 15° C. should be specified.—S. I. L.

Essential oil of Myrica Gale. M. Schoofs. J. Pharm. Belg., 1921, 3, 769—773. Chem. Zentr., 1922, 93, I., 1340—1341.

Two essential oils were isolated from *Myrica Gale* by steam distillation. The one which was insoluble in the aqueous distillate had the following constants: sp. gr. 0·9068 at 15° C., $[\alpha]_D = -8° 46'$, $n_D^{25} = 1·4820$, acid value 1·5, saponif. value 17·8, iodine value 168·84, combined alcohols $(C_{10}H_{18}O)$ 4·4%, linalyl acetate 5·6%, free alcohols 11·1%. The other oil was extracted from the distillate and had the following constants: sp. gr. 0·8956 at 15° C., $[\alpha]_D = -5·9°$, $n_D^{25} = 1·4656$, acid value 1·8, saponif. value 18·19, combined alcohols 4·5%, linalyl acetate 5·73%, free alcohols 7·06%, iodine value 56·70.
—G. F. M.

Lantana Camara; Essential oil of ——. K. L. Moudgill and P. N. Vridhachalam. Perf. Essent. Oil Rec., 1922, 13, 173—174.

The essential oil of *Lantana Camara*, a wild shrub growing on waste lands in Southern India, was isolated by steam distillation, with a yield of about 0·2%. It is a greenish-yellow, slightly fluorescent oil, having an odour recalling that of sage. It is soluble in 5 vols. of 97% alcohol, and has the following characters:—Sp. gr. 0·8842 at 30°/4° C., $[\alpha]_D^{30} = +14·7°$, n=1·4899, acid value 1·6, saponif. value 4·6, acetyl value 23·4, aldehyde content 2·4%. On repeated fractionation three fractions were finally obtained: 55°—75° C. at 12 mm., 12% by volume; 75°—125° C., 8%; and 125°—130° C. at 12 mm., 74%. The first fraction proved to be *l*-α-phellandrene. The second fraction contained the odoriferous principles of the oil, and from the constants these appear to be mainly an aldehyde and an alcohol. The third fraction was mainly a bicyclic sesquiterpene closely resembling caryophyllene, although the solid caryophyllenic alcohol could not be obtained. On distilling this fraction under ordinary pressure the distillate differed considerably, particularly in rotation, from the original. The change does not appear to be simply a racemisation.—G. F. M.

Patents.

Synthetic camphor; Manufacture of ——. L. and E. Darrasse and L. Dupont. E.P. 164,357, 6.6.21. Conv., 9.6.20.

A solvent such as chlorinated hydrocarbon, turpentine, and anhydrous oxalic acid are heated together to the boiling point of the mixture, whereby bornyl oxalate is produced, the reaction taking place rapidly in the absence of inorganic chlorides. The bornyl oxalate is rapidly saponified by an aqueous solution of soda. It can be separated from the small quantity of uncombined turpentine by distilling off the latter. The reaction takes place most rapidly in tetrachloroethane solution.—H. C. R.

Medicinal compound [reduced araroba extract] and method of producing the same. J. F. Schamberg and G. W. Raiziss, Assrs. to Dermatological Research Laboratories. U.S.P. 1,417,771, 30.5.22. Appl., 21.4.20.

The amorphous powdered extract of araroba is dissolved in acetic acid and treated at the boiling point with metallic tin and hydrogen chloride. The reaction being completed, the solution is filtered and cooled, after removal of the acetic acid. The product separates out in minute yellow crystals, m.p. 190° C.; it is slightly soluble in ether and methyl alcohol, more soluble in acetic acid, chloroform, benzene, and ethyl alcohol.—G. F. M.

Urea; Producing —— from cyanamide. E. Lie. U.S.P. 1,419,157, 13.6.22. Appl., 10.6.20.

See E.P. 170,329 of 1920; J., 1922, 391 A.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Light sensitivity; Interpretation of —— in photography. T. Svedberg. Phot. J., 1922, 62, 310—320.

The author discusses the application of Einstein's law of the photochemical equivalent to various photochemical reactions, and to the particular case of the photographic process. He draws a distinction between plate-sensitiveness, grain-sensitiveness, and sensitiveness of the silver halide material of the grain. A description follows of some of his previous statistical work on the occurrence and distribution of developable centres in the grains, and of experiments which prove that in the case of the small spherical grains of a slow emulsion these centres are distributed on the surface.—W. C.

[Photographic] reduction with ammonium persulphate; Action of soluble chlorides and bromides on ——. S. E. Sheppard. Phot. J., 1922, **62**, 321—333.

The characteristic differential reducing action of ammonium persulphate is not necessarily due to the presence of chloride ions. The presence of low concentration of silver ions and of acid reduce the maximum rate of reduction, but do not eliminate the differential action of low densities. Bromide has no greater effect than chloride. The experimental evidence seems to favour the "dispersoid" theory of Lüppo-Cramer rather than the "catalytic" theory. The results obtained on reduction with ammonium persulphate are compared with those obtained by Higson (J., 1922, 234 A) with potassium persulphate. The effect of acid concentration on the reaction velocity is discussed, together with the actual mechanism of the reaction. —W. C.

Patents.

[Photographic] negatives; Process for the manufacture of —— *from opaque originals.* M. Ullmann. E.P. 156,691, 7.1.21. Conv., 7.1.20.

In the manufacture of negatives for photolithography from originals that do not allow light to pass through them, the chromate colloid coating is rendered insoluble in and impervious to water, by treatment with salts or basic or acid dyestuffs, *e.g.*, by dyeing in a dilute solution of pentamethyl-*p*-rosaniline and then bathing in a dilute aqueous solution of diaminostilbene-disulpho acid diphenol. —W. C.

Gelatin printing plates; Process for the production of ——. H. Renck. E.P. 168,578, 1.3.21. Conv., 2.9.20.

A printing relief surface is produced by exposing a bichromated gelatin plate behind a negative, thus causing the exposed parts to become hardened or insoluble, then treating with water to swell the unexposed parts, and subsequently exposing to dry heat to evaporate the water absorbed by the unexposed parts, thus causing these parts to sink lower than the hardened exposed parts.—W. C.

Sensitive plates and films for X-ray photography. N. E. Luboshey. E.P. 181,087, 2.3.21.

A layer of intensifying screen material (*e.g.*, calcium tungstate) is enclosed between the sensitive emulsion and the glass or film support, and forms a permanent part of the photographic plate or film. The material may be of the "single" or "duplex" form. In the former the glass or film support is coated on one side with intensifying screen material, and on this the sensitive emulsion is laid. In the "duplex" form each surface of the support is coated with an intensifying screen coating, and to each of these coatings is applied a layer of sensitive emulsion. The X-ray plates or films thus prepared may be enclosed within light-proof envelopes of opaque material coated with intensifying screen material on one or both sides of one or both sheets of the envelope, the envelopes being removed before development. X-ray plates or films as described may have an additional screen or screens affixed to the actual emulsion surface or surfaces by means of adhesive substances which allow of the removal of the screen or screens without wetting. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 2243 of 1915, and 125,490, and in pursuance of Sect. 8, Sub-sect. 2, to E.P. 163,903; J., 1916, 386; 1919, 389 A.)—W. C.

Sensitising [photographic] papers and other fabrics; Machines for ——. B. J. Hall. E.P. 181,460, 10.3.21.

The floor space occupied by the drying apparatus for sensitive papers and other fabrics after coating is reduced to a minimum by passing the paper after sensitising over a stationary heated body termed the radiator, the uncoated side of the paper being in direct contact with the heated radiator surface. In the event of sensitisers being used which would be injured or prevented from sliding by direct contact of the paper with the radiator, an endless revolving band of canvas or other material is interposed between the radiator and the paper.—W. C.

XXII.—EXPLOSIVES; MATCHES.

Nitrocellulose; Behaviour of —— *on heating with water under pressure.* A. Logothetis and G. Gregoropoulos. Z. ges. Schiess- u. Sprengstoffw., 1922, **17**, 89—90.

The stability of nitrocellulose can be increased by heating it in an autoclave with water. The maximum stability is usually reached after one or two treatments for 2 hrs. The pressure should not exceed 2 atm., or decomposition of the fibrous structure may result, together with loss of nitrogen and a lowering of the temperature of explosion. —H. C. R.

XXIII.—ANALYSIS.

Dialyser; A rapid ——. A. Gutbier, J. Huber, and W. Schieber. Ber., 1922, **55**, 1518—1523.

The apparatus consists of a wooden disc supporting a framework composed of glass rods in the form of a hollow cylinder. The membrane is passed over the framework and secured in its natural folds to the wooden disc. A stirrer is placed within the vessel, which is mounted in such a manner that the frame and stirrer can be rotated in opposite directions. The apparatus is placed in an inverted, tubulated bell-jar, through the tubulus of which water is admitted; the water can be heated or cooled by coils placed in the jar, and the level of the water and its discharge are governed by a lever arrangement. Comparative experiments show the dialyser to be much more rapid in its action than those of Graham or Zsigmondy and Heyer (J., 1910, 1249). In addition to rapidity of action, the following advantages are claimed: exclusion of external air from the internal liquid, from which, however, samples may be readily taken; small liability to change in volume, particularly to dilution of the internal liquid; great safety in action, [illegible] only a single piece of parchment is used; simple method of securing a continuous change of the external water; the possibility of dialysis at raised or lowered temperatures without complicated arrangements.—H. W.

Sampling horn: Kellogg's ——. J. W. Kellogg. J. Ind. Eng. Chem., 1922, **14**, 631.

A new type of horn for obtaining official samples of foodstuffs, fertilisers, etc., for analysis consists of a brass tube 31·5 inches long and 1$\frac{1}{16}$ inches internal diameter, which can be disjointed in the middle so as to be less cumbersome to carry about. The upper section has a four-inch handle, and the threaded end is protected with a screw-cap. The lower section has a bevelled, sharpened, knife-edge point, *which is protected with a cap. Slots run longitudinally down the tube, one edge of which is sharpened, which aids in forcing the sample into the horn. The slots are ¼ inch in width, and are designed especially to facilitate the removal of the sample with a spatula.—G. F. M.*

Micro-analysis; Furnace and burner for use in ——. E. Diepolder. Chem.-Zeit., 1922, **46**, 455.

A **burner** for use in micro-chemical combustions consists of a T-shaped tube; the gas is admitted through the vertical stem, which is provided with an air inlet and regulator, whilst the horizontal arm is perforated and constitutes the burner. The perforations may be closed separately so that the number of flames may be regulated at will.
—W. P. S.

Pycnometry. R. Saar. Chem.-Zeit., 1922, **46**, 433-435.

Tables and formulæ are given for calculating specific gravities determined at one temperature into similar values at another temperature.
—W. P. S.

Soxhlet apparatus; Extraction of small quantities of liquids in a ——. H. Handorf. Z. angew. Chem., 1922, **35**, 257—258.

The liquid to be extracted is placed in the inner tube (see Figs.). If the liquid is extracted by a solvent lighter than itself, the condensed solvent drops into the funnel (Fig. 1) and rises in drops from the rose through the liquid. If the liquid is extracted by a solvent heavier than itself, a short funnel ending in a capillary rests on the top of the tube (Fig. 2), and the condensed solvent falls through the liquid and rises in the inner tube. The apparatus is suited for the extraction of liquids containing colloidal substances.—H. [illegible]

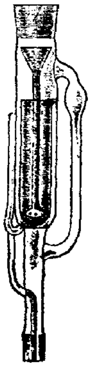


Fig. 1.

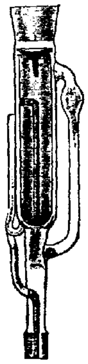


Fig. 2.

Aluminium and iron; Separation of —— by means of o-phenetidine. K. Chalupny and K. Breisch. Z. angew. Chem., 1922, **35**, 233—234.

Ferrous salts are not affected by *o*-phenetidine, whilst aluminium salts are precipitated completely by this reagent. To ensure reduction of any ferric salt present, the solution containing iron and aluminium salts is acidified slightly with hydrochloric acid and treated for 10 mins. with a current of hydrogen sulphide; carbon dioxide is then passed through the solution until all excess of hydrogen sulphide has been expelled. Ammonium carbonate is added until a precipitate forms; this is dissolved by adding a small quantity of dilute hydrochloric acid, and the mixture is treated with an excess of 5% alcoholic *o*-phenetidine solution. The flask is closed, the mixture heated at 60° C., and the precipitate collected, ignited, and weighed as Al_2O_3. To determine aluminium in the presence of copper and other metals, the copper must be separated electrolytically, the iron and aluminium then precipitated as basic acetates, the latter dissolved in dilute hydrochloric acid, and the aluminium precipitated from this solution as described.—W. P. S.

Manganese; Determination of ——. L. W. Winkler. Z. angew. Chem., 1922, **35**, 234—235.

The method described previously (J., 1921, 607 A, 751 A) for the determination of cadmium as phosphate may be applied to the determination of manganese; 1 mg. is deducted from the weight of the precipitate obtained when the latter weighs from 0·2 to 0·3 g. Sodium chloride must not be present in the solution, but potassium chloride does not interfere.—W. P. S.

Magnesium; Colorimetric method for the estimation of small amounts of ——. F. S. Hammett and E. T. Adams. J. Biol. Chem., 1922, **52**, 211—215.

The method is designed for application to urine, blood, and tissue extracts, and is a modification of Kramer and Tisdall's method (J. Biol. Chem., 1921, **48**, 223). The precipitate of ammonium magnesium phosphate obtained in the latter method is dissolved in $N/100$ hydrochloric acid and the phosphorus estimated colorimetrically by Bell and Doisy's method (J. Biol. Chem., 1920, **44**, 55). The amount of magnesium is then calculated from this result.—E. S.

Potassium ferrocyanide; Potentiometric titrations by means of ——. II. Potentiometric titration of zinc. I. M. Kolthoff. Rec. Trav. Chim., 1922, **41**, 425—437.

The results obtained in potentiometric titration of zinc by means of potassium ferrocyanide solution are reliable, and the method is convenient in practice. Although the method is applicable at ordinary temperatures, it is quicker at 70° C., and at the higher temperature the change in potential is more marked. As previously mentioned (J., 1922, 485 A), ferricyanide should be added to the ferrocyanide solution; the quantity recommended is 1 g. per litre. The molecular concentration of the ferrocyanide used was $\frac{1}{10}$. The best results are obtained in weak acid solution; 1 or 2 c.c. of $4N$ sulphuric acid is sufficient, and excess should be avoided, as the solubility of the precipitate of potassium zinc ferrocyanide is thereby increased, and this causes a decrease in the change of potential when the end-point is reached. Results obtained in neutral solution are from 1% to 1·5% too low. At ordinary temperatures the presence of a quantity of potassium sulphate or ammonium sulphate gives results which are usually about 0·5% too high. The latter salt at 70° C. introduces error in the opposite direction, as does ammonium chloride at ordinary temperatures. The titration of ferrocyanide by means of zinc may also be carried out with speed and accuracy by the potentiometric method.
—H. J. E.

Arsenic; Colorimetric determination of —— by means of quinine molybdate. D. Chouchak. Ann. Chim. Analyt., 1922, **4**, 138—142.

Quantities of arsenic as small as 0·00002 mg. yield a turbidity with quinine molybdate reagent. The arsenic solution under examination is treated with nitric acid, evaporated to dryness, and the residue treated with 0·5 c.c. of 17·5% nitric acid, 4·5 c.c. of water, and 20 c.c. of quinine molybdate reagent. The turbidity or opalescence produced is compared with that given by a known quantity of arsenic under similar conditions. The reagent, which is *saturated with quinine arsenomolybdate, is prepared by dissolving 0·5 g. of quinine hydrochloride in 10 c.c. of water, adding 5 c.c. of arsenic acid* solution (containing 0·01 mg. of arsenic per c.c.), 10 c.c. of 17·5% nitric acid, and 1 c.c. of sodium molybdate solution (3·5 g. of sodium carbonate and 9·5 g. of molybdic acid per 100 c.c.). After a few minutes the mixture is diluted to 120 c.c. and filtered through a filter-paper washed previously with dilute nitric acid and hot water. In the presence of heavy metals a preliminary separation of the arsenic by distillation with hydrochloric acid, potassium bromide, and hydrazine sulphate is necessary. The distillate is then oxidised with nitric acid, evaporated to dryness, and the test applied to the residue.—W. P. S.

Electrolysis; Rapid —— without rotating electrodes. G. Edgar and R. B. Purdum. J. Amer. Chem. Soc., 1922, **44**, 1267—1270.

Rapid electrolysis may be carried out without the use of rotating electrodes if the solution is stirred by means of a current of air. An apparatus is described for such analysis. The cathode is a platinum gauze cylinder in the centre of which is a spiral platinum electrode. The electrodes are contained in a glass tube, 31 mm. diam., to which are sealed three glass "air lifts" connected in a single tube at the bottom and entering symmetrically about halfway up the wide tube, the seals being made tangentially. When air is forced into the apparatus half filled with liquid, both vertical and rotational stirring is effected. Experiments on the electrolytic determination of copper, zinc, iron, and nickel are described which show that the results obtained with this apparatus are equally as good as those obtained with rotating electrodes.—J. F. S.

Adsorption of iron by precipitates of manganese dioxide. M. Geloso. Comptes rend., 1922, **174**, 1629—1631. (*Cf.* Nicolardot and others, J., 1920, 351 A.)

When manganese is precipitated as its dioxide by the addition of ammonium persulphate to an acid solution of manganese sulphate containing some iron salt, the amount of iron adsorbed by the precipitate varies directly as the concentrations of the iron and manganese and inversely as the acidity of the solution. The presence of ammonium sulphate does not affect the results. The iron adsorbed is mostly in the form of hydroxide.—W. G.

Permanganate; Oxidation of manganese to —— in alkaline solution. J. Heslinga. Chem. Weekblad, 1922, **19**, 274.

As little as 0·005 mg. of manganese may be detected by oxidising to permanganate in boiling solution in presence of bromine water, potassium hydroxide, and excess of copper sulphate. The coloration develops immediately. The reaction is not suitable for the colorimetric estimation of manganese. (*Cf.* J.C.S., August.)—S. I. L.

Radium; Direct determination of small quantities of —— by the penetrating rays. B. Szilard. Comptes rend., 1922, **174**, 1695—1698.

The electrometer previously described (*ibid.*, 1922, **174**, 1618) has been modified so as to provide a portable instrument working without either a high-tension battery or a projection mirror. By means of it rapid measurements can be made of the penetrating rays. The sensitiveness of the instrument corresponds to 10^{-4} U.E.S. Working with 500 g. of material containing 10^{-9} g. of radium per g. the results were accurate to within 2·5%.—W. G.

Cyanogen; Determination of ——. H. Yanagisawa. Yakugakuzasshi (J. Pharm. Soc. Japan), 1922, No. 483, 369—377.

The cyanogen compound is heated with dilute sul*phuric acid in a sealed tube at 200° C. for 4 hours, whereby cyanogen is converted into ammonia.* After cooling the resulting mixture is rendered alkaline with caustic soda, distilled into *N*/4 sulphuric acid, and the excess of acid titrated with *N*/4 ammonia as usual.—K. K.

Precipitates; Carrying down [of soluble salts] by ——. P. Dutoit and E. Grobet. J. Chim. Phys., 1922, **19**, 328—330.

The carrying down of soluble salts by precipitates is explained as due to the adsorption of these substances on the surface of the precipitate, whereby the soluble substance locally attains a value which exceeds its solubility product. This is prevented by stirring the solution very rapidly during the addition of the reagent, and in this way very good quantitative results may be obtained. (*Cf.* J. C. S., Aug.)—J. F. S.

Gases; Determination of suspended impurities in ——. W. W. Scott. J. Ind. Eng. Chem., 1922, **14**, 432—433.

Dust particles or liquid mist in gases can be detected by their visibility in a beam of solar or arc light. The observation is best made in a direction towards the source of light. A filter of loose dry asbestos, 2 in. thick, effectually removes liquid or solid matter. The estimation of liquid suspended in gases, for instance, sulphuric acid in contact process gases, may be carried out by aspirating the gas through a filter of blue Cape asbestos, extracting the asbestos with water, and titrating the solution with standard alkali; the gas is measured by a dry gas meter.—H. M.

Pyrogallol solutions for gas analysis; Oxygen absorption and concentration of ——. F. Hoffmann. Z. angew. Chem., 1922, **35**, 325—328.

Experiments to determine the absorptive powers for oxygen of solutions prepared with different proportions of pyrogallol and caustic potash were made by introducing successive quantities of 60 c.c. of air into a pipette containing 0·5 c.c. of the solution under test, the results being added together and tabulated in a Gibbs triangular diagram for the ternary system pyrogallol, caustic potash, and water. A line of maximum absorptions was found corresponding to mixtures containing pyrogallol and caustic potash in the proportion of 3 to 2. In the field to one side of this line, corresponding to a smaller proportion of caustic potash, the absorptive power falls sharply. From practical considerations the optimum proportion is stated as 20 pts. of pyrogallol, 20 pts. of potash, and 60 pts. of water, or 40 g. of pyrogallol in 90 c.c. of water with 70 g. of concentrated potash solution of sp. gr. 1·55.—H. M.

Oxygen; Method for the estimation of minute amounts of —— and its application to respiratory air. H. M. Sheaff. J. Biol. Chem., 1922, **52**, 35—50.

The method is intended mainly for use in following the oxygen consumption of plant and animal tissue under different conditions. By means of the apparatus, which is described and illustrated, it is stated that oxygen can be estimated in amounts as small as 1×10^{-7} g. The method depends upon the conversion of the oxygen, in the presence of nitric oxide and sodium hydroxide, into sodium nitrite, and the estimation of the latter colorimetrically by means of sulphanilic acid and α-naphthylamine.—E. S.

Organic compounds; Determination of chlorine in ——. J. Klimont. Chem.-Zeit., 1922, **46**, 521—522.

When monochloroacetic acid is neutralised, then boiled under a reflux condenser with alcoholic potassium hydroxide solution and the excess of the latter titrated subsequently, the saponification value thus obtained is a measure of the chlorine in the molecule, the substance being converted quantitatively into potassium acetate and potassium chloride. The method, however, yields unsatisfactory results when applied to the determination of chlorine in acetylene dichloride, monochlorohydrin, monochloroacetone, dichloroacetone, α-chloronaphthalene, bornyl chloride, pinene hydrochloride, trichloroethane, acetylene tetrachloride, and α-dibromohydrin, either because the molecule of the substance is incompletely hydrolysed or because secondary reactions occur.—W. P. S.

Trypsin; Method for the quantitative determination of ——. *A modification of Gross' method.* S. Kai. J. Biol. Chem., 1922, **52**, 133—136.

The relative strengths of trypsin preparations are estimated by measuring the time taken by equal amounts of each to digest 25 c.c. of a casein solution, the time of digestion being inversely proportional to the concentration of the trypsin. The end point of digestion is determined by adding a solution of sodium acetate and acetic acid to test portions withdrawn from time to time, no precipitate being produced when digestion is complete.—E. S.

Sulphur; Rapid estimation of ——. *I.* L. Losana. Giorn. Chim. Ind. Applic., 1922, **4**, 204—206.

When a sulphur compound is heated with powdered iron out of contact with the air and the mass thus obtained then treated with hydrochloric acid, the whole of the sulphur is liberated as hydrogen sulphide. The latter may be absorbed by zinc acetate solution and the sulphide so formed titrated with standard iodine solution. The amount of the substance taken for analysis is 1 g., 0·5 g., or 0·1 g., according as the percentage of sulphur present is 0—5, 5—10, or more than 10. A mixture of the substance with 2 g. of pure powdered iron and 0·5 g. of sodium hydrogen carbonate is introduced into a hard glass tube, covered with a layer of the iron several mm. in depth, and heated to incandescence for a few minutes. The treatment of the mass with acid is carried out in a small round-bottomed flask with a ground stopper sealed to the tube of a reflux condenser, the upper end of the tube being bent over to pass through the cork of a bulbed absorption tube charged with about 150 c.c. of 2·5% zinc acetate solution acidified slightly by acetic acid. A gas delivery tube dipping into a little water in the flask is sealed horizontally through the head of the ground stopper, and ends in a vertical cross-piece to form a T-piece. The top of the latter is connected with a source of carbon dioxide and the bottom with a rather long rubber tube joined to a tapped funnel. The hard glass tube containing the heated mixture is allowed to cool somewhat, and is dropped while still hot into the flask and thus broken by the cold water. A rapid current of carbon dioxide, washed by permanganate solution and then by water, is passed through the flask, and hydrochloric acid introduced through the funnel. When the reaction slackens the flask is heated gently, and when evolution of gas ceases carbon dioxide is passed briskly through the apparatus for about five minutes. The liquid from the absorption bulbs is transferred to a beaker, diluted to 300—400 c.c., mixed with a known volume in excess of standard iodine solution, allowed to settle, and titrated with thiosulphate solution, the sulphur being calculated from the equation, $ZnS+I_2=ZnI_2+S$. The content of sulphur in the reagents used is determined by a blank experiment. Tests made on flowers of sulphur and on copper, lead, barium, and cobalt sulphates gave virtually theoretical results. The estimation may be completed in about 40 minutes. When the estimation is to be made on an organic compound, this is first mixed with copper oxide or lead chromate and the mixture heated in a porcelain crucible, or, if the compound is volatile, in a narrow glass tube in which it is covered with a deep layer of the oxidising material. —T. H. P.

Oxidation by means of sulphuric acid and chromates. L. J. Simon. Comptes rend., 1922, **174**, 1706—1708.

For the wet combustion of organic compounds by means of chromic acid the most satisfactory results are obtained by the use of a mixture of concentrated sulphuric acid and silver chromate, using about 15 c.c. of the acid and 12 g. of the chromate for about 0·1 g. of substance. This oxidising mixture completely oxidises acetates or acetyl compounds, whereas chromic anhydride and sulphuric acid together do not.—W. G.

See also pages (A) 577, *Benzene in gases* (Krieger); *Carbon monoxide, hydrogen, and methane* (Wallers). 583, *Degree of beating of paper pulp* (Skark). 584, *Sulphite acid* (Genberg). 586, *Chlorine and hypochlorous acid* (Taylor and Gammal). 590, *Rational analysis of ceramic materials* (Rieke). 591, *Softening temperature of refractory materials* (Steger); *Testing porcelain* (Rieke and Gary). 594, *Vanadium in steel works materials* (Briefs); *Chromium in steels* (Losana and Carozzi); *Vanadium in steel* (Kropf). 595, *Lead* (Odajima); *Uranium* (Buell). 603, *Sucrose* (Canals); *Artificial honey* (Auerbach and Borries). 604, *Wine* (Ferré). 606, *Volatile fatty acids* (Wiegner and Magasanik). 608, *Cholesterol* (Kahlenberg); *Action of chlorine dioxide on organic substances* (Schmidt and Braundsdorf); *Sulphate in neoarsphenamine* (Elvove). 609, *Lactic acid* (Clausen); *Oxalic acid* (Witt); *Acetic anhydride* (Sage). 610, *Spirit of camphor* (Scheringa).

PATENT.

Gas analysing apparatus; Registering devices for —— [*for recording two or more series of analyses on a single chart*]. Svenska Aktiebolaget Mono. E.P. 157,895, 4.1.21. Conv., 16.1.20.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given; they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Bechhold. Filters. 19,640. July 17.

Bollmann. Distilling apparatus, 19,031. July 11.

Boulton, Ltd., and Johnson. 19,535. *See* VIII.

Brackett, and Brackett and Co. Rotary filters etc. 18,896. July 10.

Brinjes and Goodwin, Ltd., and Seaman. Mixing, emulsifying, etc. machines. 19,412. July 14.

Hall. Centrifugal separators. 19,192. July 12. (U.S., 15.7.21.)

Hunt, and Hunt and Co. Grinding and crushing mill. 19,638. July 17.

McGinness. Grinding-mill. 20,137. July 22.

Mackey. Apparatus for clarifying liquids containing finely-divided matter in suspension. 19,986. July 21.

N. V. Philips' Gloeilampenfabr. Separating gases from a mixture thereof. 19,860. July 19. (Holland, 19.4.22.)

Podszus. Obtaining powders of great fineness. 19,202. July 12. (Ger., 12.[illegible].21.)

Rule. Chemical process. 19,563. July 17.

Russell. Recovery of waste heat. 19,231. July 13.

Shaw. Separating matter suspended in fluid. 19,845. July 19.

Soc. l'Air Liquide. Separating constituents of air etc. 20,130. July 22. (Fr., 12.8.21.)

Soc. l'Air Liquide. Purification of gases by cooling. 20,135. July 22. (Fr., 13.8.21.)

Vautin. Apparatus for removing gases from substances. 19,260. July 13.

COMPLETE SPECIFICATIONS ACCEPTED.

35,975 (1920). Brutzkus. Effecting chemical reaction in the interior of compressors. (155,776.) July 19.

786 (1921). Lilienfeld. Manufacture of colloidally soluble substances and suspensions or emulsions. (156,725.) July 26.

2003 (1921). Wade (Schneible). *See* XVIII.

6746 (1921). Gardner. Mixing and/or disintegrating machines. (182,850.) July 26.

9677 (1921). Dine and Sieff. Preparation for removing scale from boilers and preventing its formation. (182,545.) July 19.

12,600 and 14,501 (1921). Heenan and Froude, and Walker. Concentration of brine etc. used as circulating medium in refrigerating apparatus. (182,982.) July 26.

19,114 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Preparation of colloids and colloidal solutions. (182,696.) July 19.

6090 (1922). Marx. Dehydrating plastic and other materials. (183,097.) July 26.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

APPLICATIONS.

Auld. 19,974. *See* III.

Batchelor. Production of artificial light. 19,505. July 15.

Bitumen Products, Ltd., and Illemann. Solid oil fuel. 19,074. July 12.

Burls. Treatment of carbonaceous substances. 19,978. July 20.

Calder and Lennox. Inflammable vaporisable liquid fuels. 20,068. July 21.

Calder and Lennox. Gas-producing plant. 20,0[illegible]. July 21.

Carbic, Ltd., and Them. 20,060. *See* VII.

Chown. Carbonising and distilling carbonaceous material. 18,925. July 10.

Coppée et Cie. Concentrating etc. carbonaceous slimes. 19,730. July 18. (Belg., 19.7.21.)

Duffield. Pulverising coal etc. 19,410. July 14.

Fabry. Coke manufacture. 19,346. July 14.

Harris and Rose. Gaseous fuel. 19,161. July 12.

Hood, and Oil Refining Improvements Co. Purification of oils. 20,129. July 22.

Kern. Obtaining mineral oils from bituminous rocks. 20,024. July 21. (Ger., 27.7.21.)

Ormandy. Manufacture of fuel briquettes. 20,046. July 21.

Quinan. Pyrolytic distillation. 20,052. July 21. (S. Africa, 6.8.21.)

Remfry. Treatment of hydrocarbons. 20,151. July 22.

Remfry. Treatment of cracked spirit. 20,152. July 22.

Simon-Carves, Ltd. Treating coal etc. slimes. 19,877. July 20.

Walker and White. Gas generators. 19,248. July 13.

COMPLETE SPECIFICATIONS ACCEPTED.

365 (1921). Freyn, Brassert, et Cie. Apparatus for washing gas. (156,490.) July 19.

1230 (1921). Polysius. Low-temperature carbonisation. (157,318.) July 26.

1785–6 (1921). Mather. Distillation of crude oil and other liquids. (182,827–8.) July 26.

7160 (1921). Plauson and Vielle. Manufacture of hydrocarbons from coal etc. or its distillation products. (182,852.) July 26.

7407 (1921). McDonald. Process for making gas. (159,886.) July 26.

9646 (1921). Bonnard. Carbonising furnaces and retorts. (182,542.) July 19.

10,303 (1921). Igranic Electric Co. *See* XXIII.

10,409 (1921). Bowen. Production of artificial fuel. (182,578.) July 19.

11,041 (1921). Wood. Gas retorts. (161,918.) July 26.

11,838 (1921). Salerni. Apparatus for distilling carbonaceous materials. (182,601.) July 19.

15,203 (1921). Maclaurin. Enriched water-gas plant. (182,648.) July 19.

19,402 and 19,994 (1921). Warden. Coking-retort ovens. (182,697 and 182,702.) July 19.

22,878 (1921). Holland. Recovery of coal from water etc. (171,670.) July 26.

34,654 (1921). L'Air Liquide. *See* VII.

10,079 (1922). Polysius. Low-temperature carbonisation. (178,126.) July 26.

III.—TAR AND TAR PRODUCTS.

APPLICATIONS.

Auld. Treatment of hydrocarbons. 19,974. July 20.

Insulators, Ltd., and Winfield. Treatment of tar, pitch, etc. 19,257. July 13.

Murphy. 19,041. *See* IX.

Remfry. 20,151. *See* II.

COMPLETE SPECIFICATIONS ACCEPTED.

4557 (1921). Atack. Oxidation of hydrocarbons. (182,843.) July 26.

9361 (1921). Blumner. Distillation of tars or oils. (182,868.) July 26.

10,603 (1921). Koppers Co. Purification of phenol-contaminated liquors. (161,976.) July 26.

12,974 (1921). Bismarckhütte. Separation of water from coal tar. (163,011.) July 19.

20,417 (1921). British Dyestuffs Corp., Green, and Green. Manufacture of phthalimide. (183,044.) July 26.

30,471 (1921). Barrett Co. Purification of naphthalene. (172,937.) July 19.

IV.—COLOURING MATTERS AND DYES.

COMPLETE SPECIFICATIONS ACCEPTED.

688 (1921). Plauson and Vielle. *See* XIII.

13,624 (1921). Bayer u. Co. Manufacture of copper compounds of substantive azo dyestuffs. (165,083.) July 19.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

APPLICATIONS.

Briggs, Palmer, and British Cellulose and Chem. Manuf. Co. Manufacture or treatment of artificial silk, films, etc. 19,488. July 15.

Caldecott, Horrocks, Rushworth, and Rushworth and Co. Treatment of fibres for brooms etc. 20,007. July 21.

Cook, and Cook and Co. Treatment of cotton etc. 19,647. July 18.

Dreyfus. Manufacture of compositions with cellulose derivatives. 19,255–6. July 13.

Kämpf. Manufacture of artificial threads etc. of viscose. 20,003–4. July 21. (Ger., 6.8.21.)

Little Inc. Cellulose derivative and process of preparing same. 18,934. July 10. (U.S., 10.4.20.)

N. V. Hollandsche Kunstzijde Ind. Manufacture of artificial silk threads etc. from viscose. 19,953. July 20. (Ger., 20.7.21.)

Wickel. Manufacture of metal-coated paper. 19,589. July 17. (Ger., 15.7.21.)

COMPLETE SPECIFICATIONS ACCEPTED.

36,001 (1920). Köln-Rottweil A.-G. Manufacture of cellulose material. (156,095.) July 19.

753 (1921). Ehrenthal. Manufacture of cotton substitutes. (156,709.) July 19.

1911 and 22,980 (1921). Clavel. Treatment of cellulose acetate or products made therewith. (182,830.) July 26.

20,703 (1921). Granton (Niessen). Manufacture of bristles for brooms, brushes, etc. from bamboo, madagascar, pepper, and similar reeds. (183,049.) July 26.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Bleachers' Assoc., Ltd., and Kenworthy. Bleaching etc. kiers. 19,541. July 17.

Farrar, Lepine, and Whitehead. Dyeing-machines. 19,455. July 15.

COMPLETE SPECIFICATIONS ACCEPTED.

4638 and 29,734 (1921). Clavel. Treatment of union or mixed fabrics. (182,844.) July 26.

10,331 (1921). Brandwood, Brandwood, and Brandwood. Dyeing, bleaching, etc. of textile fibres. (182,575.) July 19.

28,921 (1921). Bloxam (A.-G. f. Anilinfabr.). Dyeing skins, hairs, etc. (183,078.) July 26.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Ashworth. Apparatus for producing bisulphites etc. 19,661. July 18.

Bäckström and Cederberg. Apparatus for catalytic oxidation of ammonia. 19,405. July 14.

Blattner (Grouchkine). Manufacture of caustic alkali. 19,615 and 20,663. July 17 and 21.

Blumenfeld and Weizmann. Titanium compounds. 19,154–6. July 12.

British Oxygen Co., and Houseman. Manufacture of sulphur dioxide. 19,820–1. July 19.

Carbic, Ltd., and Them. Manufacture of calcium carbide cakes. 20,060. July 21.

Charlesworth and Johnson. Machine for drying and neutralising sulphate of ammonia etc. 19,546. July 17.

Cochran and Marsh. 19,738. *See* X.

Farrell. Caustic soda recovery apparatus. 20,100. July 22.

Mond (Chem. Fabr. Griesheim-Elektron). Manufacture of alumina. 19,700. July 18.

Soc. l'Air Liquide. 20,130. *See* I.

COMPLETE SPECIFICATIONS ACCEPTED.

1911 (1921). Helbronner and Pipereaut. Manufacture of sulphuric acid. (157,281.) July 26.

6801 (1921). Norsk Hydro-Elektrisk Kvaelstofaktieselskab. Manufacture of ammonia. (159,878.) July 19.

7533 and 23,759 (1921). Broadbridge, Edser, and Sellers. Treatment of caliche. (182,859.) July 26.

7597 (1921). Goldschmidt. Manufacture of magnesium chloride. (161,165.) July 26.

9832 (1921). L'Air Liquide. Synthesis of ammonia. (160,811.) July 19.

10,771 (1921). Chem. Fabr. Griesheim-Elektron. Production of stable compounds of calcium hypochlorite. (182,927.) July 26.

16,164 (1921). Courtaulds, Ltd., and Jones. Manufacture of caustic soda. (182,661.) July 19.

32,216 (1921). Weyman. Neutralising and drying sulphate of ammonia. (183,089.) July 26.

34,654 (1921). L'Air Liquide. Manufacture of hydrogen. (175,605.) July 19.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Boulton, Ltd., and Johnson. Cloth for filter presses for treating potters' clay etc. 19,535. July 17.

Bundy. Glass etching. 19,783. July 19.

Damard Lacquer Co., Lloyd, Potter, and Robinson. Pottery etc. 19,366. July 14.

COMPLETE SPECIFICATIONS ACCEPTED.

9749 (1921). Mathys (Bicheroux, Lambotte et Cie.). Manufacture of raw plate glass. (182,551.) July 19.

10,168 (1921). Clark. Electro-fining glass furnace. (161,192.) July 19.

19,329 (1921). Ges. f. Tuff- u. Ton-Technik. Production of ceramic materials, glass, and glazings. (166,558.) July 19.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Bühler. Manufacture of Portland cement. 20,005. July 21. (Switz., 15.10.21.)

Davies. Oxychloride cement coverings. 19,553. July 17.

Lanhoffer. Roasting or calcining cement. 19,149. July 12. (Fr., 3.4.22.)

Murphy. Soluble tar, bituminous etc. compound for roads etc. 19,041. July 11.

Samuel. 19,174. *See* XI.

COMPLETE SPECIFICATION ACCEPTED.

3950 (1921). Lyon. Artificial maturing or seasoning of wood. (182,504.) July 19.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Ashcroft. Treatment of sulphide ores etc. 19,422. July 14.

Ashcroft. Recovering tin from tinplates, alloys, etc. 19,483. July 15.

Ashcroft. Separating metals from fused melts of zinc and/or lead chloride. 19,616. July 17.

Beardmore and Co., and Neilson. Cleaning out open-hearth furnaces. 18,849. July 10.

Cochran and Marsh. Reclaiming spent pickling solution. 19,738. July 18. (U.S., 3.8.21.)

Craig, Pearson, and Durelco, Ltd. Manufacture of tungsten. 19,197. July 12.

Hansgirg. 18,928. *See* XI.

Imray (Dietzsch and Prain). Treatment of copper ores. 18,897. July 10.

Levoz. Side-blast converter furnaces. 19,051. July 11. (Fr., 9.8.21.)

Maynard. Vanning-table for concentrating gold, silver, tin, etc. 20,105. July 22.

N. V. Philips' Gloeilampenfabr. Manufacture of tungsten powder. 19,430. July 14. (Holland, 29.7.21.)

Rodriguez. Production of alloys. 19,054. July 11.

Complete Specifications Accepted.

64 (1921). Parr, Mawer, and Painton. Annealing and hardening high and low carbon steels etc. (182,825.) July 26.

9163 (1921). Goskar and Hitch. Composition for case-hardening iron and steel. (182,527.) July 19.

11,066 (1921). Chem. Fabr. Griesheim-Elektron, and Beielstein. Recovery of light metals from scrap. (182,948.) July 26.

1[illegible],129 (1921). Burgess. Reduction of aluminium oxide. (182,609.) July 19.

12,260 (1921). Usines Metallurgiques de la Basse-Loire. Production of basic steel. (163,693.) July 26.

13,235 (1921). Brunskill. Treatment to obviate rusting or oxidation of iron or steel surfaces. (182,988.) July 26.

19,474 (1921). British Thomson-Houston Co. (General Electric Co.). Manufacture of bodies of tungsten alloys. (182,699.) July 19.

XI.—ELECTRO-CHEMISTRY.

Applications.

Casale. Apparatus for electrolysis of water. 19,617. July 17.

David and Dutt. Primary batteries. 19,979. July 20.

David and Dutt. Storage batteries. 20,023. July 21.

F. I. A. T. Electric furnaces. 19,344. July 14. (Ital., 23.12.21.)

Felten u. Guilleaume Carlswerk. 19,739. *See* XIII.

Hansgirg. Electrolysis of zinciferous materials. 18,928. July 10.

Reichenstein. Stabilising detector and reinforcing effect of electrolytic cells. 19,581. July 17. (Ger., 19.7.21.)

Samuel. Electrical and thermal insulator. 19,174. July 12. (Fr., 1.8.21.)

Complete Specifications Accepted.

14,571 (1921). Heap, and Chloride Electrical Storage Co. Secondary batteries. (183,012.) July 26.

19,744 (1921). Hooker Electrochemical Co. Electrolysis of solutions. (167,469.) July 26.

1253 (1922). Frick. Electric-induction furnaces. (174,084.) July 19.

XII.—FATS; OILS; WAXES.

Applications.

Benson. Obtaining oil products. 19,039. July 11.

Zipser. Extraction of fatty etc. matters by means of volatile solvents. 20,059. July 21. (Austria, 27.7.21.)

Complete Specification Accepted.

9434 (1921). Webster. Treating the vapours and gases formed by heating fatty oils, gums, resins, etc. (182,869.) July 26.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Baggaley. Manufacture of invisible pencils, printers' and writing inks, etc. 19,803. July 19.

Felten u. Guilleaume Carlswerk. Protective covering for submarine cables. 19,739. July 18. (Ger., 18.7.21.)

Fletcher, West, and Titanine, Ltd. Manufacture of dopes, varnishes, or paints. 20,142. July 22.

Complete Specifications Accepted.

688 (1921). Plauson and Vielle. Manufacture of resins and oil-soluble dyestuffs. (182,497.) July 19.

9434 (1921). Webster. *See* XII.

10,214 (1921). Dehn (Satow). Manufacture of insoluble condensation products from phenol and formaldehyde. (182,886.) July 26.

18,949 (1921). Hetherington and Allsebrook. Manufacture of lead chromate pigments. (182,693.) July 19.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Barnes (Miller Rubber Co.). Manufacture of hard rubber articles. 19,071. July 12.

Barnes (Miller Rubber Co.). Manufacture of vulcanised rubber articles. 19,481–2. July 15.

Draemann. Manufacture of rubber filaments or threads. 19,744–5. July 18.

Naugatuck Chemical Co. Vulcanising rubber. 19,203. July 12. (U.S., 15.5.22.)

Complete Specifications Accepted.

1769 and 1782 (1921). Hopkinson. Treatment of rubber containing latex. (157,975 and 157,978.) July 19 and 26.

4950 (1922). Hug. Improving and regenerating indiarubber. (177,495.) July 26.

XV.—LEATHER; BONE; HORN; GLUE.

Application.

Ampt and Lansdown. Utilising cork, leather, etc. for manufacture of leather substitute. 19,015. July 11.

Complete Specifications Accepted.

54 (1921). Croad, Knowles, and McArthur and Co. Manufacture of tanning agents. (182,823.) July 26.

55 (1921). Croad, and McArthur and Co. Manufacture of tanning agents. (182,824.) July 26.

666 (1921). Chem. Fabr. Worms. Process for tanning hides. (156,670.) July 26.

1595 (1921). Reubig. Treating and finishing leathers. (157,864.) July 26.

XVI.—SOILS; FERTILISERS.

Application.

Kreiss. Phosphatic fertilisers. 19,747. July 18. (U.S. 13.9.21.)

Complete Specification Accepted.

15,694 (1921). Desmond and Tisdall. Fertilisers. (182,654.) July 19.

XVII.—SUGARS; STARCHES; GUMS.

Application.

Soc. Anon Etabl. Olier. Apparatus for extracting sugar from raw materials. 20,056. July 21. (Fr., 6.8.21.)

Complete Specifications Accepted.

1800 (1921). Campbell. Manufacture of starch. (182,829.) July 26.

7024 (1921). Corn Products Refining Co. Separation of gluten from starch. (159,838.) July 26.

7456 (1921). Mauss. Treatment of sugar juice. (182,855.) July 26.

XVIII.—FERMENTATION INDUSTRIES.

Applications.

Distillers Co., and Meyer. Treatment of yeast. 19,633. July 17.

Guthrie, and McEwan and Co. 19,069. *See* XIX.

Complete Specification Accepted.

2003 (1921). Wade (Schneible). Distilling alcoholic and other liquids. (182,832.) July 26.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Elektrizitätswerk Lonza. 19,703. *See* XX.

Guthrie, and McEwan and Co. Manufacture of food products from yeast. 19,069. July 12.

Jackson (Deuts. Ges. f. Schädlingsbekämpfung). Insecticides. 20,026. July 21.

Maclachlan Reduction Process Co. Treatment of sewage sludge. 19,185. July 12. (U.S., 12.4.22.)

Marks (Royal Baking Powder Co.). Effervescent mixtures. 19,048. July 11.

Morison. Degassing boiler feed water. 19,386. July 14.

Silver Springs Bleaching and Dyeing Co. Treating waste liquors. 20,000. July 21.

Complete Specifications Accepted.

7024 (1921). Corn Products Refining Co. *See* XVII.

10,603 (1921). Koppers Co. *See* III.

12,189 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Dissolving dried or concentrated milk. (182,612.) July 19.

XX.—ORGANIC SUBSTANCES; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Boehringer u. Söhne. Preparation of anthranilic acid derivatives. 19,511. July 15. (Ger., 20.7.21.)

Elektrizitätswerk Lonza, and Johnson. Production of metaldehyde and obtaining combustible substances therefrom. 19,703. July 18. (Ger., 9.3.22.)

Complete Specifications Accepted.

1627 (1921). Elektrochem. Werke, Bosshard, and Strauss. Production of sulphonated condensation products. (158,512.) July 26.

1628 (1921). Elektrochem. Werke, Bosshard, and Strauss. Production of a condensation product for naphthalene and glycollic acid. (171,956.) July 26.

13,004 (1921). Howards and Sons, Blagden, and Nierenstein. Manufacture of amino derivatives of hydrogenated cinchona alkaloids and their derivatives. (182,986.) July 26.

389 (1922). Lowe. Manufacture of saccharin. (174,913.) July 26.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Complete Specification Accepted.

7788 (1921). Kelley. Treating and dyeing photographic images. (160,137.) July 26.

XXII.—EXPLOSIVES; MATCHES.

Application.

Friederich and Rathsburg. Manufacture of priming compositions. 19,428. July 14. (Ger., 27.3.22.)

XXIII.—ANALYSIS.

Complete Specifications Accepted.

7162 (1921). König. Method and apparatus for measuring the density of gases. (159,845.) July 26.

10,303 (1921). Igranic Electric Co. (Cutler-Hammer Manuf. Co.). Combustion of proportioned quantities of fluid for measuring the calorific value. (182,573.) July 19.

I.—GENERAL; PLANT; MACHINERY.

Fractionating columns; Efficiency and capacity of ——. W. A. Peters, jun. J. Ind. Eng. Chem., 1922, 14, 476—479.

Using the definition given by Lewis of a theoretically perfect plate, the following formula showing the relation existing between the composition of the vapour rising from one plate, the liquid flowing back from the plate above, and the heat balance in the theoretical column is given, viz., $X_{n+1}=Y_n-Y_c(1-\rho)/\rho$, where X_{n+1} is the equivalent latent heat fraction of low boiling point material in the liquid on the (n+1)th plate; Y_n is the equivalent latent heat fraction of the low boiling point material vaporising from the *n*th plate; Y_c is the equivalent latent heat fraction of low boiling point material in the distillate; and ρ is the ratio of heat required to volatilise the reflux liquid divided by the total latent heat in vapour passing up through any horizontal cross section of the column. Knowing ρ, Y_n, and Y_c, X_{n+1} can be found, and thus the composition of the liquid and vapour at every point in the theoretical column can be fixed. In practice ρ, Y_n, and Y_c, are measured experimentally from columns working on known mixtures, and then the number of plates in a theoretical column which will give similar values is calculated. By dividing the calculated number of plates by the actual number of plates employed the efficiency factor, K, is found. With filled columns a measure of the efficiency can be obtained by dividing the calculated number of plates in the theoretical column by the height of the filled column in any chosen units. The reciprocal of this efficiency the author terms the height of the equivalent theoretical plates. Testing a sieve-type column, using a mixture of acetic acid and water, the author obtained values of K from 0·538 to 0·500, when ρ varied from 0·82 to 0·87, and found that for acetic acid and water mixtures in this type of column, with 1 in. of liquid on the plates, K is independent of ρ within the limits 0·8 to 1·0. Another series of tests was made on a Badger bubbler cap plate column, using alcohol and water mixtures, and it was found that with mixtures containing less than 90% by weight of alcohol K=0·70, but with mixtures richer in alcohol K had a smaller value. To determine whether the different values of K obtained from these two sets of experiments were due to the type of column, or to the difference in behaviour of the two mixtures, tests were made on a bubbler cap plate column using both mixtures under exactly similar conditions. The results indicated that there is no difference in the efficiency between plate columns of the sieve type and those of the bubbler type, provided that the immersion and diameter of perforations are comparable, but that there is a marked difference in efficiency of the same column for different mixtures. It is predicted that K will be less for materials of high molecular weight, and that for materials of equal molecular weight those mixtures in which there is less attraction between the unlike than between the like molecules will show a higher value of K. With packed columns it was found that the reciprocal of the efficiency varies nearly directly with the mean diameter of the filling pieces, and hence, to effect a given separation, columns may be of very short length when filled with very small pieces. The relative costs of the plate and filled columns are discussed, and it is concluded that with fillings 0·25 in. in diam., costing $30 per cubic foot, the filled column would be the cheaper.

—S. G. U.

Wood as a chemical engineering material. C. S. Robinson. J. Ind. Eng. Chem., 1922, 14, 607—610.

The advantages and disadvantages of chemical plant made of wood are discussed and the action of common chemicals on eleven usual kinds of wood given. The extent of the contamination of liquids with colouring matter from the wood is also given. The order of the popularity of woods for chemical work is as follows:—Cypress, yellow or hard pine, Californian redwood, white pine, Douglas fir, hard maple, yellow poplar, white oak, tamarack, spruce, Norway pine. The methods of construction of wooden tanks and pipes are illustrated.

—H. C. R.

Patents.

Filter presses. H. O. Traun's Forschungslaboratorium, Ges. m. b. H. E.P. (a) 155,834 and (b) 181,023, 24.12.20. Conv., 5.7.18.

(a) A filter press for working at pressures of 100 atm. or more consists of a cylinder fitted internally with three equidistant ribs to keep the filtering medium in position. The recesses thus formed act as passages for the filtrate, which is discharged through a valve mounted on the side of the cylinder at the lowest point. The filtering medium may be made of annuli of wire gauze, perforated cores wound round with wire of suitable thickness, or thin perforated concentric cylinders. The wire gauze annuli can be pressed together by screwing up the nut which forms the upper end of the containing cylinder. Inside the filtering medium revolves a worm, the lower end of which rotates in a boss formed in the base of the cylindrical casing. The upper end of the worm passes into another cylinder which is screwed into the nut forming the cover of the casing. On the top of this cylinder is a stuffing-box and gland through which passes the spindle for driving the worm. The material to be filtered is forced into the press through a valve mounted on the side of this worm cylinder. The liquid flows radially outwards through the filtering medium, and the worm forces the solid matter deposited on the inner surface of the filtering medium down to the base of the press and out through a valve mounted on the bottom of the containing cylinder directly in line with the worm. In another type of press the worm and filtering medium are housed in a telescopic casing. The worm at its lower end works inside a conical discharge pipe fitted in a flange through which pressure can be applied to the filtering medium. Special provision is made for taking up the end thrust in the worm shaft and to prevent leakage at the stuffing-box on the worm shaft. The outlet of this press is fitted with a plug valve held in position by a lever with weight or spring control to regulate the pressure of discharge. Sometimes a thin perforated metal cylinder is fitted in the press to prevent the nets or coils becoming too closely compressed and fouling the worm. (b) In a press of the type described above, to be used to filter colloidal precipitates, the coarser meshes of the filtering medium are filled with a permeable medium such as gypsum or cement paste. This is done by filtering a suspension of the substance, and, after the filter bed has been properly permeated, allowing the cement or the like to set before the filtration of the colloid is undertaken.—S. G. U.

Filters; Rotary ——. H. A. Valles. E.P. 181,879, 6.4.21.

In a non-continuous rotary vacuum filter, with a discharge channel for the filter-cake in the bottom of the casing, the outlet for the cake is midway of the length of the filter, and a worm conveyor leads thereto from each end. The filtrate is removed by means of a hollow shaft, which may also be used to admit pressure water or air for discharging, and which may work in conjunction with external sluicing jets. Means are provided whereby the thickness of the cake is shown on an indicator outside the casing.—B. M. V.

Evaporating apparatus. E. Barbet et Fils et Cie. E.P. 158,569, 27.1.21. Conv., 27.1.20.

The liquid is discharged from a tubular heater into a separator at a level not higher than the level of liquid maintained in the separator, and a pump receiving liquid from the separator delivers it to the heater. A diaphragm with a restricted orifice is arranged in the path of the liquid passing from the heater to the separator to secure a higher pressure in the heater than in the separator, thus ensuring superheating in the heater and vaporisation in the separator. A regulator is provided for maintaining a constant level of liquid in the heater and a valve for controlling the flow of liquid from the separator to the heater. The tubes may be closely arranged in the heater, a fan being used to increase the speed of circulation of the heating steam. Liquids readily deteriorated by heat, *e.g.*, milk, grape juice, gelatin, etc., are heated by circulation of hot water, which is heated by steam. For saline solutions the lower part of the separator in which the salts precipitate is conical.—H. H.

(A) *Evaporation; Method of ——.* (B) *Centrifugal separator and evaporator.* (C) *Process of treating liquid substances to change the condition thereof by evaporation.* (D) *and* (F) *Art of treating liquid substances.* (E) *Evaporating apparatus.* (G) *Apparatus for treating substances.* (H) *Multiple-effect apparatus.* (J) *Device for the evaporation of liquids and in the drying of substances.* (K) *Centrifugal dryer.* C. R. Mabee. U.S.P. 1,420,641—50, 27.6.22. Appl., (A) 18.2.19, (B) 31.8.12, (C) 23.12.12, (D) 24.10.13, (E) 9.12.13, (F) 19.7.15, (G) 12.2.16, (H) 23.10.15, (J) 15.12.13, (K) 15.12.13. Renewed (D) 12.7.16, (J) 18.3.20, and (K) 1.3.19.

The liquid to be evaporated, condensed, or dried to a powder, is spread circumferentially in a thin layer on the inside of a heated cylindrical container and at the same time moved from end to end either by slow speed spreaders or by centrifugal force. Either a portion or the whole of the container surface may be heated; in the former case the material is fed to the unheated portion, allowed to form the thin layer, and then passed to the heated portion. A large free space is left for vapours along the axis of the machine, and these are removed by a vacuum, or a fan, or merely by their own slight pressure. In the multiple-effect apparatus claimed in (H), the container has several compartments, the vapour from one section heating the next. The apparatus described in (J) has a vertical axis, the material being retained on the cylindrical walls by ridges or fins; in the other cases the axis of the apparatus is horizontal.
—B. M. V.

Crystallisation; Process of —— and apparatus therefor. Soc. Gén. d'Evaporation Proc. Prache et Bouillon. E.P. 159,815, 21.2.21. Conv., 5.3.20.

The solution is circulated between a reservoir and the tubes of an evaporator at such a speed that the crystals in suspension scratch the surfaces of the tubes and thus prevent the adhesion thereto of crystals in formation and remove any deposit formed. Crystals not circulated accumulate in the conical bottom of the reservoir.—H. H.

Filling columns, towers, etc., or the like through which gas is passed in an opposite direction to liquid; Bodies for ——. G. Petzel. E.P. (A) 160,180 and (B) 175,273, 16.3.21. Conv., 17.3.20.

(A) The packing is made by bending rectangular strips of sheet metal to form pieces having the shapes shown in cross-section in Fig. 1. The object of the invention is to provide a cheaply constructed filling having great contact area and which does not greatly reduce the passage-way. Perforated or non-perforated plates may be used in the construction of either type of packing. (B) The packing is made of any suitable material such as iron, porcelain, glass, terra-cotta, or unglazed brick, and is of the shapes shown in cross-section in Fig. 2. It is claimed that these packings provide a large number of baffling and contact surfaces which promote intimate contact between the gas and liquid.
—S. G. U.

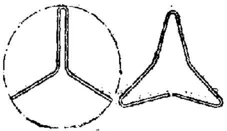


Fig. 1.

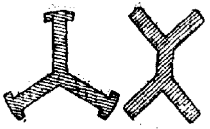


Fig. 2.

Waste heat; Utilisation of ——. Metallbank u. Metallurgische Ges. A.-G., and W. Gensecke. E.P. 181,787, 12.3.21.

The heat of waste steam, vapours, etc. from technical processes, such as drying processes or the chilling or granulating of hot slag in water, is used for generating steam. The heat is transferred by direct contact to a liquid medium, such as water, which is then separated from the waste steam, etc. and allowed partially to evaporate to generate steam for power or heating. The partial evaporation may be effected by injecting the liquid in a finely divided state into a vessel provided with an outlet for the steam generated. In the application to the chilling of slag, the water retained by the granulated slag may be continuously replaced by condensed water from a turbine or like plant. Drying apparatus may be heated by the waste steam from the high-pressure stage of a reaction engine of which the low-pressure stage is operated by the steam generated in the evaporator by the heat of the waste steam or vapour produced in the drying process.—H. H.

Mixing, reducing, or grinding and like machines. J. McIntyre. E.P. 181,877, 6.4.21.

A number of flexible blades are mounted on the rotating part of the machine so that their flat surfaces exert a rubbing action against the fixed outer part of the machine. Alternatively the blades may be fixed and the casing of the machine rotated.
—B. M. V.

Mixing machines. F. E. and G. H. Adams and T. D. M. Linkie. E.P. 181,920, 7.5.21.

Fixed blades co-operate with rotating blades within a container adapted to be tilted. The upper portion of the container is divided longitudinally into two parts, each hinged to the lower portion, and means are provided for retaining the two parts in the closed position.—H. H.

Disintegrators. J. K. Blum. E.P. 181,974, 20.6.21.

The aim of the invention is to provide a simple means of disintegrating the material, and separating particles of the desired fineness from the coarser particles. Disintegration is effected by means of a hammer cylinder rotating inside a

casing. The inlet and discharge openings of the machine are both situated in the top portion of the casing and on the same side of the vertical centre line of the machine. These openings are separated inside the casing by a breaker plate, which projects to a point in substantial proximity to the path of the rotor, thus preventing the short-circuiting of the air current between the intake and the discharge pipe. The under surface of this plate acts as the roof of the separating chamber, and is designed to give a swirling motion to the air discharged from the rotor before the air enters the discharge pipe. The rotor, by centrifugal action, throws the crushed material across the separating chamber in such a manner that it impinges on the breaker plate. The air currents are thus able to take up the fines in suspension and carry them away to the discharge pipe, whilst the coarse material drops back into the rotor chamber. The upper surface of the breaker plate is arranged so as to deliver the material fed to the machine tangentially to the rotor which also functions as a centrifugal blower. An auxiliary fan or blower may be used to provide a supplementary means of regulating the strength of the air current.
—S. G. U.

Crusher and pulveriser. M. F. Williams, Assr. to Williams' Patent Crusher and Pulveriser Co. U.S.P. 1,420,354, 20.6.22. Appl., 28.10.21.

The casing of the machine contains a series of segmental plates, each having a number of ridges, gradually diminishing in depth and parallel to the axis of the rotor. The bottoms of these ridges are rounded so as to form a continuous surface between the short face of one ridge and the long face of the ridge immediately above. The shorter face of each ridge is normal to the cylindrical surface swept out by the rotor arms at the point where its projection would intersect this surface. Provision is made for adjusting the distance between the rotor and the two upper segments, and the axis of the rotor is placed relatively to that of the casing, so as to provide a gradually diminishing space between the rotor and the plates. The machine is fed from the op, the feed hopper being placed on the side of he vertical centre line near the greatest opening between rotor and pates.—S. G. U.

Drying machine for coal or other granular material; Centrifugal ——. R. F. F. Fabry. E.P. 182,006, 23.7.21.

The machine consists of a conical shell, at or near the smaller end of which the material to be dried is continuously delivered by an inclined shoot. Fastened to the larger end of the shell, but separated from it by a continuous annular slit, is a short cylindrical extension. Sludge or water which has been removed escapes through this slit, while the dried material travels outward to the larger end and into a receiver. A jet of compressed air may be employed to prevent clogging of the slit by the granular material.—A. R. M.

Drying kiln. R. Thelen. U.S.P. 1,420,296, 20.6.22. Appl., 2.3.21.

A drying chamber is fitted with doors at either end and with a set of rails raised above the floor. The material to be dried is stacked on trucks which run on the rails. The drying medium is admitted at the base of the chamber near the exit end for the material, and is so baffled that it passes upwards through the material on the truck nearest the exit door, downwards through the material on the next truck, and so on until on rising through the material on the truck nearest the inlet door it is discharged by a fan placed on the roof of the chamber at the charging end. After every downward pass through the material the drying medium is reconditioned by suitable appliances mounted on the floor of the chamber.—S. G. U.

Dehydrating; Process and apparatus for ——. O. Q. Beckworth and O. J. Hobson, Assrs. to Anhydrous Food Products Co. U.S.P. 1,420,679, 27.6.22. Appl., 27.1.19.

The plant consists of two chambers placed back to back and suitably fitted internally to hold the articles to be dried. Along the back wall of each chamber is a radiator to supply radiant heat to the articles in the chamber. The front walls of each chamber are hollow and contain radiators to condition the medium, which is circulated through the chamber. In starting the process a vapour of high density and temperature enters the apparatus at the bottom, and passing upwards and across the goods to be dried, leaves the chamber through a valve placed in the roof. This medium is used to warm and moisten the goods, and suitable valves and piping are provided whereby this medium can be reheated and returned to the chamber. When the warming and moistening of the goods is completed this medium can be drawn off and replaced by a less dense medium, also at a high temperature, which can also be circulated through the reconditioner and chamber. Means are provided for circulating vapour and air through the chamber and for cooling the goods after dehydration has been completed.—S. G. U.

Drying machine. G. Stone, Assr. to M. T. Stevens and Sons Co. U.S.P. 1,421,856, 4.7.22. Appl., 15.12.21.

Superposed horizontal rows of conveying rollers conduct the material in a sinuous course through the machine, the rollers of each row being separated by air spaces. Heated air is delivered beneath each row through independent conduits, and is exhausted and discharged upwards through the spaces between the rollers, thus serving both to dry and to lift the material in transit on the rolls.—H. H.

Air, gas, or vapour; Apparatus for purifying ——. P. Graefe. E.P. 182,201, 29.3.21.

The gas or air under treatment is passed between a series of parallel units which are built up as follows:—Each unit consists of two parallel plates, namely, the back plate and the scale plate, which are joined together round the edges to form a narrow chamber. This chamber is sub-divided into a number of parallel chambers by distance strips or similar contrivances, which slope at such an angle that any liquid or dust immediately slides down and is deposited at the bottom of the unit. The scale plate of each unit has a series of openings round which are scales or wedge-shaped projections which are placed in rows and so arranged that the gas flowing from one row will impinge on the projections of the next row at right angles to the projecting surfaces. Any foreign matter travelling with the gas is thus deposited on the projections, and falls therefrom into the space between the plates and so to the bottom of the unit. In forming a plant the units may be placed with the back plate of No. 2 unit touching the scale tips of No. 1 unit; or with the tips of the scales of No. 2 unit touching the scale plate of No. 1 unit and the tips of the scales of No. 1 unit touching the scale plate of No. 2 and the back plate of No. 2 touching the back plate of No. 3 unit; or with the tips of the scales of No. 1 touching the tips of the scales of No. 2 and the back plate of No. 2 touching the back plate of No. 3 unit. The gas after passing through the spaces between the units is discharged into a separate chamber from that connected with the spaces between the plates forming the units. Plants can be designed for working with either a horizontal or vertical gas flow.—S. G. U.

Removing suspended matter from gases; Apparatus for ——. J. P. Fisher, Assr. to Doherty Research Co. U.S.P. 1,420,986, 27.6.22. Appl., 29.8.19.

The gases pass from end to end of a separating chamber fitted near the inlet with a fan adapted to throw material centrifugally to the walls of the chamber, and near the outlet with a second fan adapted to create a smaller centrifugal effect than the inlet fan. The outlet fan is arranged to cause gases to pass directly through it to the outlet. The length of the chamber is made substantially greater than the combined width of the fans in order to enable the suspended matter to settle out of the gases whilst they are passing from one fan to the other.—H. H.

Removing a liquid from the surface of molten metal; Method of ——. Thermal Industrial and Chemical (T.I.C.) Research Co., Ltd., and J. S. Morgan. E.P. 182,302, 7.6.21.

In the distillation of liquids or similar processes of heat treatment by means of a bath of molten metal, the residual liquid is removed from the surface of the molten metal, *e.g.*, lead, by means of a disc or drum dipping into the metal and a scraper which removes the liquid from the drum. The drum or disc has a surface of non-metallic material, preferably silica.—B. M. V.

Catalyser and method of producing the same. W. D. Richardson, Assr. to Swift and Co. U.S.P. 1,419,986, 20.6.22. Appl., 9.3.20.

A catalyst is produced by abrading a suitable metal in the presence of water.—B. M. V.

Volatilising, distilling, or separating absorbed vapours; Method of ——. C. L. Voress and V. C. Canter, Assrs. to Gasoline Recovery Corp. U.S.P. 1,420,613, 20.6.22. Appl., 9.12.21.

Vapour mixtures are recovered or removed from gas mixtures by absorption in a solid absorbent, from which they are subsequently distilled by heated distillation vapours. The distillation vapours are passed into intimate contact with the charged absorbent for a time sufficient only to volatilise the major portion of the absorbed vapours, and substantially denuded gas is then passed through the absorbent for the displacement of condensed products from the distillation vapours.—H. H.

Roasting, calcining, etc. materials containing oxygen or carbon dioxide; Process of ——. A. Helfenstein. G.P. 352,241, 24.4.21.

The material, previously dried as far as possible, and reduced to a finely granular or powdered condition, is fed downwards in a thin layer along the heated walls of a shaft furnace, the material collecting at the bottom of the shaft being then raised to a higher temperature, and, if desired, sintered, by heat radiated from the walls of the shaft. The material collecting at the bottom of the shaft may also be submitted to the action of a gaseous cooling medium, which is subsequently employed to preheat or dry the material to be roasted. The shaft tapers from the top downwards for about two-thirds of its length and then becomes wider again. It is closed at the lower end by hollow crushing rollers in which a gaseous cooling medium circulates.
—J. S. G. T.

Air or other gaseous mixtures; Process of recovering constituents of ——. R. Wucherer and F. Pollitzer, Assrs. to The Linde Air Products Co. U.S.P. 1,420,802, 27.6.22. Appl., 24.8.17.

See G.P. 319,992 of 1916; J., 1920, 545 A.

Treating substances in a finely-divided condition; Apparatus for ——. P. Poore. U.S.P. 1,420,944, 27.6.22. Appl., 13.4.20.

See E.P. 162,769 of 1920; J., 1921, 461 A.

Filters and method of producing same. R. Zsigmondy and W. Bachmann. U.S.P. 1,421,341, 27.6.22. Appl., 23.7.19.

See G.P. 329,117 of 1916; J., 1921, 203 A.

Separators employed for the separation of liquids of different density. W. H. Bateman. U.S.P. 1,421,658, 4.7.22. Appl., 17.1.22.

See E.P. 179,209 of 1920; J., 1922, 489 A.

Kneading, mixing, stirring, and beating machines; Apparatus for actuating ——. A. Zehnder. E.P. 175,975, 17.2.22. Conv., 25.2.21.

Separators; Magnetic —— for removing solids from liquids. E. B. Chapman. E.P. 181,898, 22.4.21.

Refrigerating and ice-making apparatus. R. J. Mott. E.P. 181,992, 7.7.21.

Ice manufacturing apparatus. R. E. Clough. E.P. 182,324, 5.7.21.

Furnaces adapted to burn various kinds of fuel. K. Petersen. E.P. 182,034, 2.9.21.

Heat exchanging apparatus or recuperators. Stein and Atkinson, Ltd., Assees. of Soc. Anon. des Appareils de Manutention et Fours Stein. E.P. 182,075, 26.8.21. Conv., 23.6.21.

Grinding mills [of the pan type] and other machines; Bearings for vertical shafts of ——. T. C. Fawcett, Ltd., D. L. Fawcett, and A. E. Bottomly. E.P. 182,669, 18.6.21.

Apparatus for chemical reactions. U.S.P. 1,420,210–2. *See* VII.

Distilling liquids. E.P. 182,069. *See* XVIII.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Gases; Ignition of —— by sudden compression. H. T. Tizard and D. R. Pye. Phil. Mag., 1922, 44, 79—121.

The tendency to detonation in internal combustion engines is closely related to the delay which occurs in the ignition of mixtures of combustible gases and air by compression. This delay in ignition is dependent on (1) the compression temperature, (2) the temperature coefficient of the reaction, and (3) the rate of loss of heat to the walls. The relationships among these three factors have been examined theoretically and experimentally for mixtures of heptane, ether, and carbon bisulphide with air. The apparatus designed by Ricardo was employed in the experimental work. The rise in absolute temperature which is necessary to treble the reaction velocity is 4% in the case of carbon bisulphide and 7% in the case of ether and heptane. This is in agreement with the relative tendencies of these substances to detonate in an interna combustion engine. Carbon bisulphide has muc less tendency to detonate than heptane, althoug its ignition temperature is considerably lower. Th rate of reaction on sudden compression appear within wide limits to be independent of the con centration of the combustible gas, and depends onl on the amount of oxygen present. The effect o turbulence is studied.—W. E. G.

Carburettor adjustments by gas analysis. A. C Fieldner and G. W. Jones. J. Ind. Eng. Chem 1922, 14, 594—600.

The proportion of carbon dioxide in the exhau gases bears a direct relationship to the com pleteness of combustion and the air-fuel rati

The air-fuel ratio for motor spirit as used at the present time, for maximum power at full load, extends from about 11:1 to 15:1. The relative mileage which may be obtained from a given quantity of fuel is measured by its thermal efficiency. Maximum thermal efficiency is obtained at an air:fuel ratio of 16·5 to 17·5:1. Power must be sacrificed to some degree to secure the greatest mileage. The relation of the air-fuel ratio to the percentage of carbon dioxide in the exhaust gases is shown by a curve obtained from laboratory tests, and another obtained from road tests on 101 different motor vehicles using different brands of spirit agrees closely with it. To adjust a carburettor by gas analysis, tests should be made on the road under the different conditions under which the machine is to be driven. The machine is run until thoroughly warmed up and then tested at a given speed on the level by taking samples of the exhaust gases and analysing for carbon dioxide content. The air-fuel ratio can then be read off from the curve given. Should the percentage of carbon dioxide be low the carburettor is given a slightly "leaner" adjustment and again tested, and a record kept of the carbon dioxide content and carburettor adjustment for each test. When the highest carbon dioxide percentage consistent with flexible working has been obtained, the machine is tested at other speeds. Then, by plotting the carbon dioxide percentages at the different speeds, the carburettor setting giving the highest average carbon dioxide percentage at the different speeds, and also flexible working, should be chosen as the best adjustment. A carbon dioxide indicator for adjusting carburettors on the road is described and illustrated. Two min. is required to sample and analyse the gas. The indicator is accurate to 0·2% with carbon dioxide contents of 14%. Tables are given showing the gain in mileage which can be obtained by proper carburettor adjustment.

—H. C. R.

Flue-gas analyses; General graphical evaluation of ——. Y. Kauko. Chem.-Zeit., 1922, **46**, 657—659.

A THEORETICAL and mathematical paper in which the fuel economy is represented graphically from considerations based on the chemical analysis of the flue gases.—A. R. P.

Petroleum; Surface tension of ——. C. K. Francis and H. T. Bennett. J. Ind. Eng. Chem., 1922, **14**, 626—628.

THE surface tension of petroleum from various parts of the United States was determined, and was found to increase with the specific gravity. The small quantity of fatty acids and wax commonly found in petroleum products does not appear to influence the surface tension. The presence of high-boiling fractions and products of high viscosity tends to raise the surface tension of the lighter petroleum products. The surface tension decreases with rise in temperature by about 0·05 dyne per sq. cm. per 1° F. The connexion between viscosity and surface tension appears to be very slight, as an increase in Saybolt viscosity from 51 to 1160 is only accompanied by an increase in surface tension from 34·4 to 37·3.—H. C. R.

Drying oils from petroleum. Gardner and Bielouss. *See* XIII.

Carbon dioxide indicator. MaoMullin. *See* XXIII.

PATENTS.

Artificial fuel. R. A. Kratochwill. E.P. 182,262, 3.5.21.

A BRIQUETTE is made from 14 oz. of coal dust and a binder composed of 30 grains of gum arabic and 18 drams of water, and is varnished in order to waterproof it.—A. G.

Carbonaceous product and method of making the same. H. Rodman, Assr. to Rodman Chemical Co. U.S.P. 1,420,754, 27.6.22 Appl., 7.9.17.

"ROTTED" coal is dissolved in an alkaline reagent, *e.g.*, an aqueous solution of ammonia, and the resulting plastic mass dried.—A. R. M.

Coking chambers for gas generators. Bismarckhütte. E.P. 163,012, 6.5.21. Conv., 6.5.20.

A COKING chamber for use in conjunction with a gas producer is provided with a horizontal plate, spaced below the open end of the chamber so as to provide a peripheral discharge opening for the coked material, and forming a support for the material being coked. At the top of the chamber there is a concentric rotary feed hopper into which coal is continuously fed from bunkers and from which it passes into the chamber through openings at the lower end. The hopper extends downwards into the chamber so as to form an annular gas-collecting space, into which dust cannot readily pass, at the top of the chamber. Attached to the bottom of the hopper there is a vertical shaft carrying a stirrer and an ejector spaced just above the horizontal plate.—H. Hg.

Vertical [*gas*] *retorts.* F. J. Collin, A.-G. zur Verwertung von Brennstoffen und Metallen. E.P. 165,744, 30.6.21. Conv., 2.7.20.

A PERFORATED pipe is laid in a channel cut in the base of the wall of a vertical retort provided with a water-seal, and is used alternatively for supplying water to the seal and steam to the retort for the generation of water-gas.—H. Hg.

[*Gas*] *retorts.* Low Temperature Carbonisation, Ltd., and T. M. Davidson. E.P. 181,894, 18.4.21.

VERTICAL retorts suitable for low-temperature carbonisation are constructed of cast iron or other metal, and the inner and outer surfaces are protected by firebrick slabs. The retorts are provided with external horizontal and internal vertical ribs of a dovetail shape in order to secure the slabs to the retort surfaces.—H. Hg.

[*Coal*] *gas; Method of and apparatus for manufacturing* ——. A. F. Kersting, Assr. to L. C. Hamlink. U.S.P. 1,420,041, 20.6.22. Appl., 2.5.19.

A NUMBER of retorts are charged in sequence with coal and, by means of suitable gas connexions between the retorts, the gas from a freshly charged retort is, during the earlier stage of carbonisation, passed through a retort containing more completely carbonised coal to an off-take.—H. Hg.

Gas producers [*; Stirrer and fuel-feeding device for* ——]. Dowson and Mason Gas Plant Co., Ltd., and E. Wilson. E.P. 182,053, 19.11.21.

IN a producer of the type provided with mechanical stirrers and automatic fuel feed, horizontal arms are supported in such a manner as to be capable of rocking on their axes. Fingers or stirrers depend from the arms and sink into the fuel to an extent regulated by the resistance offered by the fuel bed. Varying leverage may be exerted on the arms by means of weighted box-castings on the ends of the arms, and the depth of the fingers in the fuel bed thus varied. Each arm with its depending fingers may be made to act independently so far as its oscillatory movement is concerned. Means are provided for obtaining relative rotary movement between the fuel bed and the oscillating stirrer arms, and for providing water cooling for the latter and the depending fingers. The drive and means for feeding and distributing the coal are controlled from the stirrer arms, which, by acting as the spokes of a wheel, may transmit the drive from a circumferential rack. The coal or other fuel is fed from a revolving drum into a continuously revolving spreader and thence distributed evenly over the area of the producer, both the drum and the spreader working in unison from the same drive.—A. R. M.

Petroleum oils; Still for fractionally distilling ——. E. C. R. Marks. From Shell Co. E.P. 182,247, 20.4.21.

The still is particularly designed for the re-fractionation of gasoline-kerosene fractions. The fraction is heated by means of the hot residues from which it was originally distilled. A long horizontal still is divided by vertical partitions and heated by tubes through which the residuum flows. The gasoline-kerosene fractions flow along this still and steam is admitted into each portion. Each section is provided with its own vapour exit.—T. A. S.

Liquid fuel. A. A. Backhaus, Assr. to U.S. Industrial Alcohol Co. U.S.P. 1,419,910, 20.6.22. Appl., 12.10.17.

A mixture of a petroleum distillate, an alcohol, and an aromatic hydrocarbon is blended with a phenol. —A. G.

Fuel for internal combustion engines. M. C. Whitaker, Assr. to U.S. Industrial Alcohol Co. U.S.P. (A) 1,420,006 and (B) 1,420,007, 20.6.22. Appl., 12.11.19.

The fuel is composed of (A) a light hydrocarbon, an alcohol, a diethyl ketone, and an ester, or (B) 35—50% of an alcohol, 25—35% of an aromatic hydrocarbon, and 20—40% of an ester.—A. G.

Oils; Process for cracking ——. R. D. George. U.S.P. 1,420,832, 27.6.22. Appl., 14.9.21.

The process consists in heating to cracking temperature heavy hydrocarbon oils in continuous flow through an upright still. The heated oil is delivered from the top of the still to a separating chamber wherein is maintained a pool of hot oil above the level of the still. In the separator the volatile portions are removed and condensed. The residual oil is freed from carbon in a separator and returned to the bottom of the still. The amount of free carbon in the cleaned oil is kept below 1%.—T. A. S.

Oil-bearing shale; Apparatus for treating ——. G. A. Heimbucher. U.S.P. 1,421,228, 27.6.22. Appl., 3.9.18.

An apparatus for treating oil-bearing shale consists of a furnace, in which several vertical retorts are arranged above a combustion chamber; a wall having helical flues surrounds the lower end of each retort, and is spaced from the outer wall of the furnace, and segmental walls meeting at their ends, and spaced from the outer wall of the furnace, partly surround the upper portion of each of the retorts, the space enclosed by these segmental walls forming a heating chamber, connected with the combustion chamber by the helical flues, and also with a chimney stack. Each retort may be fitted with a mechanically operated rotating grate and with a tapered perforated pipe, which projects upwards from the centre of each grate. Outside each pipe is a device for agitating the shale in the retort when the grate is rotated.—A. B. S.

Hydrocarbon oils; Treatment of ——. D. T. Day. U.S.P. 1,422,038, 4.7.22. Appl., 17.6.19.

Hydrocarbon oils of low boiling point are produced from those of high boiling point by vaporising part of the oil to be treated and compressing the vapour immediately in a cylinder by means of a piston, which moves "substantially instantaneously" to generate sufficient heat and pressure to convert the vapour into the desired product. —A. B. S.

Coal; Method of cleaning ——. *Process of purifying materials;* [*coal*]. W. E. Trent, Assr. to Trent Process Corp. U.S.P. 1,420,163 and 1,420,165, 20.6.22. Appl., 9.7.19 and 25.2.20.

See E.P. 146,931 and 159,497 of 1920; J., 1921, 616 A; 1922, 243 A.

Peat and the like; Process for the dry distillation and coking of raw ——. A. J. H. Haddan. From Torfverwertungsges. Pohl und von Dewitz. E.P. 159,464, 22.2.21. Addn. to 158,513.

See G.P. 340,634 of 1920; J., 1922, 6 A.

Coal; Coking of ——. S. R. Illingworth. U.S.P. 1,422,269, 11.7.22. Appl., 1.3.21.

See E.P. 164,104 of 1920; J., 1921, 501 A.

Retort [*coke oven*]. L. L. Summers. U.S.P. 1,422,634, 11.7.22. Appl., 12.8.20.

See E.P. 179,235 of 1921; J., 1922, 493 A.

Gas producer. L. Fornas. U.S.P. 1,422,093, 11.7.22. Appl., 1.2.19.

See E.P. 123,323 of 1919; J., 1920, 260 A.

Coal gas; Method of stripping the illuminants from and of purifying —— *by means of charcoal. Apparatus for purifying coal gas.* F. Soddy. U.S.P. 1,422,007—8, 4.7.22.

See E.P. 125,253 of 1918; J., 1919, 352 A.

Oil shales; Method for working ——. W. W. Hoover and T. E. Brown. U.S.P. 1,422,204, 11.7.22. Appl., 19.12.19.

See E.P. 156,396 of 1919; J., 1921, 537 A.

Coke; Plant for quenching and conveying ——. H. A. Fränkel. E.P. 182,357, 19.8.21.

Discharging coke or residues from retorts, producers, and the like; Means for ——. G. D. Hardie, and Maclaurin Carbonisation, Ltd. E.P. 182,576, 8.4.21.

Burning of pulverised fuel; Means or apparatus for use in the ——. R. N. Buell. E.P. 182,418, 25.2.21.

Gas retort mouthpieces. A. E. Burton and A. H. Jackson. E.P. 182,216, 30.3.21.

Gas producers and other furnaces; Rotary grates for ——. L. Tréfois. E.P. 182,343, 2.8.21. Addn. to 153,163.

Drying coal etc. E.P. 182,006. *See* I.

Sludge acids. U.S.P. 1,421,688. *See* VII.

Cement manufacture and low-temperature carbonisation. E.P. 181,811. *See* IX.

Electrochemical reactions. E.P. 181,848–9. *See* XI.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Patents.

Carbonaceous substances; Apparatus or kilns for the drying and distillation of ——. H. Alexander. E.P. 181,794, 15.3.21.

The retorts are surrounded by an annular space into which fuel is charged, this fuel being subjected intermittently to the action of an air blast to provide heat for carbonising the fuel in the retorts. During such "blowing period" the hot products can be passed upwards into a superposed dryer, to assist in drying the raw material, which then falls from the dryer into the retorts. The carbonised residue is withdrawn from the retorts and is used for the manufacture of briquette or other fuel. The walls of the retorts are perforated so that the hot gases from the surrounding heating chamber can be passed through the charge.—A. G.

Retort furnace. T. R. Blanchard and E. B. Kenefic. U.S.P. 1,420,958, 27.6.22. Appl., 17.11.21.

A horizontal retort is placed over a heating chamber, and pairs of upwardly converging flues extend from the chamber through the retort into a horizontal flue above the retort. Dampers are placed in the horizontal flue between the openings of successive pairs of flues.—H. Hg.

Alloy for filaments. U.S.P. 1,422,019. *See* X.

Errata.—This Journal, July 15, 1922, p. 497, col. 1: lines 35 to 36 from the top, for "2-Hydroxybenzanthrone or the corresponding 3-hydroxy derivative," read "2-Hydroxyanthraquinone or 3-hydroxyanthranol"; line 32 from bottom, after "hydroxybenzanthronecarboxylic acid," insert "(yield about 26% of the weight of hydroxyanthraquinone)"; the sentence "Small amounts . . . simultaneously produced," lines 22—26 from bottom, should come after the word "heating" on line 31 from bottom.

III.—TAR AND TAR PRODUCTS.

Patents.

Anthraquinone; Purification of ——. H. F. Lewis, Assr. to National Aniline and Chemical Co., Inc. U.S.P. 1,420,198, 20.6.22. Appl., 29.3.20.

Crude anthraquinone is treated with a halogenated hydrocarbon solvent, and the solution, which contains the impurities, is separated from the purified anthraquinone.—L. A. C.

Sludge acids. U.S.P. 1,421,688. *See* VII.

Electrochemical reactions. E.P. 181,848—9. *See* XI.

IV.—COLOURING MATTERS AND DYES.

2.3.2′.3′-*Naphthindigo.* H. E. Fierz and R. Tobler. Helv. Chim. Acta, 1922, 5, 557—560.

The conversion of 2.3-hydroxynaphthoic acid into 2.3-aminonaphthoic acid is effected by heating with ammonium chloride and ammoniacal zinc chloride in a current of ammonia at 180°—190° C. for 36 hours. The yield is 68—70% when zinc chloride of good quality is used, and the unchanged 2.3-hydroxynaphthoic acid can be recovered. The presence of zinc oxychloride causes side reactions with the formation of β-naphthylamine and dinaphthacridone. Condensation of the 2.3-aminonaphthoic acid with chloroacetic acid is quantitative, with the formation of 2.3-naphthylglycinecarboxylic acid, crystallising from alcohol in yellow needles, m.p. 240° C. The conversion of the glycine into 2.3.2′.3′-naphthindigo gives very poor yields by any of the usual methods. The pure dye crystallises from nitrobenzene in nearly black tablets. It dyes greenish-blue shades from the hydrosulphite vat; the brominated dye is green. The dye takes up three atoms of bromine, but is not thereby rendered fast to chlorine. The shade is purer than that of Ciba Green G, however, and it is equally fast to light. —E. H. R.

peri-*Naphthindigo; Attempts to prepare* —— *and the behaviour of azo dyes from naphthylglycines.* H. E. Fierz and R. Sallmann. Helv. Chim. Acta, 1922, 5, 560—566.

Attempts to prepare peri-naphthindigo from 1.8-naphthylglycinecarboxylic acid failed, owing to the unstable character of the naphthylglycine. The maximum yield of naphthostyril obtained by oxidation of naphthalimide with sodium hypochlorite was 50%. By condensing naphthostyril with chloroacetic acid, naphthostyrylacetic acid, m.p. 256° C., was obtained, which, by boiling with sodium ethoxide, gave disodium 1.8-naphthylglycinecarboxylate, a white powder. The following naphthylglycinesulphonic acids were prepared by condensing the corresponding naphthylaminesulphonic acids with chloroacetic acid:—1.8-acid, colourless needles containing $1H_2O$; 1.4-acid, yellow crystals with $1H_2O$, having a strong blue fluorescence in alkaline solution; 1.5-acid, anhydrous colourless leaflets or needles, with green fluorescence in alkaline solution; 2.1-acid, colourless fan-shaped needle aggregates, with $2H_2O$. The azo dyes from all these naphthylglycinesulphonic acids are decomposed by boiling water. Azo dyes were made by coupling diazobenzene and *p*-nitrodiazobenzene with β-naphthylglycine ethyl ester; the m.ps. were 135° and 156° C. (decomp.) respectively. The latter dye, when decomposed with boiling acetic acid, gave as identifiable products αβ-naphthyl-(*p*-nitrophenyl)-dihydrotriazinecarboxylic ester, naphthimidazole, and *p*-nitraniline. (*Cf.* J.C.S., Sept.)—E. H. R.

Patents.

Acridine dyestuffs; Manufacture of new halogen derivatives of basic ——. Durand & Huguenin A.-G. E.P. 165,721, 14.6.21. Appl., 30.6.20.

Halogenated dyestuffs containing several halogen atoms in the molecule are obtained by direct treatment of basic acridine dyestuffs or their leuco-derivatives with halogen, or with an agent capable of liberating halogen. These products will dye red-orange to pure red shades on leather and on tannin-mordanted cotton, and can also be applied to dyeing natural or artificial silk. They are fast against the action of chlorine. *Example:* 20 pts. of Acridine Orange sulphate and 36 pts. of sodium bromide are slowly stirred into 400 pts. of concentrated sulphuric acid at 0° C. After some hours the temperature is slowly raised to 50° C. until a sample dissolves in water with a vivid red colour. The product is then poured on to ice, salted out, filtered, washed with brine, and dried at 60° C. The substance is a dibromo-derivative, and dyes pure red shades on tannin-mordanted cotton.—G. F. M.

Soluble acid colouring matters; Manufacture of a new series of —— *and of intermediate compounds for the manufacture thereof.* A. G. Green, K. H. Saunders, and British Dyestuffs Corp., Ltd. E.P. 181,750, 18.12.20 and 16.8.21.

A new series of dyestuffs of the benzene and naphthalene series is described which dye wool and silk from an acid bath, and which owe their solubility and acid character to the presence of an alcoholic sulphuric acid group, $-CH_2.O.SO_3H$, attached to nitrogen. This $-SO_4H$ group is termed a sulphato group, and it may be introduced in a variety of ways either into the structure of dyestuffs or into their intermediates. For example, an N-oxyalkyl derivative may be prepared from either an intermediate or a dyestuff by the action of ethylenechlorohydrin, and this, on treatment with concentrated sulphuric acid, or fuming sulphuric acid, chlorosulphonic acid, etc., under such conditions as would normally convert ethyl alcohol into the hydrogen sulphate, yields the sulphato compound. Another method consists in reacting in neutral or alkaline solution with chloroethyl hydrogen sulphate, prepared by dissolving ethylenechlorohydrin in sulphuric acid, on a dyestuff or its component or intermediate, containing a primary or secondary amino group. In this way the ethyl sulphato group is introduced at one step. The method is not limited to the ethyl group, as propylene, butylene, or glycerol chlorohydrins may be used in the same way as ethylenechlorohydrin. A large number of examples are given of the preparation ofsulphato acids of intermediates and of azo dyestuffs, triarylmethane dyestuffs, and of oxazine, azine, and thiazine colouring matters of the benzene and naphthalene series.—G. F. M.

Colouring matters [hydroxyethyl, hydroxypropyl, etc. derivatives of oxazine, azine, and thiazine dyestuffs]; Manufacture of ——. British Dyestuffs Corp., Ltd., A. G. Green, K. H. Saunders, and E. B. Adams. E.P. 182,031, 30.8.21.

Dyestuffs possessing a quinoneimide structure, and containing one or more hydroxyalkyl groups attached to nitrogen, are obtained by applying the standard reactions for the preparation of oxazines, azines, or thiazines to intermediates containing such hydroxyalkyl groups. Thus oxazine dyestuffs are obtained by condensing a nitroso derivative of a hydroxyalkylarylamine with a phenolic compound. For example, violet to blue dyestuffs of the gallocyanine type are obtained by using gallic acid, gallamide, etc. in the above reaction. If a nitroso derivative of a *m*-hydroxyoxyalkylarylamine is condensed with an alkylarylamine or an oxyalkylarylamine, oxazine dyestuffs are also produced, whilst if the arylamine is naphthylamine or its derivatives blue dyestuffs of the Nile Blue type, but of greatly increased solubility are obtained. Oxyalkylthiazine dyestuffs are produced by converting a nitroso derivative of an oxyalkylarylamine into the corresponding *p*-diaminethiosulphonic acid by treatment with thiosulphate, or by converting a *p*-nitroso-alkylarylamine into the *p*-diaminethiosulphonic acid, and oxidising this together with an oxyalkylarylamine. In the preparation of azine dyestuffs a nitroso derivative of an oxyalkylarylamine may be condensed with an oxyalkyl- or other N-substituted *m*-diamine, or a nitroso-derivative of an alkylarylamine may be condensed with an oxyalkyl-*m*-diamine. In each case the intermediate indamine is converted into the azine in the usual way. Azine dyestuffs of this class may also be obtained by the oxidation of a mixture of a *p*-diamine with two arylamines, one of which is primary, whilst oxyalkyl groups may replace one or more hydrogen atoms in the amino groups of the second arylamine or of the *p*-diamine. Lastly, the oxyalkyl group may be introduced into oxazine dyestuffs, particularly those of the gallocyanine type, by subsequent condensation with components such as oxyalkyldiamines which contain this group attached to one nitrogen, whilst the other amino group is unsubstituted.—G. F. M.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

[Wool] fleece of the Blackface lamb; Micrological study of the ——. F. A. E. Crew and J. S. S. Blyth. J. Text. Inst., 1922, **13**, 149—156.

In the examination of the fleeces of Blackface lambs which were either still-born or had died shortly after birth, three types of fibres were found. One, in its proximal portion, had the characters of typical hair, at its tip the characters of typical wool, and the middle portion had a structure intermediate between hair and wool. The second type of fibre had the structure of wool near its tip, but its proximal portion resembled the middle portion of the first type. The third type of fibre resembled wool from root to tip. Those fibres which resembled wool constituted more than half of the fleece and compared very favourably with wool of recognised commercial value.—A. J. H.

Wool; Sorption of neutral soap by —— *and its bearing on scouring and milling processes.* British Research Assoc. for the Woollen and Worsted Ind. J. Text. Inst., 1922, **13**, 127—142.

The wool used in the experiments was purified by scouring it with potash-olive oil soap and sodium carbonate, and afterwards extracting it three times with absolute alcohol. The soap was prepared from sodium carbonate and pure oleic acid and was afterwards purified by extraction with hot alcohol; it finally contained a slight excess of fatty acid. The wool was immersed in a soap solution for a definite time at a definite temperature and the loss of alkali and fatty acid by the soap solution was then determined. The alkali portion of soap is sorbed much more than the fatty acid, so that the soap solution becomes charged with an excess of fatty acid. The loss of fatty acid by the soap solution is due to sorption of actual soap and to precipitation on the wool fibre of some of the fatty acid liberated as the result of the preferential sorption of caustic soda. In the case of dilute solutions, this precipitation is the main cause of the loss of fatty acid by the solution. This precipitaton of fatty acid decreases with increase of concentration of the soap solution owing to the "protective colloid" action of the soap, so that with strong solutions the loss of fatty acid is chiefly due to sorption of actual soap. The sorption of soap by wool proceeds for several hours without sign of equilibrium, and is greatly accelerated by rise of temperature. During the initial stages of the contact between wool and a soap solution the rate of loss of alkali is very much greater than the rate of loss of fatty acid, but this difference lessens with time, and after prolonged contact the two rates become roughly equal. With mixtures of soaps of oleic and palmitic acids there is a preferential sorption of the oleic acid by wool, but potassium and sodium oleates do not differ essentially with respect to the absorption of either alkali or fatty acid. The sorption of alkali by wool from a chemically neutral soap solution is equal to that from a solution of caustic alkali of very much smaller concentration, and this suggests a method of measuring the "effective alkalinity" of neutral soaps and other salts such as sodium carbonate and borax which are alkaline in aqueous solution. Comparison of the alkali absorption by wool from caustic soda solutions and from soap solutions under identical conditions showed that the ratio of the concentration of caustic soda to that of the soap solution giving equal sorption, increases with increase of dilution. In the treatment of wool with alkaline soap liquors, the known advantage of having free alkali (carbonate) present may be due to its physical action in increasing emulsification, and also to its action in opposing the liberation of fatty acid. In soap-milling processes it is probable that the alkali of the soap is the real milling agent and that the liberated fatty acid exerts only secondary functions in controlling the extent of the sorption of caustic soda from the soap, in preserving the handle of the wool, and in acting as a lubricant.—A. J. H.

Wool; Standard method for the estimation of soap in ——. British Research Assoc. for the Woollen Worsted Ind. J. Text. Inst., 1922, **13**, 143—149.

The sample of wool is extracted twelve times (this is usually sufficient) with absolute alcohol in a Soxhlet extractor lagged with asbestos tape or cord and having ground-in joints (corks are not satisfactory). The hot solution is then filtered through thin Swedish filter paper No. 1 F, the bulk of the alcohol is evaporated, the residue is evaporated to dryness in a wide-necked glass flask on a water-bath, and is afterwards dried first in a water oven and then to constant weight *in vacuo*. The dried residue is boiled with a known excess of *N*/10

sulphuric acid, allowed to cool, shaken out three times with neutral ether, and the ethereal layer then separated and washed with water, the washings being added to the aqueous layer. The residue containing total oil and fatty acid, obtained by evaporating the ethereal extract, is dissolved in absolute alcohol and titrated with $N/10$ caustic soda or potash and phenolphthalein, whereby the fatty acid content is determined. The soap is determined by back titration of the aqueous extract with $N/10$ caustic potash, the difference between the acid originally added and that remaining being calculated to sodium oleate. This method of back titration is necessary, since the whole of the soap is decomposed only on boiling with excess of acid. The calcium soaps extracted may be determined by estimating calcium by the usual methods in the above aqueous extract, which has been titrated for soap. It frequently happens that a persistent emulsion forms when shaking out with ether, and it is then advisable to separate as much ether as possible, evaporate the acid liquor to dryness, and wash the residue with ether to remove fatty acid or oil. The amount of fatty matter in such an emulsion may amount to 0·03% on the weight of the wool. Although alcohol is a satisfactory solvent for soap, it is not possible to recover from wool the same amount of soap as is placed in it, since there is distinct evidence that some of the alkali of the soap combines with or becomes absorbed by the wool substance itself, leaving free fatty acid on the fibre. Atmospheric carbon dioxide is able to decompose soap into an "acid soap" and an alkali carbonate, and this affects the process of analysis.
—A. J. H.

Lignin of fir wood; Constitution of the ——. P. Klason. Svensk Kem. Tidskr., 1922, 34, 4—17. Chem. Zentr., 1922, 93, III., 55—56.

The calcium salt of α-ligninsulphonic acid was prepared by treating sulphite-cellulose waste liquors with calcium chloride. Waste liquor was also precipitated in three separate fractions with sodium chloride and the β-naphthylamine salts were prepared from the three fractions and from the residual liquor. All these preparations were substantially identical, corresponding with the formula $C_{20}H_{20}O_6+H_2SO_3+C_{10}H_7NH_2$; hence it is inferred that α-ligninsulphonic acid is a uniform substance. β-Naphthylamine salts have been prepared from several derivatives of the calcium α-ligninsulphonate, *e.g.*, from compounds with hydroxylamine, semicarbazide and ammonia, also from the product of acetylation with acetic anhydride at 50°—100° C. for twelve days. α-Naphthylamine salts of the α-lignosulphonic acid itself, of its methylated derivative, and of the carboxylic acid formed by oxidation with hydrogen peroxide at the ordinary temperature for forty-five days are also described. It is concluded that α-lignin is a definite uniform substance containing a coniferyl aldehyde nucleus, the presence of which throws light on the chemistry of the bisulphite process; it also contains a flavone or coumarone ring, whereby it is related to the catechins, flavones, etc. but differs from them in that it is characterised by an acrolein complex which is combined like an acetal with the carbohydrates of the wood.—J. F. B.

Patents.

Textile and other fabrics, thread, yarn, and the like; Process of treating —— [to remove starches, gums, and other impurities]. J. Takamine and J. Takamine, jun. U.S.P. 1,421,613, 4.7.22. Appl., 8.10.20.

Textiles, threads, yarns and the like are treated in a bath containing proteolytic and diastatic enzymes, to dissolve and remove starchy matter, gums, and other impurities, and are then washed with water.—D. J. N.

[Nitrocellulose composition;] Compound sheet material [from ——]. Manufacture of waterproof material. C. Claessen. E.P. (A) 174,317, 8.7.21, and (B) 174,588, 12.1.22. Conv., 21.1.21, 28.1.21. Addns. to 155,778 (J., 1922, 459 A).

(A) A compound sheet material resembling wax cloth is made by interposing a supporting fabric between two thin skins of the nitrocellulose composition described in the original patent, and uniting the three layers by pressing or rolling. (B) A strong waterproof material, suitable for packing joints, for chair seats and other purposes, is made by cementing together, by heat and pressure, alternate layers of the nitrocellulose composition and fibrous materials such as vulcanised fibre, cardboard, or paper, and allowing the mass to cool under pressure.—D. J. N.

Artificial silk and the like; Manufacture of ——. W. P. Dreaper. E.P. 181,758, 19.1.21.

Skeins of artificial silk, during the final drying process, are supported in a drying chamber in such a manner that they occupy the major portion of the cross-section of the chamber, and a blast of heated air, travelling at the rate of 3—5 m. per sec., is driven along the chamber through the skeins to keep the individual filaments in relative movement to one another during the drying process, the arrangement of the skeins being such that entanglement is prevented. This method of drying prevents the cohesion of the filaments and gives a bulky thread of high covering power.—J. F. B.

Cellulose [viscose]; Manufacture of threads, filaments, strips or films of ——. Courtaulds, Ltd., and M. T. Callimachi. E.P. 181,900, 23.4.21.

Starch is dried at a moderate temperature, preferably under reduced pressure, until it contains not more than 5% of moisture. 58 pts. of the dried starch is added rapidly, with continuous stirring, to 100 pts. of 62% sulphuric acid cooled below 0° C. When a homogeneous paste is obtained the mixture is allowed to warm up spontaneously, whilst the starch goes into solution. The resulting liquid is diluted with 540 pts. of water, and is used for the preparation of acid saline coagulating baths for the spinning of viscose threads etc.—J. F. B.

Cellulose [viscose]; Manufacture of threads, filaments and the like of ——. Courtaulds, Ltd., and H. J. Hegan. E.P. 181,901, 23.4.21.

The tendency for filaments to break at the jet orifice during spinning is counteracted by the addition to the viscose of a substance capable of lowering the surface tension of the viscose relatively to the coagulating bath. For viscose prepared from cotton the addition of 2 pts. of sodium oleate per 10,000 pts. of viscose is suitable.—J. F. B.

Cellulose [viscose]; Manufacture of coloured threads, filament strips or films of ——. Courtaulds, Ltd., and L. J. Wilson (legal representative of L. P. Wilson). E.P. 181,902, 23.4.21.

Coloured filaments etc. are produced from viscose by incorporating with the viscose a leuco-compound of a vat or sulphur dyestuff, and spinning and coagulating the coloured viscose in the usual manner. The alkaline solution of the dyestuff, reduced by sodium hydrosulphite, is either added directly to the viscose or is mixed with the caustic soda solution employed for dissolving the cellulose xanthate.—J. F. B.

Cellulose derivatives; Manufacture of artificial silk and the like from ——. H. Dreyfus. E.P. 182,166, 21.3.21.

In spinning artificial silk by the dry method of projecting solutions of cellulose esters or the like in volatile organic solvents into heated air, the rate of solidification is controlled by the addition of limited quantities of solvents of high boiling point to the cellulose solution, thereby enabling it to be drawn down to extremely fine filaments before solidification. For example: 100 pts. of cellulose acetate is dissolved in 400 pts. of acetone, and 25—50 pts. of diacetonealcohol (b.p. 163°—165° C.) is added to control solidification. Other suitable solvents of high boiling point are: acetonealcohol (acetylcarbinol), acetylacetone, cyclopentanone.—J. F. B.

Cellulose ester products [*and artificial silk of standardised dyeing speed*]; *Method of preparing* ——. H. S. Mork and O. F. Coffin, jun., Assrs. to The Lustron Co. U.S.P. (A) 1,421,288, (B) 1,421,289, and (C) 1,421,290, 27.6.22. Appl., (A) 12.3.21, (B, C) 16.11.21.

Cellulose ester products of standardised dyeing speed are made by: (A) blending together in presence of a solvent such quantities of several previously prepared batches of ester as will give a homogeneous product having the desired dyeing speed; or (B) equalising the dyeing speeds of a number of batches of the ester by suitably treating those batches which have the slower dyeing speed, and subsequently uniting all the batches in a solvent. (C) Several lots of artificial silk are prepared, and their dyeing speeds are substantially equalised by suitably treating those lots which show the slower dyeing speed.—D. J. N.

Paper product and process of making the same. E. G. Acheson. U.S.P. 1,419,951, 20.6.22. Appl., 15.7.20.

In a process of making filled papers, a step consists in incorporating with the pulp a filling material in a deflocculated state.—L. A. C.

Paper; Method of removing ink from printed ——. H. R. Eyrich and J. A. Schreiber, Assrs. to The Paper De-Inking Co. U.S.P. 1,421,195, 27.6.22. Appl., 27.4.21.

Ink is removed from paper by applying an alkaline solution of bentonite.—A. B. S.

Cotton substitutes; Manufacture of ——. B. Possanner von Ehrenthal. E.P. 156,709, 7.1.21. Conv., 7.8.19.

See G.P. 331,802 of 1919; J., 1921, 343 A.

Artificial threads, films and the like; Process for the production of —— *from viscose.* H. Jentgen. E.P. 171,691, 15.11.21. Conv., 15.11.20.

See G.P. 340,289 of 1920; J., 1921, 808 A.

[*Viscose*] *artificial silk; Manufacture of* ——. E. Bronnert. U.S.P. 1,422,412, 11.7.22. Appl., 31.8.20.

See E.P. 170,874 of 1920; J., 1921, 886 A.

Pulp for paper, cardboard, artificial leather, and the like from peat; Process for the manufacture of ——. A. L. Burlin. U.S.P. 1,420,303, 20.6.22. Appl., 30.7.20.

See E.P. 168,355 of 1920; J., 1921, 732 A.

Paper-making machines. F. J. Brougham. From J. M. Voith. E.P. 181,793, 15.3.21.

Paper-making machines. W. P. Carpmael. From The Bagley and Sewall Co. E.P. 181,809, 17.3.21.

Glue from cellulose waste liquors. G.P. 352,138. *See* XV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Modified steam oven [*for lecture experiments on steaming of cotton fabrics*]. A. G. Perkin. J. Soc. Dyers and Col., 1922, 38, 186—187.

An adaptation of the ordinary laboratory water oven suitable for the development of colour on cotton fabrics by steaming in lecture experiments. A short upright pipe terminating in a funnel-shaped opening for the purpose of charging the oven with water and having a tap fixed just below the funnel, is fixed to the usual steam exit. To this tube at a point just below the tap is connected another metal pipe which also has a tap and which is led into the interior of the oven through the usual central thermometer opening which is closed with a perforated cap. A small tube having a tap is connected to the steam jacket of the oven and serves as a safety device. The oven can thus be used in the usual manner or the steam generated in the jacket can be directed into the interior of the oven and escape through the perforated cap. The door of the oven may be provided with a jacket filled with asbestos powder so that the steam within the oven remains dry. A hollow saddle through which hot water circulates and on which fabrics may be dried is also attached to the water jacket of the oven. The oven is provided with hinged supports. —A. J. H.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sulphuric acid concentration; Thermal considerations in ——. F. C. Zeisberg. Chem. and Met. Eng., 1922, 27, 22—26.

The data available as to the specific heat, boiling point, partial pressure, heat of dilution, and heat of vaporisation of solutions of sulphuric acid in water are summarised. When a solution of sulphuric acid has been raised to its boiling point the heat necessary to carry on concentration is the sum of the heat of vaporisation of water (added to that of sulphuric acid if the latter is not negligible), the heat of dehydration (equivalent to the heat of dilution), and the heat necessary to maintain ebullition or the summation of the increments of heat necessary to raise the temperature of the acid to new and continually higher boiling points. These quantities are calculated and shown graphically. The curve of the total heat necessary is almost a straight line from 65% to 98% H_2SO_4 and over this range there is less than 2% error in assuming that 23·3 B.Th.U is required per lb. of H_2SO_4 per 1% difference. From these curves the thermal efficiencies of concentrators can be calculated, that of the Gilchrist surface evaporator (J., 1922, 585 A) on the data given, being 86·3%.—C. I.

Sulphur trioxide; Physical properties of ——. A. Berthoud. Helv. Chim. Acta, 1922, 5, 513—532.

Sulphur trioxide is supposed to exist in two solid modifications, α and β. Experiments show that the silky form, β, is probably a hydrated form; it owes its formation to the presence of water, but cannot contain more than 1 mol. of water per 1000 mols. of sulphur trioxide. The following constants of sulphur trioxide were measured with the greatest care: m.p. 16·85° C.; b.p. 44·52° C. (760 mm.); critical temp., 218·3° C.; critical pressure, 83·8 atm.; critical density, 0·633; molecular heat of vaporisation, 10,300 cals.; van der Waals' constants, $a = 0{\cdot}01629$, $b = 0{\cdot}002684$. (*Cf.* J.C.S., Sept.) —E. H. R.

***Hydrofluoric acid; Apparatus of transparent bakelite for measuring* ——.** L. J. Curtman. J. Ind. Eng. Chem., 1922, 14, 610.

Hydrofluoric acid (48%) is without appreciable action on transparent bakelite, and 10 c.c. graduated vessels made from this material have been successfully used in analytical work. They were made slightly conical in shape to facilitate pouring from the wax containers. They are less brittle than glass, non-inflammable, do not soften or become distorted, and can be readily cleaned with hot water. A medicine dropper of the same material can be used with advantage in testing for silica. —H. C. R.

[*Ammonium nitrate; Preparation of* ——]. *The equilibrium of double decomposition between soluble salts and some of its applications. II.* E. Rengade. Chim. et Ind., 1922, 7, 1090—1098.

The preparation of ammonium nitrate by double decomposition between sodium nitrate and ammonium chloride is not possible by methods similar to those by which potassium nitrate is obtained, as ammonium nitrate is at all temperatures the most soluble of the salts in equilibrium. The amount of nitrate and ammonium ions, expressed arbitrarily as ammonium nitrate left in the solution, after the crystallisation of sodium chloride, is 63·6% of the total salts at 80° C., and 81% at 108° C. From this mixture it is possible to obtain only small quantities of pure ammonium nitrate by extraction of the sodium chloride with cold water, *e.g.*, 9·7% at 0° C., and the process is therefore useless technically. The principal points of the equilibrium diagram of the system at 20° C. were determined. The double decomposition between sodium nitrate and ammonium sulphate in presence of alcohol gave more promising results, and in fact, if the mixed salts, containing an excess of sodium nitrate just sufficient always to maintain some of this salt in the solid phase, are treated with alcohol the decomposition will be complete. The excess of nitrate required will be equal to the amount dissolving in the alcohol. To prevent the formation of two layers the alcoholic strength must be at least 97% at the boiling temperature, or 78% if the operation is conducted at ordinary temperatures (25° C.). It is therefore preferable to work at 25° C., and a rapid equilibrium is attained by the following procedure: Sufficient 92% alcohol and water to make 360 pts. of 78% alcohol are taken, 102·5 pts. of sodium nitrate is dissolved in the water, with the aid of heat, 66 pts. of ammonium sulphate added, and then the 92% alcohol, and the whole is allowed to cool. The solution strained off from the insoluble sodium sulphate contains 22·2% of ammonium nitrate and 4·8% of sodium nitrate. The alcohol is recovered and rectified up to 92% for re-use, and the crude salt is freed from sodium salts by extraction with 6·7 parts of cold water for every 4·8 parts of sodium nitrate it contains. This will also dissolve 11·0 pts. of ammonium nitrate, leaving a net yield of pure salt of 51%. The solution is returned to the process, and the total yield is therefore 100% theoretically.—G. F. M.

Ammonium chloride; Preparation of —— *at low temperatures.* P. Mondain-Monval. Comptes rend., 1922, 175, 162—164.

The conditions governing the crystallisation of ammonium chloride, at 0° C., from solutions containing in addition one or more of the salts, sodium chloride, sodium carbonate, and ammonium carbonate, were studied in a similar manner to that previously described for 15° C. (J., 1922, 369 A), and a Le Chatelier diagram is given showing the surfaces of saturation. The zone of crystallisation of sodium carbonate shows two distinct areas, one corresponding to the crystallisation of $Na_2CO_3,10H_2O$, and the other to that of a hydrate of the formula, $2Na_2CO_3,5H_2O$, the existence of which, although disputed by Wegscheider (J., 1912, 69), is now confirmed.—G. F. M.

Aluminium nitride; Heat of formation of ——. F. Fichter and E. Jenny. Helv. Chim. Acta, 1922, 5, 448—454.

Aluminium nitride prepared from aluminium bronze contained about 91% AlN and 0·5% Si, the remainder being alumina. The heat of combustion as measured in a bomb calorimeter, the nitride being mixed with a proportion of benzoic acid to facilitate combustion, was

$$2AlN+3O=Al_2O_3+N_2+258{\cdot}2 \text{ Cals.}$$

Subtracting this from $2Al+3O=Al_2O_3+380{\cdot}2$ Cals. the heat of formation of aluminium nitride is $Al+N=AlN+61{\cdot}0$ Cals. If the silicon present in the nitride is in the elementary form, a correction is necessary and the final result is 62·7 Cals. —E. H. R.

Boron nitride; Reaction between —— *and various metallic oxides with production of nitric oxide.* U. Sborgi and A. G. Nasini. Gazz. Chim. Ital., 1922, 52, I., 369—387.

Measurements have been made of the yields of nitric oxide obtained when air is passed over mixtures of boron nitride with various metallic oxides heated at different temperatures. The highest yields of nitric oxide were obtained with ferric oxide (66·57—71·86% of the theoretical quantity, at 850°—970° C.), nickel oxide, Ni_2O_3 63·66—65·86%, at 800°—880° C.), cobalt oxide, Co_2O_3 (60·26—72·08%, at 820°—920° C.), manganese dioxide (59·88—71·60%, at 800°—840° C.), and manganese oxide, Mn_3O_4 (50·85—71·72%, at 700°—790° C.). The residue, after the reaction, contains a considerable proportion of the oxide uncombined and can be used for decomposing further quantities of boron nitride. The reactivity of the boron nitride diminishes on keeping; the above results were obtained with a nitride (85·84% BN) prepared from boron trioxide and ammonia at about 1100° C., and preserved *in vacuo*.—T. H. P.

Sodium sulphide; Analysis of commercial ——. *Committee on limeyard control. V.* W. R. Atkin. J. Soc. Leather Trades' Chem., 1922, 6, 239—243.

8—10 g. of the sample is dissolved in distilled water to make 1 litre, and 50 c.c. of the solution titrated in a comparator to $p_H=10$, using phenolphthalein or thymolphthalein as indicator. 10 c.c. of neutral formaldehyde is added and the mixture titrated with $N/10$ hydrochloric acid to neutrality. The second titration measures the amount of sulphide. 1 c.c. $N/10$ HCl=0·0078 g. of Na_2S.—D. W.

Reagents free from arsenic; Preparation of ——. G. Lockemann. Z. angew. Chem., 1922, 35, 357—360.

The preparation of arsenic-free reagents for, *e.g.*, determinations of small traces of arsenic for toxicological purposes may be conveniently divided into three groups: (1) neutral salts, alkalis and ammonia, (2) acids, and (3) hydrogen. The purification of reagents comprised in the first class is based on the adsorption of arsenic by freshly-precipitated ferric hydroxide, prepared as follows:—Ferric ammonium sulphate is freed from arsenic by repeated crystallisation and the purified salt is dissolved in water to a concentration of 225 g.p.l. (corresponding to 50 g.p.l. of ferric hydroxide or 1·404 N); the freedom from arsenic of this solution is checked by testing 20 c.c., acidified with 20% sulphuric acid, in a Marsh's apparatus.

The ammonia solution used for precipitation of the ferric hydroxide is prepared by diluting 240 c.c. of a 10% solution of ammonia to 1 litre, and adjusting its strength, by titration, until equivalent in normality to the iron solution; a portion is tested, after acidification, in a Marsh's apparatus, and the solution freed from arsenic, if present, by treatment with freshly-precipitated ferric hydroxide. For this purpose 100 c.c. of the ammonia solution is mixed with 100 c.c. of the purified ferric ammonium sulphate solution, and after stirring well, the ferric hydroxide is filtered off, washed with cold water, transferred to a litre flask, shaken up with the bulk of the ammonia solution to be purified, the residue allowed to subside and the supernatant layer, after its freedom from arsenic has been ascertained, adjusted to the before-mentioned strength. The two solutions described are employed for freeing from arsensic, all neutral water-soluble reagents which do not react with either iron or ammonia. For this purpose the reagent in question is dissolved to about a litre volume of solution not quite saturated at 0° C., cooled with ice, and 10 c.c. of iron solution added. 3 c.c. of the ammonia solution is next added, and the mixture stirred, allowed to stand for 15 mins., treated with a further 7 c.c. of ammonia solution to precipitate the iron completely, allowed to stand for 4 hrs., and filtered. The author claims a more complete adsorption by such fractional precipitation. 10 c.c. of the iron solution corresponds to 0·5 g. of $Fe(OH)_3$, and this quantity is sufficient to remove the following quantities of arsenic from a litre of solution: at 0° C. 40 mg., 20° C. 30 mg., 40° C. about 15 mg., and 80° C. about 9 mg. The accompanying adsorption of non-arsenical salts must be taken into consideration when calculating the quantity of iron adsorbent necessary for purification. The effectiveness of the adsorption of arsenic and the quantity adsorbed are tested by thoroughly washing the ferric hydroxide precipitate with cold water until free from the reagent originally to be purified, dissolving in 4*N* sulphuric acid and testing in a Marsh's apparatus. By a second trial adsorption of the purified solution with 3 c.c. of iron solution and 1+2 c.c. of ammonia solution, and testing of the precipitate, the completeness of the first adsorption is determined. The ammonium sulphate formed as a secondary product of the ferric hydroxide precipitation may be removed by recrystallisation, or its presence avoided by adsorbing the arsenic on to previously precipitated ferric hydroxide, but owing to the lower efficiency in such cases a much larger amount, *e.g.*, 10—25 g., of ferric hydroxide per litre must be employed. Arsenic-free nitric and hydrochloric acids are prepared by the interaction of arsenic-free sulphuric acid and alkali nitrate and chloride respectively, freed from arsenic by the treatment with ferric hydroxide already described. Arsenic-free sulphuric acid is prepared by leading a current of hydrochloric and hydrobromic acid gases, obtained by the action of sulphuric acid on a solution of 3 g. of potassium bromide in 10 c.c. of water to which has been added 50 g. of potassium chloride, through 600 c.c. of sulphuric acid maintained at 150° C., the reduced and volatilised arsenious chloride being distilled over and the last traces removed by raising the temperature of the sulphuric acid to 200° C. and displacing the arsenious chloride by carbon dioxide. Any accompanying sulphurous acid must be removed by subsequently oxidising with potassium permanganate and distilling in a porcelain retort. The original paper contains details of the apparatus and its manipulation by which it is claimed that 600 c.c. of acid may be freed from arsenic in 2¼ hrs. Arsenic-free hydrogen is most conveniently generated by the action of arsenic-free hydrochloric acid on an alloy consisting of 9 pts. of zinc to 1 pt. of copper, which retains the whole of the arsenic, unlike zinc of low copper content (0·1—0·2%), which evolves its arsenic along with the hydrogen.—A. de W.

Arsenic and antimony; Volatilisation of —— by methyl alcohol. L. Duparc and L. Ramadier. Helv. Chim. Acta, 1922, 5, 552—556.

By passing a current of air through a solution of arsenious or antimonious oxide in concentrated hydrochloric acid containing a suitable proportion of methyl alcohol, the whole of the arsenic can be carried over into an absorbing solution. In this way 0·1 g. of As_2O_3 dissolved in concentrated hydrochloric acid can be volatilised in 1 hr. at 55° C. after addition of 45 c.c. of methyl alcohol saturated with dry hydrogen chloride. In the case of Sb_2O_3 not more than 59% can be volatilised under similar conditions, and volatilisation can be entirely prevented by diluting the hydrochloric acid with an equal volume of water. The method may be applicable for separating arsenic and antimony from other metals or from each other.—E. H. R.

Positive rays; Analysis by —— of the heavier constituents of the atmosphere, of the gases in a vessel in which radium chloride had been stored for 13 *years, and of gases given off by deflagrated metals.* J. J. Thomson. Proc. Roy. Soc., 1922, **A 101**, 290—299.

The residues from many thousands of tons of liquid air have been examined by the positive ray method of analysis for the presence of molecules heavier than krypton and xenon. Two new constituents of the atmosphere were found with molecular weights 163 and 260. The lighter of these is the more abundant, but the quantity in the air is very small compared with xenon. No place in the periodic table can be found for a new element with atomic weight 163, and it is possible that the two new substances are diatomic molecules of krypton and xenon. The gases from radium stored in an evacuated vessel for about 13 years, showed the presence of helium and hydrogen, but no xenon nor H_3 was found. Evidence was obtained of the existence of a compound of hydrogen and helium. The gases from the deflagration of fine wires of tungsten, gold, or copper by powerful electric currents did not yield any helium, although H_3 was detected. In gases which had stood over radium for a considerable time the presence of doubly, triply and quadruply charged atoms of oxygen and nitrogen, and doubly and triply charged carbon atoms was indicated by the positive ray method of analysis. A compound OH_2, carrying a double charge, was also noted.—W. E. G.

Urea from ammonia. Matignon and Fréjacques. *See* XX.

PATENTS.

Sulphuric acid manufacture; Recovery of oxides of nitrogen in ——. A. M. Fairlie. U.S.P. 1,420,477, 20.6.22. Appl., 19.5.20.

The normal quantity of sulphur dioxide contained in the exit gases is removed, the lower nitrogen oxides are oxidised to higher oxides, and these are absorbed.—H. R. D.

Sulphur burner. A. G. Hinzke. U.S.P. 1,421,232, 27.6.22. Appl., 17.6.21.

A sulphur burner comprises a shell, on the top of which is a melting vessel, with feed supply orifices and valve-controlled means for regulating the flow of molten sulphur into the shell; a central duct extends through the melting vessel and shell, and has a discharge pipe at its upper end. Means are provided for causing the molten sulphur to follow a serpentine course to the lower end of the central duct, up which the resulting hot gases pass.

—A. B. S.

[Sludge] acids; Method of treating ——. I. Hechenbleikner and T. C. Oliver, Assrs. to Chemical Construction Co. U.S.P. 1,421,688, 4.7.22. Appl., 16.6.21.

Sludge acid is concentrated in two stages, the first being checked before the charring point is reached. —C. I.

(A) *Hydrochloric acid and carbon monoxide; Process of manufacturing* ——. (B) *Apparatus for use in effecting chemical reactions.* (C) *Apparatus for effecting chemical reactions [by means of amalgams].* (D) *Method of and apparatus for electrolytic reduction and oxidation.* (E) *Manufacture of [metal] oxalate.* H. W. Paulus, Assr. to Royal Baking Powder Co. U.S.P. 1,420,209—13, 20.6.22. Appl., (A) 19.7.20, (B—E) 26.7.20.

(A) A mixture of hydrochloric acid and carbon monoxide is prepared by passing a mixture of chlorine and steam in the correct proportions through an incandescent mass of carbon contained in a vessel sealed from the atmosphere, sufficient air being introduced with the mixed gases to maintain the carbon at the temperature necessary to effect the desired chemical reactions. (B) An apparatus for use in effecting chemical reactions comprises a horizontal, jacketed, cylindrical drum provided with a shaft supported in jacketed heads at the ends of the drum. Spiders are mounted on the shaft at each end of the drum, and adjustable scrapers, supported in staggered relation from the spiders, are provided to keep the interior surface of the drum clean. A relatively large inlet is provided for admitting gases into the drum, while waste gases are withdrawn through a number of relatively small outlets. Means are also provided for heating or cooling the drum, to maintain the contents at a desired temperature. (C) An apparatus for effecting chemical reactions by means of amalgams comprises an electrolytic cell in which the amalgam is formed, a reaction chamber, and a cooling trough between the cell and the chamber. The electrolytic cell is divided into a series of longitudinal channels to facilitate the passage of mercury through the apparatus, while the bottom of the cooling trough is provided with a series of transverse depressions for the same purpose. The reaction chamber is divided into a series of channels, some of which receive mercury from the trough, while the mercury in others passes back to the cell, the mercury in the channels being impelled in one or the other direction by two sets of paddles. Means are provided for returning the mercury from the chamber to the cell. (D) An apparatus for electrolytic reduction and oxidation comprises a cell for containing the electrolyte, a stationary plate electrode in the cell, and means for imparting a rotary motion, relative to the surface of the electrode, to the electrolyte admitted to the cell. (E) Metal oxalates are prepared by dropping finely divided, dry metal formates into a descending stream of inert gases maintained at 360°—440° C.—L. A. C.

Halogen compounds [hydrochloric acid and methyl chloride]; Preparation of ——. W. O. Snelling. U.S.P. 1,421,733, 4.7.22. Appl., 4.6.20.

Methane and chlorine are allowed to interact, and the gas mixture scrubbed successively with solvents for methyl chloride and for hydrogen chloride. —C. I.

Hydrogen and ammonia; Preparation of ——. The Nitrogen Corp., Assees. of J. C. Clancy. E.P. 163,323, 17.5.21. Conv. 14.5.20.

Sulphur vapour is subjected to direct contact with superheated steam, at about 800° C., in a refractory tube furnace. The exit gases, consisting chiefly of sulphur dioxide, hydrogen, and excess of steam, may be separated in various ways. Hydrogen may be used for the synthesis of ammonia, and the latter used for absorbing the sulphur dioxide, whereby ammonium sulphite is formed and can be oxidised to ammonium sulphate.—H. R. D.

Ammonia; Oxidation of ——. *Catalyst. Manufacture of sulphuric acid.* (A) C. H. MacDowell, H. H. Meyers, and W. B. Pattison, (B, C) C. H. MacDowell and H. H. Meyers, Assrs. to Armour Fertiliser Works. U.S.P. (A) 1,420,201, (B) 1,420,203, and (C) 1,420,202, 20.6.22. Appl., (A) 3.12.18, (B, C) 20.1.19.

(A) A mixture of ammonia and an oxidising gas is brought, at a high temperature, in contact with a composite catalyst composed of vanadium oxide and porous alumina made from alunite. (B) A composite catalyst comprises a compound of vanadium and a compound of aluminium in which each compound contributes to the catalytic activity. (C) A mixture of gases containing sulphur dioxide and oxygen, at a temperature suitable for the catalytic production of sulphur trioxide, is brought in contact with the composite catalyst described in (B).—L. A. C.

Sulphate of ammonia; Manufacture of dry neutral ——. Ebbw Vale Steel, Iron and Coal Co., Ltd., and D. Thickins. E.P. 181,884, 9.4.21.

The process of neutralisation and drying is carried out in a form of tower by an ascending current of hot air and ammonia gas. The tower is provided with a central rotating shaft fitted in the upper part with brush arms which sweep the salt across sieves, and in the lower part with scrapers which work over slotted or perforated plates. The exit gases are passed into an absorbent for pyridine. —C. I.

Aluminium chloride; Method of manufacturing ——. Aluminium Co. of America, Assees. of F. C. Frary. E.P. 163,975, 30.12.20. Conv., 26.5.20.

See U.S.P. 1,354,818 of 1920; J., 1920, 749 A. A mixture of alumina and metallic aluminium may be used in place of aluminium dross.

Titanium dioxide from bauxite; Process for preparation of ——. E. E. and P. C. Dutt. E.P. 181,775, 18.2.21.

One pt. of finely powdered bauxite (containing 7—10% TiO_2) is mixed with 5 pts. of ammonium sulphate, and the mixture heated to about 350°—400° C. After the reaction is complete, the product is treated with water. The double sulphates of alumina and iron with ammonia pass into solution, whilst titanium dioxide remains in the liquid in the form of a very fine suspension, which can be decanted off from any residue. The titanium dioxide is then separated by filtration, washed, and dried.—H. R. D.

Sulphur, metallic sulphides and the like; Recovery of —— *from a condition of emulsion without filtration or evaporation.* B. Hunt. E.P. 181,984, 16.3.22.

An emulsion of sulphur and gangue in water is heated above the melting point of sulphur in an autoclave, with agitation. The earthy matter remains in suspension, while liquid sulphur may be run off from the bottom. Certain metallic sulphides if mixed with sulphur and treated as above are removed with the molten sulphur.—C. I.

Sodium carbonate; Separation of ——, *from liquors or solutions containing caustic soda.* Courtaulds, Ltd., and R. O. Jones. E.P. 182,411, 11.6.21.

100 pts. of liquor containing about 19% of caustic soda and 7% of sodium carbonate, is treated at 20°—30° C., with 10 pts. of finely divided calcium

carbonate, and allowed to stand, stirring at intervals, whereupon the double carbonate of calcium and sodium is precipitated.—H. R. D.

Sodium carbonate and the like; Process of purifying ——. F. H. Merrill. U.S.P. 1,419,463, 13.6.22. Appl., 30.4.21.

SODIUM carbonate is freed from carbonaceous matter by heating with sodium nitrate.—J. B. F.

Sodium carbonate from common salt; Electrolytic process of manufacture of ——, *employing a diaphragm cell.* Chem. Fabrik Griesheim-Elektron. G.P. 352,002, 19.8.19.

A SOLUTION of potassium bicarbonate, potassium chloride, and sodium chloride is used in the cathode compartment of the cell and is electrolysed until the bicarbonate is neutralised. The supply of sodium chloride is then replenished and the solution treated with carbon dioxide.—J. S. G. T.

Vanadium solutions; Process of removing phosphorus from ——. A. N. Erickson, Assr. to Union Carbide and Carbon Research Laboratories, Inc. U.S.P. 1,421,191, 27.6.22. Appl., 5.10.21.

PHOSPHORUS is removed from vanadium solutions by adjusting the hydrogen ion concentration to about that of very dilute acetic acid, and then precipitating the phosphorus as phosphate.—A. B. S.

Bleaching powder. E. T. Ladd and E. C. Speiden, Assrs. to Isco Chemical Co., Inc. U.S.P. 1,421,503, 4.7.22. Appl., 7.2.22.

THE claim is for screened chlorinated calcium hydroxide, from which a substantial proportion of the smaller sized particles has been removed before chlorination.—H. R. D.

Alumina; Process of obtaining ——. R. S. Sherwin, Assr. to Aluminium Co. of America. U.S.P. 1,422,004, 4.7.22. Appl., 16.1.14. Renewed 3.4.19.

A SINTERED unfused alumina-silica-lime-soda mixture is heated with an alkaline solution of a sodium compound to a temperature not above 200° F. (93° C.) preparatory to leaching.—H. R. D.

Arsenic trichloride; Process of making ——. L. H. Milligan, Assr. to N. D. Baker. U.S.P. 1,421,978, 4.7.22. Appl., 12.6.20.

A PROCESS of making arsenic trichloride comprises heating an arsenic compound with chlorine and a reducing agent.—H. S. H.

Lead oxide; Apparatus for production of —— *by oxidising molten lead.* L. Kübler. G.P. 351,328, 16.11.20.

THE molten lead is contained in a large tall vessel preferably provided with a heat-insulating jacket. Two oppositely directed pipes for admission of compressed air are provided in the lower part of the vessel, and another similar pipe below a perforated false floor in the vessel.—J. S. G. T.

Colloidal iron solution having a neutral or feebly alkaline reaction; Production of ——. H. Timpe. G.P. 351,384, 23.12.20.

A VERY dilute solution of a ferric salt is added in equivalent proportion to a solution of an alkaline pyrophosphate of definite strength. The ferric pyrophosphate produced is filtered off, purified, mixed with water, and treated with the equivalent quantity of a solution of an alkali carbonate; a protective colloid may be added to the resulting colloidal solution.—J. S. G. T.

Continuous process of lixivating salts, more especially crude potassium salts. Fellner u. Ziegler, and M. König. G.P. 351,533, 26.7.19.

THE material is supplied to a casing in which it is mixed with leaching fluid by stirring gear rotating within the casing and provided with heating tubes. The material is carried through the upper layers of the leaching fluid on lifts disposed on the circumference of the stirring gear and then falls back into the trough of the apparatus. Adjustable sliding plates are disposed along the circumferential walls of the stirring chamber, and may be inclined so that material falling upon them from the walls of the chamber moves either in a forward or backward direction, and the transportation of the material through the apparatus is thus either accelerated or retarded.—J. S. G. T.

Sodium sulphide, sodium bisulphate, etc.; Process of atomising fused masses of ——. V. Zieren. G.P. 351,581, 11.3.19.

THE fused mass is atomised and simultaneously cooled by currents of air impinging at an angle so as to produce turbulence. For example, three air streams, one incident upon the fused mass from below, the others impinging upon the sides, may be used.—J. S. G. T.

Sulphate; Manufacture of —— *by the Hargreaves process.* F. Siemens. G.P. 352,115, 20.3.20. Addn. to 339,818.

IN a process carried out in accordance with G.P. 339,818 (J., 1921, 813 A), sulphur compounds, such as kieserite or sulphur ores, are mixed with the charge. When reduced substances decomposed with difficulty, *e.g.*, calcium sulphide, are formed, they are decomposed with carbon dioxide, acid, or steam, and made available for further use. Oxy-salts, such as gypsum, which are difficult to decompose, are mixed prior to the briquetting process, with easily decomposed chlorine compounds, *e.g.*, waste lyes from the potash industry. Coal rich in sulphur may be used for the purpose of recovering their sulphur in the form of sulphates by the Hargreaves process.—J. S. G. T.

Calcium bisulphite lye and sulphur; Process for the simultaneous production of ——. Rhenania Verein Chem. Fabr. A.-G., Zweigniederlassung Mannheim. G.P. 352,126, 11.6.20.

CALCIUM sulphide is added to a solution of calcium bisulphite into which sulphur dioxide is passed. Alternatively, a concentrated aqueous solution of sulphur dioxide into which sulphur dioxide is constantly passed is treated with calcium sulphide. —J. S. G. T.

Graphite; Process of producing ——. T. F. Baily. U.S.P. 1,420,512, 20.6.22. Appl., 31.1.22.

A BATH of superheated molten iron is saturated with carbon, and poured into a closed cooling chamber wherein it is cooled sufficiently to cause the separation of the surplus carbon in the form of graphite. —H. R. D.

Air; Liquefaction of ——. H. N. Davis, Assr. to Research Corp. U.S.P. 1,420,625, 27.6.22. Appl., 24.4.20.

IN a process for effecting heat exchange in the liquefaction of air, one gaseous stream flows in counter-current heat-exchanging relation with a second colder gaseous stream, and in order to equalise, as far as possible, the effective heat-transferring capacities of the two streams, a portion of the gas is withdrawn from the warmer stream, cooled, and then returned to counter-current heat-exchanging relation with the colder stream at a point colder than its point of withdrawal.—H. H.

Sulphur; Contact furnace for producing —— from hydrogen sulphide or gases containing it. Rhenania Verein Chem. Fabr. A.-G., and F. Projahn. G.P. 352,178, 18.10.18. Addn. to 298,844.

In a process operated in accordance with the earlier patent (J., 1920, 749 A) the gas is supplied through a number of nozzles, and a number of tubes closed below to serve as pockets for thermometers are arranged in the furnace between the door and the grate. The furnace is suitable for carrying out the Claus process.—J. S. G. T.

Ammonia; Synthesis of ——. Nitrogen Corp., Assees. of J. C. Clancy. E.P. 155,592, 20.12.20. Conv., 20.12.19.

See U.S.P. 1,363,392 of 1920; J., 1921, 469 A.

Chromic oxide and sodium sulphide; Process for the manufacture of —— from sodium chromate. C. J. Head. U.S.P. 1,422,703, 11.7.22. Appl., 14.1.21.

See E.P. 166,289 of 1920; J., 1921, 623 A.

Electrochemical reactions. E.P. 181,848–9. *See* XI.

VIII.—GLASS; CERAMICS.

Lamination [in clay]; Discussion of cause and cure of ——. J. J. F. Brand. J. Amer. Ceram. Soc., 1922, 5, 355—375.

Laminations are divided into two classes, viz., differential lamination caused by the differential flow of the clay through the die etc., and interfacial lamination due to the imperfect union of formed masses of clay. Neither the character of the clays studied nor the kind of machines used accounted for the difficulties attending the moulding and drying of the clay wares. The effect of pugging and of working upon the character of the clays was studied, and it is concluded that the presence of air in the clay caused the difficulties in moulding. It is suggested that the air should be removed from the clays prior to and during the tempering and pugging process.—H. S. H.

Clay briquettes; Simplified method of determining the dry volume of ——. J. L. Crawford. J. Amer. Ceram. Soc., 1922, 5, 394—396.

The dry volume of a clay briquette is obtained by dividing its dry weight by its bulk specific gravity, determined on a separate test-piece. This method eliminates the drying of oil-saturated test-pieces when determining the change of volume of a clay briquette after various heat treatments.—H. S. H.

Ceramic products; Firing —— in electrically heated furnaces. A. Granger. Comptes rend., 1922, 175, 98—100.

A comparison of the different types of porcelain obtained by firing in electrically heated furnaces as compared with the same materials fired in industrial furnaces. The results with the electrically heated furnaces are quite satisfactory, and it is shown that the reducing action in furnaces may be due to carbon in the form of carbon monoxide, which is oxidised to carbon dioxide and deposits carbon, and not necessarily to flames too rich in carbon.—W. G.

Terra-cotta; Firecracking of ——. E. C. Hill. J. Amer. Ceram. Soc., 1922, 5, 299—310.

Large pieces of terra-cotta made from various clays and grogs were fired and cooled at different rates. The absorption, porosity, and transverse strength of the various bodies were determined and their tendency to firecrack after weathering was noted. All bodies similar to those used in practice showed a tendency to firecrack when cooled rapidly and all were free from cracks when cooled slowly, the rate of cooling having a much greater effect on the tendency to firecrack than the composition or physical properties of the body. Owing to the difference in the expansion of sand and clay, sandy clays were more liable to produce firecracks than non-sandy, vitrifying clays. The tendency of a body to develop firecracks depended much more upon the character of the clay itself, regardless of the impurities it contained, than upon the absorption, porosity, or transverse strength of the body. No relation was found to exist between the porosity and transverse strength of a body and its tendency to firecrack. The greatest tendency to firecracking was found in a body with all the grog finer than 40-mesh, but a body with all the grog coarser than 40-mesh did not appear to have much less tendency to firecrack. Increase of grog reduced the tendency to firecrack. The kind of grog used had less effect on the tendency to firecrack than the size and the amount, the kind of grog being of much less importance than the kind of clay used.—H. S. H.

Porcelain; Tensile strength of ——. F. H. Riddle and J. S. Laird. J. Amer. Ceram. Soc., 1922, 5, 385—393.

The tensile strength of porcelain test-pieces was determined in a small tensile testing machine as used in the testing of Portland cement. Different strengths were shown by specimens prepared in different ways. Good triaxial porcelain had a strength of 3000 to 6000 lb. per sq. in., while special high-temperature porcelains showed strengths up to 10,000 to 12,000 lb. per sq. in. The ratio of tensile to compressive strength was 5·9 for the special porcelains studied, and for triaxial porcelains had an average of 7·6. The tensile strength tests showed a little more variation than the compressive strength tests. The tensile strength gave more reliable indications of the impact resistance of porcelain than did the compressive strength.—H. S. H.

Glazes; The field of porcelain —— maturing between cones 17 *and* 20. R. Twells, jun. J. Amer. Ceram. Soc. 1922, 5, 430—439.

Porcelain glazes were prepared based on the formula $(0{\cdot}3K_2O,0{\cdot}7CuO),xAl_2O_3,ySiO_2$, where RO was kept constant, x varied between 0·8 and 1·6, and y varied from 6·0 to 1·6. The glazes were applied on green porcelain discs which were air-dried but which were dipped in water before dipping in the glaze. The body chosen was vitreous from cone 17—19, but was overfired at cone 20 if the firing period was long. The test-pieces were fired in commercial kilns to cones 17¾, 18, 19, and 20. It was found that fine crazing due to a relatively high flint content could be corrected by firing to a higher temperature, though it was better to decrease the flint content. Coarse crazing in glazes of high flux content seemed to be caused or accelerated by an increased firing temperature and could be remedied by increasing both the flint and clay content, the latter to a lesser extent than the former. The best glazes for temperatures between cones 17 and 20 have ranges of composition as follows:—clay 21·9 to 27·2%, flint 40·8 to 51·8%, felspar 17·2 to 23·6%, whiting 7·2 to 10·0%.—H. S. H.

Enamel reactions; Microscopic study of ground coat and cover coat ——. E. E. Geisinger. J. Amer. Ceram. Soc., 1922, 5, 322—337.

Ground coat and cover coat enamels were applied to steel pieces and the cross-sections of the enamel examined under the microscope after correct firing in an oxidising atmosphere and also after overfiring and after firing in a reducing atmosphere.

Excessive intermingling of ground coat and cover coat was observed due to their flowing temperatures being too close to one another, and also to the interaction between ingredients. The formation of large bubbles, with a resulting weak structure, was noted with enamels of high viscosity which did not allow the ready escape of occluded air and gases. Enamels of low viscosity formed a dense glass-like structure. The tendency to excessive gasification in the enamel on the ware at high temperatures could be seen. An enamel which was heterogeneous, showing some unmelted matrix, did not exhibit fish-scaling or shivering as did a dense glass-like enamel. An enamel showing excessive bubbling would often shiver, but one which contained small, uniformly dispersed bubbles was generally free from shivering and fish-scaling.
—H. S. H.

Glaze and enamel calculations; A modification of the empirical formula in ——. J. E. Hansen. J. Amer. Ceram. Soc., 1922, 5, 338—345.

The disadvantages of the usual type of molecular formula for enamels and glazes are reviewed and it is shown by calculation back to the batch mixture how the molecular formula may be misinterpreted. The following type of empirical formula is proposed:—(Na_2O, Na_2F_2, K_2O, CaO, CaF_2, BaO, ZnO, PbO), (Al_2O_3, Al_2F_6), SiO_2, SiF_4, B_2O_3, Sb_2O_3). It is claimed that this formula presents its data in a simple and graphic manner, and indicates the mineralogical and physical condition in which most of the important constituents are introduced into the batch. There is little danger of obtaining the wrong batch mixture upon calculating back to the raw materials, and the conclusions to be drawn from the formula are fixed and definite.—H. S. H.

Patents.

Glass; Manufacture of ——. Westinghouse Lamp Co., Assees. of A. H. Compton. E.P. 170,563, 15.9.21. Conv., 16.10.20.

A glass resistant to the chemical action of vapours of the metals of the sodium group contains no silica and is made by fusing at least 50% of boron oxide with one or more of the oxides (or substances which yield the oxide) of sodium, potassium, lithium, rubidium, cæsium, aluminium, calcium, barium, strontium, and magnesium. If the glass contains only boron oxide and one or more of the alkali metals it is soluble in water, but this can be avoided by adding one or more of the oxides of aluminium, calcium, barium, strontium, and magnesium.
—H. S. H.

Glass; Gathering of ——. H. Blanc. E.P. 182,011, 27.7.21.

A helical coil of piping through which cold water is flowing is lowered into the molten glass in the furnace. Within this coil is placed a similar but smaller coil which constitutes the gatherer. The local chilling of the glass produces a crust of glass between the convolutions of the gathering coil. The gathering coil is then raised and the glass removed is dropped into a receptacle placed at a higher point within the furnace and subjected to the hot furnace gases. The reheated glass is allowed to flow from this receptacle as required.—H. S. H.

Glass; Method and apparatus for the manufacture of ——. *Manufacture of glass.* R. Good, Assr. to Hazel Atlas Glass Co. U.S.P. (A) 1,421,210 and (B) 1,421,211, 27.6.22. Appl., 1.12.19.

(A) The batch is fed vertically downward into the glass-melting tank through one or more tapering pipes, wherein, by reason of the lessening diameter, the material is subjected to a progressively increasing temperature, until fusion is effected and the material flows into the tank. (B) The batch is heated in a vertical conical receptacle until it becomes semi-molten and flows into a tank, in which it is further heated by a heating medium out of contact with the batch until it is thoroughly molten and refined, and provides a continuous supply of glass ready for use.—A. B. S.

Glass; Method of producing non-shatterable ——. O. S. Marckworth. U.S.P. 1,421,974, 4.7.22. Appl., 26.3.19.

A method of producing non-shatterable glass comprises immersing the assembled glass and celluloid laminæ in a solution of fusel oil, camphor, and methyl salicylate at a temperature of 24°—35° C. and subsequently raising the temperature of the solution, applying pressure to the laminæ, and subjecting the parts to a progressively increasing temperature, during the application of pressure.
—H. S. H.

Sheet glass; Method and apparatus for producing ——. J. P. Crowley and C. A. Rowley, Assrs. to The Libbey-Owens Sheet Glass Co. U.S.P. 1,422,036, 4.7.22. Appl., 17.1.21.

Sheet glass is produced continuously by allowing a stream of molten glass to flow downward into a space between a pair of horizontal cylindrical metallic rollers, having their faces tinned. The rollers are cooled internally and are rotated in opposite directions in a heated chamber, the lower portions of the rollers dipping into receptacles containing molten tin. The thickness of the sheet of glass is regulated by varying the distance between the rollers. The sheet of glass is cooled as it emerges from the heated chamber enclosing the rollers.—A. B. S.

Kilns [*for burning ceramic wares*]. W. G. de Steigner. E.P. 181,502, 16.3.21.

A continuous kiln consisting of a heating chamber having a horizontal middle portion and downwardly inclined end portions is so heated as to be progressively cooler from the middle portion to the ends. Means are provided for moving a series of articles step by step through the kiln. The articles are maintained in an upright position throughout their passage through the heating chamber, the carriers being moved horizontally and vertically step by step.—H. S. H.

Clay; Process for weatherproofing ——. W. H. Allen. U.S.P. 1,421,888, 4.7.22. Appl., 6.9.21.

A coating of a weather-resisting medium is applied after calcium silicate has been deposited by chemical action in the surface pores of the unbaked clay.
—H. S. H.

Glass; Apparatus for forming window —— *by the lifting process.* W. G. Clark. E.P. 160,806, 29.3.21. Conv., 29.3.20.

Glass; Manufacture of raw plate —— *and method and apparatus for use therein.* A. W. Mathys. From Bicheroux Lambotte et Cie. E.P. 182,551, 1.4.21.

Refractory silica brick and process of manufacture. O. Rebuffat, Assr. to Pomilio Bros. Corp. U.S.P. 1,420,284, 20.6.22. Appl., 5.12.21.

See E.P. 159,865 of 1921; J., 1922, 464 A.

IX.—BUILDING MATERIALS.

Stucco and flooring; New developments in oxychloride ——. J. B. Shaw and G. A. Bole. J. Amer. Ceram. Soc., 1922, 5, 311-321.

A Californian magnesite was calcined at 1000° C. and a dolomitic limestone at 650°—700° C. and at 770°—800° C., about 18% of free lime being present after the latter calcination. Cements were prepared from these substances with calcium or magnesium chloride solutions, sawdust being used as a filler. The time of setting, shrinkage and tendency to crack on drying, specific gravity, and tensile strength were determined. It was found that magnesite must be diluted with some coarse aggregate to give a satisfactory cement with magnesium chloride. Cements made from dolomite were as satisfactory as those made from magnesite with an equal magnesia content, but free lime resulting from overburning the dolomite was injurious. Both dolomite and magnesite gave cements of higher tensile strength than Portland cement. Calcium chloride can be substituted for magnesium chloride only under special conditions, *e.g.*, the solution should be more dilute and less filler should be used. Mixtures of the two chlorides did not give as good cements as either separately. The effect of fineness of grinding, temperature and humidity of the atmosphere during setting, strength of the chloride solution, the addition of different kinds of coarse aggregate, expansion, and weathering on cements prepared from various dolomites was examined.—H. S. H.

Cement; Effect of low temperatures on the hardening of ——. H. Kreuger. Beton u. Eisen, 1922, **21**, 74—78. Chem. Zentr., 1922, **93**, IV., 32.

The objectionable action of frost on the setting of cement is prevented if the temperature is kept at 4—6° C. for 2 days before exposure to frost. Moist cement-mortar and concrete when exposed alternately to heat and frost attain a lower strength than under normal conditions. On keeping cement in air at temperatures between 0° and 16° C., the hardening proceeds more slowly the lower the temperature, but considerable hardening takes place even at 2° C.—A. B. S.

Yellow pine crude oil; Toxicity of Western —— *to Lenzites Saepiaria, Fries. Studies in wood decay.* H. Schmitz. J. Ind. Eng. Chem., 1922, **14**, 617—618. (*Cf.* J., 1921, 660 A.)

The low toxicity and high rate of evaporation of the crude oil from the distillation of Western yellow pine make it of little value as a general wood preservative. It may, however, be adapted to special uses, as in the manufacture of shingle stains and preservative paints. The toxicity was determined with sawdust from three species of wood as culture media. The toxicity point varies slightly with the species of wood used. It is suggested that an ideal way to determine the toxicity of wood preservatives to wood-destroying fungi would be to set up such a culture series as was used in this work, and to determine the actual decomposition of the wood as indicated by the loss in weight of the flasks. The disadvantage would be that at least three months would be necessary, during which a volatile preservative would evaporate considerably. The Petri dish method was also used in this investigation.

—H. C. R.

Patents.

Cement manufacture [and low-temperature carbonisation.] Merz and McLellan, and E. G. Weeks. E.P. 181,811, 17.3.21.

A cement kiln is worked in conjunction with a low-temperature carbonisation plant in such manner that the coke residue from the latter, with or without other fuel, is used to heat the kiln, and the exhaust gases from the kiln (with or without the sensible heat and/or heat of combustion of gas from the carbonisation plant) are used to raise steam for use in the carbonisation process.—A. B. S.

Stone; Process and composition for coating natural and artificial ——. W. Schneider. E.P. 182,213, 30.3.21.

Natural or artificial stone is coated with a mixture of a cementitious material (15 kg. of sulphur, 4 kg. of graphite or sandstone, and 1 kg. of small shot, melted together and afterwards ground and mixed with about half its weight of Portland cement or plaster of Paris), and a metal or metals, such as tin or lead, or an alloy melting at a low temperature. A hot iron is subsequently passed over the material to produce a smooth, continuous metal surface. A sheet of metal may be applied to the coating, whilst the metallic portions thereof are in a molten condition, and a portion of the coating may be cut away, so as to leave a raised design or inscription in metal.—A. B. S.

Insulating cement or mortar. A. S. Elsenbast and W. L. Jordan. U.S.P. 1,421,192, 27.6.22. Appl., 19.3.21.

An insulating cement is made of powdered diatomaceous earth, clay, and starch.—A. B. S.

Cement kilns; Method of utilising waste-heat gases of ——. J. E. Bell. U.S.P. 1,421,386, 4.7.22. Appl., 26.9.19.

A plant comprising a cement kiln, a waste-heat flue leading therefrom, and an element for utilising the heat of the gases in the flue is so operated that the waste gases in the flue contain a considerable amount of free oxygen. The temperature and heat efficiency of the gases in the waste-heat flue and heat-utilising element are increased by feeding finely divided fuel into the flue in such quantity that it combines with the free oxygen in the waste gases and raises the temperature of the whole body of gas.—H. S. H.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Boiler plates; Strength and elasticity of —— *at elevated temperatures.* H. J. French. Chem. and Met. Eng., 1922, **26**, 1207—1209.

In all grades of plates the tensile strength decreased at a temperature of about 95° C., increased to a maximum at about 290° C., and at 400° C. again approximated to the value at atmospheric temperature. The limit of proportionality increased to a maximum at about 150° C., firebox plate showing a more distinct change than the marine grade. Variation in the value of the proportional limit was not so marked at the higher temperatures. Elongation showed only a slight decrease until 95° C. was exceeded, after which a maximum value was obtained at 245° C., which temperature also marked a minimum value for the reduction in area. The maximum tensile strength did not coincide with the minimum value for the reduction in area or the maximum proportional limit.—C. A. K.

Manganese in steels, alloys, and ores; Colorimetric estimation of ——. J. Heslinga. Chem. Weekblad, 1922, **19**, 302—303.

Oxidation to manganate or permanganate is not suitable for colorimetric estimation if iron be present. The compound, H_2MnO_3, gives a brown colour in alkaline solution very suitable for the estimation. Trivalent metals and copper are precipitated from the solution of the sample by shaking for a few minutes with powdered zinc oxide. The filtered solution is added to a mixture of 3% hydrogen peroxide and 10% potassium hydroxide, and the colour produced compared with that given by a standard manganese solution. Lead does not interfere if excess of alkali be used; if nickel or cobalt be present potassium cyanide is added. 0·02 mg. of manganese is easily detected.—S. I. L.

Nickel; Structure of electrolytically deposited ——. V. Kohlschütter and H. Schödl. Helv. Chim. Acta, 1922, 5, 490—512.

It was shown by Kohlschütter and Vuillemier (Z. Elektrochem., 1918, **24**, 300) that, according to the conditions under which it is deposited, electrolytic nickel shows a linear contraction to a greater or less extent, and a method was devised for measuring this contraction. It was later found by Stäger (J., 1920, 787 A) that this contraction could be more or less eliminated by the use of depolarisers or by superposing on the direct current an alternating current. Comparisons have now been made of the micro-structures of different deposits, some of which showed contraction on deposition and some of which did not. Although the surfaces of the deposits differed in appearance their internal structures were practically indistinguishable. It is concluded that the phenomenon is purely a surface one involving aggregation of particles originally deposited in a highly disperse form. Deposits obtained with direct current were brittle, those obtained with a superposed alternating current were more flexible. There is no apparent relation between brittleness and the contraction effect. The brittleness is probably due to the presence of hydrogen in the metal. (*Cf.* J.C.S., Sept.) —E. H. R.

Nickel; Influence of superposed alternating current on the deposition and solution potential of ——. V. Kohlschütter and H. Schödl. Helv. Chim. Acta, 1922, 5, 593—609.

In this paper are recorded potential measurements made in the course of the investigation previously described (*cf. supra*). The superposition of an alternating current causes a lowering of the cathode potential more or less parallel with the lessening of the contraction effect in the metallic deposit. The relation, however, between the structure and contraction of the metal on the one hand, and the deposition potential on the other, may not be so close as at first appears to be the case. It is impossible to observe the structure of the deposit formed at an abnormally high cathode potential, since contraction, probably accompanied by a modification of structure, is almost instantaneous. Undoubtedly hydrogen is the dominant factor in these phenomena.—E. H. R.

Metals; Apparatus for the deposition of —— *on large surfaces by cathodic projection.* P. Lambert and A. Andant. Comptes rend., 1922, 175, 154—156.

The apparatus consists of two large concentric glass bell jars. The outer stands on a glass or enamelled plate, the joint being made by means of a rubber ring. The inner jar stands in a slot, cut in the plate, and filled with mercury. The vacuum is made by means of a Gaede mercury pump, combined with a preparatory pump. The inner jar and the annular space between it and the outer jar are simultaneously exhausted, the former through an iron pipe passing through the plate and forming at the same time the anode, and the latter through the neck which is provided with a ground-in stopper. The slight difference in pressure between the inner and outer bell jars does not cause the mercury in the slot to rise more than 1—2 cm. When the desired vacuum has been reached in the inner jar it is automatically cut off from the pump by a small mercury manometer, whilst the connexion is still maintained for the lower vacuum in the outer jar. The cathode is carried by an iron rod joined to a platinum wire which passes through the stoppers of the two bell jars. The cathode itself consists of an iron disc to which is attached a thin leaf of the metal to be projected.—G. F. M.

Liquid metals; Precipitation [segregation] in ——. W. Kroll. Metall u. Erz, 1922, **19**, 317—324.

In the liquation of metallic residues containing large proportions of tin, lead, and copper with smaller amounts of arsenic and antimony and a little iron, nickel, bismuth, and precious metals, the first runnings consist of the tin-lead eutectic containing most of the precious metals, whilst the iron and about half the arsenic, antimony, and copper remain in the portion still solid at 800° C. The remainder of the copper and antimony is distributed throughout the several fractions that have liquated at different temperatures. Addition of zinc or cadmium to the metal before liquating causes the antimony to go into the tin fractions and the copper to remain in the residue. Aluminium, on the other hand, holds the antimony, arsenic, and copper with itself in the residue. Experiments on the purification of lead, tin, and copper containing other metal impurities showed that antimony, arsenic, bismuth, sulphur, selenium, and tellurium may be precipitated, or caused to segregate, from the molten metal by addition of alkali or alkaline-earth metals, such as sodium or calcium, which form difficultly fusible compounds with these elements and in most cases do not remain themselves in the metal undergoing purification. Zinc, cadmium, and the precious metals are not affected by this treatment. Results of a number of tests carried out on antimonial lead, lead-bismuth, copper-antimony, and tin-antimony alloys are tabulated.—A. R. P.

Alloys; Analysis of —— *by the aid of specific heats.* K. Zahlbruckner. Chem.-Zeit., 1922, **46**, 637—638.

The proportion of two metals, of known specific heat, in an alloy may be found by determining the specific heat of the alloy by means of the usual water calorimeter, the value found being equal to the sum of the products of the percentage of each constituent present and its specific heat. In the case of a ternary alloy the proportion of one constituent must be found by chemical analysis, *or*, assuming that the specific gravity of the constituents is also known, by determining the specific gravity of the alloy and plotting two equations. In order to obtain results to 1% by this method the temperature measurements must be made in hundredths of a degree. Examples and graphs showing the application of the method are given. —A. R. P.

Gases from deflagrated metals. Thomson. *See* VII.

Patents.

Magnetic alloy sheets; Manufacture of ——. A. F. White. From The Valley Holding Corp. E.P. 181,401, 8.12.20.

In order to control the grain size of the metal the pressure and temperature are carefully regulated during the final rolling. The ingot is reduced in stages by heating the metal slowly to 1200° F. (650° C.), and then raising the temperature and rolling into sheets. The temperature of the metal before the final pass under controlled pressure is such that the finished sheet leaves the rolls at about the recalescence point of the metal. The heating processes are conducted so that the sheets are kept out of contact with the flame.—C. A. K.

Iron or steel articles; Process for coating —— *with lead with or without other metals.* W. J. Mellersh-Jackson. From Leadizing Co. E.P. 181,781, 19.2.21.

See U.S.P. 1,405,167 of 1922; J., 1922, 221 A. The solution may contain 40—50% by wt. of lead acetate and 5% or more of acetic acid; it is used at a temperature of about 70°—80° C.

Alloy steel; Process of making ——. J. McConnell, Assr. to Interstate Iron and Steel Co. U.S.P. 1,420,328, 20.6.22. Appl., 5.6.20.

A charge of crushed alloying metal and aluminium shot is added to molten open-hearth steel as it flows from the furnace into the ladle.—C. A. K.

Alloy steel. C. M. Johnson. U.S.P. 1,420,707–8, 27.6.22. Appl., (A) 6.8.20, (B) 28.3.21.

The steel contains (A) 10—20% Cr, 9—25% Ni, and 1—10% Si, or (B) 6—18% Cr, 12—36% Ni (the nickel being at least double the chromium content), 1—10% Si, and at least 50% Fe.—A. R. P.

Internal members of the human body; Material [steel] for artificial ——. F. Hauptmeyer. U.S.P. 1,421,776, 4.7.22. Appl., 3.9.20.

Chromium-nickel steel containing 18—23% Cr, 5—10% Ni, and 0·1—0·4% C is used for the manufacture of artificial internal members for the human body.—C. A. K.

Ferromanganese; Melting ——. J. H. Hall and R. D. Jordan, Assrs. to Taylor-Wharton Iron and Steel Co. U.S.P. 1,421,218, 27.6.22. Appl., 15.7.20.

Successive layers of ferromanganese and coke are charged into a cupola, together with a substance capable of neutralising the oxides produced during melting. The cupola is worked at its full capacity, and the molten ferromanganese is tapped off at frequent intervals.—C. A. K.

Alloys [e.g. aluminium-silicon alloy]; Method of producing ——. A. Pacz. E.P. 160,426, 18.3.21. Conv., 18.3.20.

A mixture of sodium silicofluoride and the requisite amount of aluminium powder to liberate the contained silicon is pressed into any suitable shape and introduced into a bath of molten aluminium at a temperature just above its melting point. The heat of the reaction may be utilised to introduce further quantities of silicon or other metal into the alloy, by adding the powdered metal to the mixture from which the briquette is made. A similar process may be used for alloying a metal of high melting point with one of a lower melting point, *e.g.* a mixture of aluminium and sodium zirconofluoride is added to molten iron, whereby an iron-zirconium alloy is obtained.—A. R. P.

Furnaces of the crucible type; Gas or oil heated ——. The Stockport Furnaces, Ltd., E. Duckworth, and A. Mead. E.P. 181,452, 9.3.21.

Cold gases for combustion are conveyed upwards through a spiral pipe fitted in an annular chamber in the walls of a crucible furnace and then downwards through a pipe to the burner. The spiral piping is of such a diameter as to extend from side to side of the annular chamber, and so forms a spiral flue for the products of combustion, which escape through an exit in the lower part of the wall of the furnace.—C. A. K.

Furnace for metallurgical and analogous purposes. Wellman Smith Owen Engineering Corp., Ltd., and A. V. Kemp. E.P. 181,863, 1.4.21.

In furnaces having superimposed arches or crowns, leaving a passage in which the air required for combustion is preheated, and a passage above for the waste gases from the furnace, the arch bricks are allowed to project into the passage-ways so as to provide a baffle arrangement.—C. A. K.

Melting furnace. A. J. Grindle, Assr. to Grindle Fuel Equipment Co. U.S.P. 1,420,312, 20.6.22. Appl., 3.3.22.

Combustion of pulverised fuel is effected in a combustion chamber at one end of a furnace, the floor of the combustion chamber being at a higher level than, and draining into, the hearth of the melting chamber.—C. A. K.

Metallic powders; Manufacture of ——. W. M. Gillespie and P. Buckley. E.P. 181,831, 21.3.21.

A solution of the required metal is electrolysed between an anode, consisting preferably of scrap metal, and a suitable cathode, the current density at the latter being such that the metal is deposited on it as a loose non-coherent powder which is continually removed by passing the electrolyte rapidly between the electrodes. The electrolyte is circulated through the cells by means of a pump, and the suspended metal is filtered off before the liquid is returned to the pump.—A. R. P.

Oxides of tungsten or molybdenum; Process for the reduction of ——. R. E. Pearson, E. N. Craig, and Durelco, Ltd. E.P. 181,837, 22.3.21.

Moist molybdenum or tungsten oxide or hydrated oxide is mixed to a paste with sulphuric acid, and the mixture is introduced into a porous pot surrounding a cathode consisting of a bundle of nickel-chromium alloy rods. The anode of the cell consists of a lead plate embedded in a mass of scrap molybdenum (or other easily oxidisable material) contained in a porous pot. On passing a direct current through the cell and agitating the paste surrounding the cathode, the oxide contained therein is reduced to a lower oxide from which, by suitable washing, impurities such as iron, calcium, and sodium salts may be more readily removed than from the original trioxide. At the same time the waste metal surrounding the anode is oxidised to trioxide, which is used to make further quantities of the reduced oxide. The latter, after washing and drying, is reduced to a metallic powder by heating in a current of hydrogen in known manner. —A. R. P.

Ores; Method of and apparatus for smelting ——. V. P. Y. Sacio. U.S.P. 1,419,764, 13.6.22. Appl., 26.4.19.

The bottom of a blast furnace discharges into a container of crucible shape detached from the furnace. The crucible is contained in an enclosed chamber, and an outlet allows the slag to fall down a vertical granulating column in which it preheats the air for the blast furnace.—C. A. K.

Tempering and annealing; Apparatus for ——. D. S. Lavaud, B. F. Clark, and C. W. Baines, Assrs. to The Metallurgical Plant Construction Co., Ltd. U.S.P. 1,420,379, 20.6.22. Appl., 2.3.22.

After treatment in a heating chamber, the heated articles are transferred to a cooling chamber in which a steam generator takes up the heat evolved from the heated material.—C. A. K.

Alloy of refractory metals [for filaments] and process of forming same. J. A. Yunck. U.S.P. 1,422,019, 4.7.22. Appl., 17.1.13. Renewed 14.7.21.

An alloy suitable for the manufacture of metal filaments consists of at least 95% of tungsten and the rest pure thorium.—A. R. P.

Metallurgical furnaces. H. D. Hibbard. E.P. 162,624, 29.4.21.

See U.S.P. 1,362,532 of 1920; J., 1921, 87 A.

Muffle furnaces; Electrically heated ——. A.-G. Brown, Boveri & Cie. E.P. 181,875, 4.4.21. (Addn. to 159,195; J., 1921, 476 A.)

See G.P. 342,912 of 1920; J., 1922, 109 A.

Aluminium alloy. F. C. Frary, Assr. to Aluminium Co. of America. Reissue 15,407, 11.7.22, of U.S.P. 1,412,280, 11.4.22. Appl., 27.5.22.

See J., 1922, 422 A.

Zinc alloy. H. Goldschmidt and K. Müller, Assrs. to The Chemical Foundation, Inc. U.S.P. 1,421,686, 4.7.22. Appl., 19.4.17.

See G.P. 301,784 of 1916; J., 1919, 869 A.

Alloy containing iron, nickel, chromium. P. Girin, Assr. to Soc. Anon. de Commentry, Fourchambault, et Decazeville. U.S.P. 1,422,096, 11.7.22. Appl., 9.12.18.

See E.P. 140,507 of 1918; J., 1920, 412 A.

Minerals containing iron, titanium, and vanadium; Process of treating ——. B. P. F. Kjellberg. U.S.P. 1,419,971, 20.6.22. Appl., 3.11.19.

See G.P. 324,581 of 1919; J., 1920, 783 A.

Zinc sulphide ores or the like; Roasting complex ——. F. W. Harbord. U.S.P. 1,422,701, 11.7.22. Appl., 13.2.19.

See E.P. 124,266 of 1919; J., 1919, 372 A.

Reheating furnaces. Stein and Atkinson, Ltd., Assees. of La Soc. Anon. des Appareils de Manutention et Fours Stein. E.P. 181,670, 16.8.21. Conv., 16.6.21.

Electro galvanising machine. F. H. Rogers. From Meaker Galvanizing Co. E.P. 181,756, 4.1.21.

XI.—ELECTRO-CHEMISTRY.

Nickel. Kohlschütter and Schödl. *See* X.

Patents.

Electrochemical reactions [oxidation of hydrocarbons to fatty acids, production of nitrates, hydrogenation, etc.]; Processes for carrying out —— and apparatus for use therein. G. Plauson. E.P. (A) 181,848 and (B) 181,849, 24.3.21.

(A) Electrochemical reactions are carried out in an electrolytic cell provided with an anode, the superficial area of which is very small compared with that of the cathode, and which is heated to a high temperature by the current. The electrolytes employed contain substances to be acted upon by nascent oxygen or its equivalent evolved at the anode, or if desired such substances are brought into the reaction zone at the anode in the form of solutions in organic solvents or as gases. Thus the substance may be introduced into the anode region through a tube, the end of which, projecting into the electrolyte, forms the anode. The gas evolved at the anode momentarily interrupts the current, so that the action is intermittent, whereby the breaking up of products formed during the electrolysis is hindered or prevented. The process is applicable to the production of substances of the nature of fatty acids, by the electrolysis of a solution of an alkali bisulphate with or without persulphate, and containing a hydrocarbon oil preferably in the form of an emulsion. Nitrates may be produced by the electrolysis of a salt of aluminium, magnesium, calcium, etc. while air or nitrogen is introduced at the anode. (B) The area of the cathode of an electrolytic cell is small compared with that of the anode and the electrolyte employed is such that an alkali metal is liberated at the cathode. The current density of the cathode is adjusted so that the temperature of the cathode exceeds 120° C. Substances such as oils, hydrocarbons, etc. are introduced into the immediate region of the cathode and undergo cracking, hydrogenation, polymerisation, etc. By suitable control of the temperature of the cathode, hydrogen and the alkali metal are produced, the former effecting hydrogenation of the added organic substance under the catalytic action of the alkali metal. If desired, salts of platinum, palladium, nickel, etc. may be added to the electrolyte, the catalytic action being accelerated by the liberation of these metals at the cathode.—J. S. G. T.

Electric furnace. K. Leander, Assr. to Ludlum Electric Furnace Corp. U.S.P. 1,420,561, 20.6.22. Appl., 19.5.20.

The furnace roof is supported in a frame so that it can be adjusted vertically, and the independent furnace body is moved into and out of position beneath the roof. Electrodes supported by the frame pass through the roof to the furnace, and means are provided for tilting the frame, furnace body, roof, and electrodes in order to discharge the furnace.—J. S. G. T.

Electric furnace. S. N. Castle. U.S.P. 1,420,687, 27.6.22. Appl., 13.8.18.

The walls of the crucible of an electric induction furnace are inclined to the vertical at an angle not less than 15°, and the bath contained in the crucible is interlinked with the core of the furnace. Windings supported at a higher level than the bath are likewise interlinked with the core.—J. S. G. T.

[Electrolyte for] electric storage battery. E. Hacking. U.S.P. 1,421,217, 27.6.22. Appl., 11.5.22.

An electrolyte for electric storage batteries consists of a gelatinous mass of sulphuric acid, sodium silicate, and mercury bisulphate, impregnated with mineral oil.—A. B. S.

Electrolytic cell. J. Harris, Assr. to Carbo-Oxygen Co. U.S.P. 1,420,037, 20.6.22. Appl., 4.8.19.

See E.P. 175,672 of 1920; J., 1921, 299 A.

Electrical resistance material; Process of manufacturing ——. F. Eichenberger, Assr. to S.-A. Kummler u. Matter. U.S.P. 1,420,980, 27.6.22. Appl., 6.11.20.

See E.P. 153,602 of 1920; J., 1921, 740 A.

Electrostatic separation of finely-divided discrete material; Process and apparatus for ——. G. R. Brown, Assr. to Electrostatic Separation Co., Ltd. U.S.P. 1,422,026, 4.7.22. Appl., 7.1.20.

See E.P. 168,479 of 1920; J., 1921, 739 A.

See also pages (A) 631, *Apparatus for effecting reactions by means of amalgams. Electrolytic reduction and oxidation* (U.S.P. 1,420,211–2). 632, *Sodium carbonate* (G.P. 350,002). 635, *Insulating cement* (U.S.P. 1,421,192). 637, *Metallic powders* (E.P. 181,831); *Reduction of oxides of tungsten or molybdenum* (E.P. 181,837).

XII.—FATS; OILS; WAXES.

China wood oil [tung oil]. K. H. Bauer and K. Herberts. Chem. Umschau, 1922, **29**, 229—232.

China wood oil contains practically no saturated fatty acid and very little oleic acid, elæostearic acid, $C_{18}H_{32}O_2$, being the characteristic acid. Both the glyceride and the fatty acid (α-acid) derived from it change to isomeric (β) forms of higher m.p. by exposure to light or by the influence of catalysts such as iodine or sulphur. The oil obtained by extraction of the seed with a solvent containing sulphur, *e.g.*, carbon bisulphide, contains the glyceride of the β-acid. The bromo-derivative of α-elæostearic acid, although having a m.p. very close to that of the bromo-derivative of linolic acid (114° and 114·5° C. respectively) is not identical with the latter, as a mixture of the two bromo-derivatives has a lower m.p. On debromination of the bromo-derivative of α-elæostearic acid, neither linolic acid nor α-elæostearic acid (m.p. 48° C.) is obtained, but β-elæostearic acid (m.p. 68°—70° C.). On esterification of α-elæostearic acid with methyl alcohol and sulphuric acid and subsequent separation of the fatty acid, β-elæostearic acid is obtained, a result attributed not to the action of alkali, but to that of the acid used for esterification. However, on saponification of α-elæostearic acid anhydride and liberation of the acid, the α-form remains unchanged. (*Cf.* Morrell, J., 1918, 181 T).—A. de W.

Oil of grape seeds. The solid fatty acids. Method of separation of stearic and palmitic acids. E. André. Comptes rend., 1922, 175, 107—109. (*Cf.* J., 1921, 477 A, 518 A.)

From the solid fatty acids, obtained from the oil of grape seeds, the author has isolated stearic, palmitic, and melissic acids. The last-named acid probably comes from the waxy layer on the outer covering of the seeds. Palmitic and stearic acids may readily be separated for identification by fractional precipitation of their lithium salts from a solution of the mixed acids in 95% alcohol.—W. G.

Lemon seeds; Oil of ——. A. H. Bennett. Perf. Essent. Oil Rec., 1922, 13, 260.

Dried lemon seeds contain about 31% of their weight of an oil, which after either hot or cold expression, had the following analytical characters:—acidity 11·6% (as oleic acid), saponif. value 189, iodine value 109, sp. gr. 0·9227, titre of fatty acids 31·9° C., mol. wt. of fatty acids 281. The oil had a bitter flavour, and was of a clear orange colour when obtained by cold extraction, but much darker when prepared by hot extraction.—G. F. M.

Fermentation of glycerol. Müller and Müller. *See* XVIII.

Samuela carnerosana fruit. Black and Kelly. *See* XX.

Patents.

Soap composition and process of making the same. E. G. Acheson. U.S.P. 1,419,952, 20.6.22. Appl., 5.10.20.

Clay is subjected to a deflocculating process, whereby it is partially transformed to the colloidal state, and the colloidal clay is subsequently re-flocculated in the presence of the residual fine material. The product is incorporated with soap-stock.
—L. A. C.

Oil or like presses or expressing apparatus of the worm screw type. G. R. Schueler. E.P. 182,171, 23.3.21.

Electrochemical reactions. E.P. 181,848–9. *See* XI.

XIII.—PAINTS ; PIGMENTS ; VARNISHES ; RESINS.

Boiled oil substitutes as protective compositions; Examination of —— *with special reference to their rust-inhibiting properties.* Maass and Junk. Z. angew. Chem., 1922, 35, 353, 360—363.

An investigation was undertaken during the war by the *Reichsausschuss für Metallschutz* to determine how far linseed oil could be replaced by materials entirely obtainable within the Central Empires for making products for use by the railway and postal services as rust-preventing and other protective coatings. Since the substances commonly used as paint oil substitutes, *i.e.*, calcium and zinc rosinates, coumarone resin, and phenol-aldehyde condensation resins, in coal-tar solvents, either furnished unsuitable films or were too scarce at the time, attention was directed to products from coniferous wood tar, dissolved in a volatile solvent, particularly as tar fractions had from previous experience shown favourable results in rust inhibition. The tests applied comprised behaviour on application to non-absorbent (glass, iron) and absorbent surfaces (plaster, pasteboard, wood), spreading power as determined by absorption on porous surfaces, elasticity and adhesion of the dried film (bending tests), weather-resistance, resistance to changes of temperature, resistance to water vapour at 80° C., water absorption and impermeability to water, and rust-inhibiting properties. On the whole the products examined (excepting one which contained 30% of linseed oil) compared unfavourably with boiled linseed oil excepting in so far as impermeability and rust-inhibition were concerned. It was concluded that linseed oil could be partly replaced in protective coatings if results up to a certain limit of efficacy only were desired.—A. de W.

Drying oils from petroleum and other products, produced by chlorination and dechlorination. H. A. Gardner and E. Bielouss. J. Ind. Eng. Chem., 1922, 14, 619—621.

A non-viscous "neutral" mineral oil consisting chiefly of hydrocarbons from $C_{17}H_{36}$ to $C_{26}H_{54}$ was successfully chlorinated without the use of any catalyst. The amount of chlorine fixed was sufficient to form tri- and tetra-chlorides. The dechlorination was carried out, without the use of any catalyst or absorbing agent for the hydrochloric acid produced, by heating the chlorinated compounds to 250° C. A partial saturation of the ethylenic linkages primarily formed takes place owing to the formation of cyclic hydrocarbons. The iodine values of the products usually varied between 70 and 130. Semi-drying oils such as soya-bean and cottonseed oils were also treated in the same way and their drying properties were greatly improved.—H. C. R.

Patents.

Pigment and methods of producing the same. P. Fireman, Assr. to Magnetic Pigment Co. U.S.P. 1,420,985, 27.6.22. Appl., 8.4.21.

Ferrous hydroxide is precipitated from a solution of a ferrous salt and the liquid and precipitate are heated and subjected to the action of air for 10—15 hrs., whereby a dark brown pigment is obtained.
—J. R.

Pigments; Method of making binders for —— [*for printing ink*]. H. A. Buck, Assr. G. Moore. U.S.P. 1,421,125, 27.6.22. Appl., 21.6.20.

A non-inflammable printing ink consists of a pigment thoroughly incorporated in a non-inflammable binder containing shellac, borax, and water.
—D. W.

Paint and process of making same. C. A. Ward. U.S.P. 1,421,625, 4.7.22. Appl., 11.2.20.

A mixture of aluminium and zinc stearates is intimately mixed with a pigment and suspended in a vehicle.—D. W.

Resinous condensation products from phenolic acids and aldehydes; Process for preparing ——. Farbw. vorm. Meister, Lucius, und Brüning. G.P. 339,495, 16.11.19.

Aromatic hydroxycarboxylic acids are heated with aldehydes or substances producing aldehydes. Small

quantities of acid or basic condensing agents and solvents may be present. For example, salicylic acid may be heated with 30% formaldehyde and water for 20 hrs. and the whitish precipitate produced separated, freed from excess of water and further heated until a sample sets to a clear glass-like substance. The duration of treatment may be shortened by adding a catalyst such as hydrochloric acid. The resin obtained is hard and of high melting point and is soluble in alcohol and acetone, in weak alkalis such as sodium carbonate, borax, and ammonia solution, and in paraldehyde. It is suitable for leather-finishing and for treating felts in the manufacture of hats. Similar resins are obtained from hexamethylenetetramine and mixtures of *o*- and *p*-hydroxybenzoic acids; from 1.3.4-hydroxytoluic acid and paraformaldehyde in the presence of ammonium acetate; and from salicylic acid and benzaldehyde in the presence of ammonia. These products are of yellow to yellowish-red colour and in consequence of their solubility in weak alkalis can be used as substitutes for shellac.
—H. C. R.

[Resinous] condensation products from hydrocarbons; Process for the production of ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 349,741, 12.7.18.

The hydrocarbon is treated with formaldehyde or substances yielding formaldehyde in the presence of sulphuric acid of concentration below 60%. For example if naphthalene is heated to 110°—115° C. with 40% formaldehyde and sulphuric acid (66° B., sp. gr. 1·84) a white resin is obtained which is soluble in acetone, benzene, solvent naphtha, carbon tetrachloride and carbon bisulphide. Phenanthrene gives under the same conditions a brownish-yellow, brittle resin soluble in benzene and xylene, anthracene a yellow resin soluble in benzene. Benzene heated under pressure to 118°—125° C. with 40% formaldehyde and 96% sulphuric acid gives a soft brown resinous mass soluble in benzene. Toluene gives a clear liquid soluble in ether, acetone, benzene, chloroform, and carbon tetrachloride. Xylene heated for six hrs. with 40% formaldehyde and 96% sulphuric acid gives a brown resin soluble in acetone, benzene, carbon tetrachloride, and solvent naphtha. The products melting below 100° C. are of value in the varnish industry.
—H. C. R.

Oils suitable for impregnating films and keeping them soft; Process for manufacturing ——. Petri und Stark, Ges. m. b. H. G.P. 349,088, 22.3.19.

Benzyl alcohol is treated with 50—80% sulphuric acid at a low temperature and for a short time so that no formation of resin occurs. A pale yellow or brownish viscous oil is obtained which is practically free from odour, has a much higher boiling point than benzyl ether, and is easily taken up by tissue and animal membranes and firmly retained by them.—H. C. R.

Dye for documents; Method of making an indestructible black stamp ——. J. Schiffmann. U.S.P. 1,421,728, 4.7.22. Appl., 8.8.21.

See E.P. 172,588 of 1921; J., 1922, 66 A.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Vulcanisation of rubber in solution. F. Boiry. Comptes rend., 1922, 175, 102—104.

If rubber, in solution in an organic solvent, is heated with sulphur at about 120° C. the nature of the product depends on the concentration of the solution and the solvent used. With dilute solutions (1—2%) and with solvents such as nitrobenzene, petrol, phenetol, etc., a gelatinous deposit is obtained which, when dried, is a hard elastic mass with a black fracture. After extraction with acetone it contains 15—30% of "combined" sulphur, depending on the conditions. With solvents such as aniline, xylene, thymol, etc. no precipitate is obtained even after boiling for several weeks. With 10% solutions, in solvents of the first group, the viscosity of the solution at first diminishes on heating, until it reaches a minimum, after which it rises first slowly and then rapidly until the liquid forms a gel. These gels show the phenomenon of syneresis. The sulphur content of the products obtained after extracting these gels with acetone is 20—30%.—W. G.

Patent.

Rubber; Process for heat vulcanisation of ——. R. Wheatley, and The Victoria Rubber Co., Ltd. E.P. 181,802, 17.3.21.

Cylinders, presses, jacketed autoclaves, and dry heat chambers for vulcanising are heated by means of one or more substances (other than a solution) having a boiling point higher than water, so that high temperatures can be obtained at low pressure. The substance or substances, *e.g.* aniline oil, are circulated between the source of heat and the vulcaniser.—D. W.

XV.—LEATHER; BONE; HORN; GLUE.

Hide; Bacteriology of fresh steer ——. G. D. McLaughlin and G. E. Rockwell. J. Amer. Leather Chem. Assoc., 1922, 17, 325—340.

The authors have isolated and studied a number of bacteria from fresh hide. Experiments on pieces of hide show that the presence of proteolytic bacteria, protein matter such as blood, a slightly alkaline medium, a moderately high temperature, the presence of oxygen and small traces of carbon dioxide favour bacterial decomposition of the hide, whilst the absence of proteolytic bacteria, acidity, the presence of fermentable carbohydrates, a large excess of carbon dioxide, the absence of oxygen, and a low temperature tend to prevent it.—D. W.

Chrome tanning. X. Modern problems in chrome tanning. D. Burton. J. Soc. Leather Trades' Chem., 1922, 6, 226—234.

The swelling power of a chrome liquor is dependent on the free acidity, the neutral salt content, the relative rates of absorption of acid and further hydrolysis of the chromium salt, and the relative rates of absorption of acid and fixation of the grain by the chromium compound. Organic substances in the chrome liquor exert a favourable influence. If sulphuric acid is replaced by a weaker acid, the chrome liquor will have a lower hydrogen ion concentration, produce less swelling and therefore give a softer leather. The procedure in tanning, the completion of the tannage, and ageing are also discussed.—D. W.

Chrome tanning. Equilibria between tetrachrome-collagen and chrome liquors. Formation of octa-chrome-collagen. A. W. Thomas and M. W. Kelly. J. Ind. Eng. Chem., 1922, 14, 621—623.

Measurement of the fixation of chrome by hide substance after contact for 8½ months with chrome liquors of various concentrations showed that maximum fixation occurred in a liquor containing 1·5 g. Cr_2O_3 per 100 c.c. The chrome-collagen compound formed in this liquor proved to be an octa-chrome-collagen, showing that the combining weight of collagen is as low as 94. The changes taking place when tetrachrome-collagen is in contact with chrome liquors over a similar time interval have been measured and show that the formation of tetrachrome-collagen is not strictly reversible. This supports the view that the absorption of chrome from chrome liquors by collagen is a chemical reaction.—H. C. R.

Chrome leather analysis. A modified method of determining the amount of alkali salts in chrome leather. D. Woodroffe and R. E. Green. J. Soc. Leather Trades' Chem., 1922, **6**, 222—223.

The leather is ashed, the ash treated with strong sulphuric acid, the excess of which is evaporated off, the residue ignited, the soluble sulphates extracted with boiling water, and estimated with barium chloride.—D. W.

Tannin analysis; A contribution to the method of ——. J. Schneider, jun. J. Soc. Leather Trades' Chem., 1922, **6**, 234—239.

For the purpose of determining total soluble matter, total solids, and non-tans, aliquot weighed portions should be employed instead of measured portions, as more accurate results are obtained. Dry chromed hide powder gives good results.
—D. W.

Tannin-analysis; Note on the Wilson-Kern method of ——. G. W. Schultz. J. Amer. Leather Chem. Assoc., 1922, **17**, 348—352.

Recent work by Thomas and Kelly (*cf.* J., 1922, 383 A) is quoted to controvert the Wilson-Kern method of analysis. A portion of the tannin absorbed by the hide powder in shake experiments is removed by washing. In strong tannin solutions, the surface of the hide particles is so completely tanned as to prevent further penetration of the tannin. The introduction of air-dry powder into tannin solutions does not parallel tannery practice.
—D. W.

Gelatin swelling; Note on the lyotrope-adsorption theory of ——. H. G. Bennett. J. Soc. Leather Trades' Chem., 1922, **6**, 223—226.

A criticism of the Procter-Wilson theory of gelatin swelling and of a recent paper by Atkin (*cf.* J., 1922, 475 A). The author affirms that the swelling of gelatin is caused by the adsorption of ions modified by the lyotrope effects of the dissolved salts.
—D. W.

Sodium sulphide. Atkin. *See* VII.

Patents.

Hides and skins; Depilation of ——. O. Richter. E.P. 182,240, 13.4.21. Addn. to 175,314 (J., 1922, 304 A).

The hides or skins are degreased prior to, or during the early stages of depilation, and protected on the flesh side against penetration by ammonia by suitable coatings or by being placed flesh to flesh. Warmed concentrated ammonia is used in place of steam to maintain the requisite degree of moisture. The hides or skins may be kept in motion, or the vapours may be circulated. The unconsumed ammonia is expelled from the chamber by warm air or other gases which do not react with the ammonia, and the latter is recovered.—D. W.

Tanning agent for the chrome tannage of leather; Preparation of a ——. A. Glover and G. Martin. E.P. 182,289, 26.5.21.

Aqueous solutions of sodium or potassium bichromate and sulphuric acid are reduced with dried whey powder.—D. W.

Tanning hides; Process for ——. Chem. Fabr. vorm. Weiler-ter Meer. G.P. 349,363, 30.9.17. Addn. to 334,004 (J., 1921, 400 A).

Ferric salts dissolved in solutions containing formic acid, with or without the addition of other tanning agents or accelerators, are used as tanning agents. For example, pickled pelts are treated with a liquor containing anhydrous ferric sulphate, sodium formate, and formic acid, with or without the addition of 30% formaldehyde and sulphite-cellulose extract. When the ferric salt has penetrated uniformly throughout the skin, an aqueous solution of sodium carbonate is added, and the skin is treated for several hours more in the solution. The use of formic acid reduces the time of the tanning process.
—L. A. C.

Glue, gelatin, and the like; Apparatus for the extraction of ——. F. H. Tunnell. U.S.P. 1,421,620, 4.7.22. Appl., 10.12.20.

The apparatus comprises an open tank having a perforated false floor spaced from the bottom and sides, a standpipe extending from the floor to a point above the top of the tank and having openings and a deflector adjacent its upper end, means for withdrawing liquid from the tank, heating means below the false floor, a screen disposed around the peripheral edge of the false floor and inwardly inclined to it, and means adjacent the bottom of the standpipe to direct a column of fluid upwards therein.—D. W.

Glue from the waste liquors from cellulose manufacture; Process for manufacturing ——. H. P. Kaufmann. G.P. 352,138, 19.3.18.

The liquors are evaporated to a thick paste or a dry powder and this is mixed with casein and lime or casein, lime, and a salt of an alkali metal. The product is characterised by greater strength and waterproof qualities than other glues made from cellulose liquors.—H. C. R.

Tanning with aluminium salts; Process for ——. O. Röhm, Assr. to The Chemical Foundation, Inc. U.S.P. 1,421,723, 4.7.22. Appl., 6.12.17.

See E.P. 110,750 of 1917; J., 1918, 217 A.

Glue; Manufacture of ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 181,865, 2.4.21.

See G.P. 344,238 of 1921; J., 1922, 186 A.

XVI.—SOILS; FERTILISERS.

Soil; Presence of cobalt and nickel in arable ——. G. Bertrand and Mokragnatz. Comptes rend., 1922, **175**, 112—114.

In a very fertile, arable soil from near Belgrade the authors have found 0·00028% of cobalt and 0·00136% of nickel and in a garden soil 0·00037% of cobalt and 0·00174% of nickel.—W. G.

Humus; Determination of —— by oxidation with chromic acid. A. Gehring. Z. anal. Chem., 1922, **61**, 273—278.

To determine humus in soil a sample is treated in a flask with dilute sulphuric acid to decompose carbonates, a current of air being passed through the flask to remove the carbon dioxide. Potassium bichromate is then added and the mixture heated while the current of air is continued; the gases resulting from the oxidation of the organic matter are passed through a heated tube containing copper oxide and lead chromate, and the carbon dioxide is then collected in a potash bulb and weighed.
—W. P. S.

Urea. Matignon and Fréjacques. *See* **XX.**

Patent.

Insecticide. U.S.P. 1,420,978. *See* **XIXb.**

XVII.—SUGARS; STARCHES; GUMS.

Beet raw sugars; Loss of sucrose in the refinery in the working of ——. J. E. Duschsky and P. G. Galabutsky. Z. Ver. deuts. Zuckerind., 1922, 401—416.

DURING the re-melting of sound "sand sugar" it is unnecessary to add lime or other alkali, since, whether a coil or direct steam be the means of heating, the amount of inversion that occurs can hardly be detected. On the other hand, when working with deteriorated sand sugar, which contains invert sugar, and has become more or less acid, alkali must be added, but the amount should be little more than that required for neutralisation, viz., an alkalinity of 0·001% CaO. It is held that a greater excess of alkali is irrational, since it causes the darkening of the liquors, and leads to an increase of the salt content of the syrup and consequently to a greater amount of final molasses. During the re-melting of deteriorated sand sugar, solution must be effected as rapidly as possible, and direct steam should be used for heating. Any unnecessary delay before discharging the syrup from the pans should likewise be avoided.—J. P. O.

Sugars; Insoluble matter content of direct consumption ——. J. P. Ogilvie. Int. Sugar J., 1922, *24, 368—369.*

IN Demerara and Trinidad yellow crystals the total insoluble matter was found to vary between 10 and 48 mg. per 100 g. of sample, and in plantation white sugars between 13 and 25 mg., of which about half consisted of inorganic matter.—J. P. O.

[*Sugar*] *cane juice; Determination of the Brix degree of raw* ——. W. D. Helderman. Archief, 1921, **29**, 1708—1713. Int. Sugar J., 1922, **24**, 381.

IF raw cane juice, which refuses readily to subside and de-aerate, be heated with about 2% of kieselguhr rapidly to boiling point in a flask fitted with a reflux condenser, cooled, and filtered, a clear liquor practically free from air, serving well for the Brix degree determination is obtained, the reading found agreeing closely with that given by the same juice which has been allowed to subside during one hour. Juice thus treated with kieselguhr should not, however, be used also for the determination of the sucrose and reducing sugars content, since during the process of heating some inversion generally occurs.—J. P. O.

Carbohydrates; Sublimation experiments with ——. P. Karrer and J. O. Rosenberg. Helv. Chim. Acta, 1922, 5, 575—576.

PICTET and Sarasin (J., 1918, 49 A) have shown that lævoglucosan is formed when starch is distilled at a low pressure. The same product has now been obtained as a sublimate by heating potato starch at about 220° C. in a very thin layer, having a cold condensing surface within 2 mm. of the heated starch, at atmospheric pressure. From α-tetramylose the same product was obtained, but by heating rhamnose at 120° C. (12 mm.) the sugar itself was sublimed.—E. H. R.

Galactosan. A. Pictet and H. Vernet. Helv. Chim. Acta, 1922, 5, 444—448.

WHEN galactose is dehydrated at 180° C. (15 mm.) the molecular weight of the product corresponds with $(C_6H_{10}O_5)_2$; at 135° C. (2 mm.) a mixture of galactosan, $C_6H_{10}O_5$, and its dimeride is formed. The galactosan can be partially purified by extraction with boiling alcohol. Chemically it behaves like glucosan and is therefore an anhydride of the α-series. In cold hydrochloric acid it forms α-galactosyl chloride, which condenses in alcoholic solution with glucose and sodium to form a new disaccharide, glucose-α-galactoside. The osazone of this new sugar has m.p. 158° C. (*Cf.* J.C.S., Sept.) —E. H. R.

Decolorising carbon; Capacity of —— *for absorbing water.* A. Scholz. Chem.-Zeit., 1922, **46**, 652.

A GOOD decolorising carbon such as that used in the sugar industry can absorb up to 45% of its weight of water without appearing at all moist. With an equal weight of water it forms a moist powder which just balls together, while with 1½ times its weight of water it first assumes the characteristics of damp slime.—A. R. P.

Samuela carnerosana fruit. Black and Kelly. *See* XX.

XVIII.—FERMENTATION INDUSTRIES.

Grain; Method of utilising the component substances of —— *for the maximum production of material useful as food or in industry.* A. Sorel. Bull. Assoc. Chim. Sucr., 1922, **39**, 358—362.

THE grain is ground to flour and digested with malt at 60°—62° C. to saccharify the starch. Lactic fermentation is allowed to proceed for a brief period in order to render soluble mineral matter ultimately to be used as a yeast food. Excessive *production of lactic acid is checked by the addition of vinasse, previously concentrated under reduced* pressure *below 65° C. Yeast is added and allowed* to act for some hours. Alcohol is distilled off at atmospheric pressure. The yields of alcohol and of yeast were 36% and 24% respectively by the Viennese yeast process; and 25% and 35% respectively by the aero-yeast method.—A. G. P.

Glycerol; Fermentation of —— *in presence of sulphur.* H. and L. Müller. Helv. Chim. Acta, 1922, 5, 628—629.

IN presence of sulphur, glycerol is attacked by yeast with the formation of carbon dioxide and hydrogen sulphide. The sulphur probably oxidises or dehydrogenates the glycerol into a fermentable compound, according to the equation $C_3H_8O_3+S=C_3H_6O_3+H_2S$. (*Cf.* J.C.S., Sept.)—E. H. R.

Formaldehyde; "Alcoholic fermentation" of ——. H. Müller. Helv. Chim. Acta, 1922, 5, 627—628.

THE reaction involved in the "alcoholic fermentation" of formaldehyde in presence of osmium (J., 1922, 118 A), $3CH_2O+H_2O=2CH_3OH+CO_2$, can be accounted for by Cannizzaro's reaction. Assuming 4 mols. of formaldehyde to give 2 mols. each of methyl alcohol and formic acid, the latter can behave as an aldehyde and by the same reaction give, from 2 mols. of formic acid, 1 mol. of formaldehyde and 1 mol. of carbon dioxide. The net result corresponds with the above equation. —E. H. R.

Lactic acid; Destruction of —— *by yeast cells.* F. Lieben. Oesterr. Chem.-Zeit., 1922, 25, 87—90.

LACTIC acid being one of the products of the degradation of carbohydrates in muscle, experiments were made *in vitro* to determine the ultimate fate of this substance under the influence of the enzymes of the yeast cell, which appear to be similar, at least, to the muscle enzymes. It was found that lactic acid disappeared to within 3—5% in 7—8 hours, under suitable conditions, and that about two-thirds of its carbon content appeared in the products as carbon dioxide, either liberated as such, or remaining combined with soda; the remainder of the carbon was represented by an increase in weight of the yeast substance, and if calculated as $C_6H_{10}O_5$ practically accounted, together with the carbon dioxide, for the whole of the lactic acid which had disappeared. It appears, therefore, that both synthesis and degradation had occurred simultaneously. No other degradation products than carbon dioxide could be detected. Similar experiments were made with vegetable acids and with amino-acids: the former were not attacked; the latter were in part consumed by the yeast, but no degradation to carbon dioxide could be detected.—G. F. M.

Brandy; Critical study and new contribution to the analysis of ——. G. Bonifazi. Mitt. Lebensmittelunters. u. Hyg., 1922, **13**, 69—95. Chem. Zentr., 1922, **93**, IV., 62—63.

The characteristics of the different kinds of brandy, including artificial brandies, are enumerated and the methods in use for differentiating between them are described. The Micko process for the fractional distillation of the esters after saponification is described in the original, and the results of its application to a number of samples of brandy are given. This method is a very valuable one for the analysis of brandies. It allows of organoleptic tests on the different fractions and also of carrying out other determinations which are necessary for judging the sample. Among these, the appearance of a maximum ester value in the fourth or fifth fraction is of importance, as it appears to be proportional to the ester value. This maximum value *only occurs in the case of natural and adulterated brandies, and not in the case of artificial* brandies. The ratio ester value/maximum value varies within narrow limits for natural brandies. The higher this ratio the more doubtful is the quality of the brandy.—H. C. R.

Brandy; Detection and estimation of vanillin in ——. T. von Fellenberg. Mitt. Lebensmittelunters. u. Hyg., 1922, **13**, 98—110. Chem. Zentr., 1922, **93**, IV., 63.

100 c.c. of the brandy is distilled, using a fractionating column of glass balls, until only 10 c.c. is left behind. The residue is shaken 300 times with 10 c.c. of ether and the aqueous solution discarded. Any emulsion that forms is broken by centrifuging. The ether solution is shaken twice with 2 c.c. of water, giving 100 shakes each time, and then treated with 3 c.c. of saturated (40%) sodium bisulphite solution and shaken for 5 min. The aqueous layer is washed twice with 2 c.c. of ether, shaking 100 times at each washing, and transferred to a beaker with 3 c.c. of sulphuric acid solution (1:1) and 1 c.c. of water, heated to boiling, and, after cooling, shaken with its own volume of ether. The ethereal solution is washed with water, dried over calcium chloride, and evaporated to 1 c.c. This is transferred to a clock glass which is covered by another one cooled with ice. The ether is evaporated off and the residue sublimed by heating it over a spirit lamp about 15 cm. away. After 10—15 min. the top glass is changed and tested by odour and microscopical examination for vanillin. If a visible sublimate is obtained the clock glass condenser is changed every 10 min. until a sublimate and the odour of vanillin are no longer obtained. The sublimates are dissolved in ether, united in a test-tube, and after evaporating the ether, tested colorimetrically by adding bromine water (0·1—0·3 c.c.) until a permanent odour of bromine is obtained, removing the excess by blowing in air, and adding 1% ferrous sulphate solution, drop by drop. The presence of vanillin is indicated by a bluish-green coloration. The quantity may be estimated by comparison with solutions of vanillin of known concentrations. Quantities of vanillin up to 0·1 mg. per litre may come from the wood of barrels. The addition of vanillin is not indicated if less than 0·2—0·5 mg. per litre is found.
—H. C. R.

Samuela carnerosana fruit. Black and Kelly. *See* XX.

Papain. Brill and Brown. *See* XX.

Patents.

Distilling alcoholic and other liquids; Process of and apparatus for ——. H. Wade. From J. Schneible. E.P. 182,069, 13.1.21.

In a sectional column still for the distillation of alcoholic and other liquors, baffle rings and discs, preferably inclined downwards towards their free edges, are arranged alternately, and between the rings and discs are sets of vertical guide vanes, each guide vane being set at an angle to the radius of the still. The guide vanes impart a whirling movement to the rising vapours and descending liquid in the column and thus prevent channelling and promote intimate mixing of the vapours and distillate. Preferably the baffle rings and discs are connected together by means of the guide vanes, and each section of the still contains a baffle ring and disc and a set of guide vanes. The still may be provided with a removable cut-off section adapted to intercept liquid descending in the still and to permit its being drawn off if necessary.
—J. R.

Yeast; Process for drying ——. E. Klein. U.S.P. 1,420,558, 20.6.22. *Appl.*, 24.3.22.

Coarsely subdivided yeast is dried by a current of an innocuous gas at such a low temperature as not to destroy the vitality of the yeast, and is simultaneously subjected to a pulverising action so that the particles of pulverised yeast are carried off in the gas current, from which the yeast is subsequently separated.—J. R.

Dried yeast and method of making the same. A. W. Hixson. U.S.P. 1,420,630, 27.6.22. Appl., 20.12.20

Compressed yeast is subjected to slow gradual drying for a protracted period until a product is obtained containing substantially 10% of moisture.
—J. R.

Yeast; Process of preparing dried ——. E. Klein. U.S.P. 1,420,557, 20.6.22. Appl., 24.3.22.

See E.P. 175,623 of 1922; J., 1922, 605 a.

XIXa.—FOODS.

Ash of foodstuffs; Alkalinity of ——. B. Pfyl. Z. Unters. Nahr. Genussm., 1922, **43**, 313—339.

The most useful values to be determined are the intrinsic alkalinity, the methyl-orange alkalinity, and the total phosphate of the ash. The first may be defined as the excess, expressed in milli-equivalents, of Na',K',Ca'',Mg'', which, after combination with PO_4''',SO_4'',Cl', remains for O'' and the weakly acid anions, CO_3''.SiO_3'',BO_2'.MnO_3'', MnO_4'',AlO_2''. If the anions are in excess the difference is expressed as intrinsic acidity. The methyl orange alkalinity is the excess, expressed in milli-equivalents, of the same four cations which, after combination with the anions, $\mathrm{H}_2\mathrm{PO}_4'$,$\mathrm{SO}_4''$,$\mathrm{Cl}'$, remains for O'' and the above enumerated weakly acid anions. Excess of anions is indicated as methyl-orange acidity. The total phosphates is expressed in milli-equivalents of PO_4'''. These three values can be obtained by titration first with methyl orange and then with phenolphthalein as indicator. Full details of simple methods of carrying out the above determinations, based on many years' experience, are given. Modifications necessary in special cases and precautions and corrections to be applied where special accuracy is needed are also indicated. The above three values are usually cal-

XVII.—SUGARS; STARCHES; GUMS.

Beet raw sugars; Loss of sucrose in the refinery in the working of ——. J. E. Duschsky and P. G. Galabutsky. Z. Ver. deuts. Zuckerind., 1922, 401—416.

During the re-melting of sound "sand sugar" it is unnecessary to add lime or other alkali, since, whether a coil or direct steam be the means of heating, the amount of inversion that occurs can hardly be detected. On the other hand, when working with deteriorated sand sugar, which contains invert sugar, and has become more or less acid, alkali must be added, but the amount should be little more than that required for neutralisation, viz., an alkalinity of 0·001% CaO. It is held that a greater excess of alkali is irrational, since it causes the darkening of the liquors, and leads to an increase of the salt content of the syrup and consequently to a greater amount of final molasses. During the re-melting of deteriorated sand sugar, solution must be effected as rapidly as possible, and direct steam should be used for heating. Any unnecessary delay before discharging the syrup from the pans should likewise be avoided.—J. P. O.

Sugars; Insoluble matter content of direct consumption ——. J. P. Ogilvie. Int. Sugar J., 1922, **24**, 368—369.

In Demerara and Trinidad yellow crystals the total insoluble matter was found to vary between 10 and 48 mg. per 100 g. of sample, and in plantation white sugars between 13 and 25 mg., of which about half consisted of inorganic matter.—J. P. O.

[*Sugar*] *cane juice; Determination of the Brix degree of raw* ——. W. D. Helderman. Archief, 1921, **29**, 1708—1713. Int. Sugar J., 1922, **24**, 381.

If raw cane juice, which refuses readily to subside and de-aerate, be heated with about 2% of kieselguhr rapidly to boiling point in a flask fitted with a reflux condenser, cooled, and filtered, a clear liquor practically free from air, serving well for the Brix degree determination is obtained, the reading found agreeing closely with that given by the same juice which has been allowed to subside during one hour. Juice thus treated with kieselguhr should not, however, be used also for the determination of the sucrose and reducing sugars content, since during the process of heating some inversion generally occurs.—J. P. O.

Carbohydrates; Sublimation experiments with ——. P. Karrer and J. O. Rosenberg. Helv. Chim. Acta, 1922, **5**, 575—576.

Pictet and Sarasin (J., 1918, 49 A) have shown that lævoglucosan is formed when starch is distilled at a low pressure. The same product has now been obtained as a sublimate by heating potato starch at about 220° C. in a very thin layer, having a cold condensing surface within 2 mm. of the heated starch, at atmospheric pressure. From α-tetramylose the same product was obtained, but by heating rhamnose at 120° C. (12 mm.) the sugar itself was sublimed.—E. H. R.

Galactosan. A. Pictet and H. Vernet. Helv. Chim. Acta, 1922, **5**, 444—448.

When galactose is dehydrated at 180° C. (15 mm.) the molecular weight of the product corresponds with $(C_6H_{10}O_5)_2$; at 135° C. (2 mm.) a mixture of galactosan, $C_6H_{10}O_5$, and its dimeride is formed. The galactosan can be partially purified by extraction with boiling alcohol. Chemically it behaves like glucosan and is therefore an anhydride of the α-series. In cold hydrochloric acid it forms α-galactosyl chloride, which condenses in alcoholic solution with glucose and sodium to form a new disaccharide, glucose-α-galactoside. The osazone of this new sugar has m.p. 158° C. (*Cf.* J.C.S., Sept.) —E. H. R.

Decolorising carbon; Capacity of —— *for absorbing water.* A. Scholz. Chem.-Zeit., 1922, **46**, 652.

A good decolorising carbon such as that used in the sugar industry can absorb up to 45% of its weight of water without appearing at all moist. With an equal weight of water it forms a moist powder which just balls together, while with 1¼ times its weight of water it first assumes the characteristics of damp slime.—A. R. P.

Samuela carnerosana fruit. Black and Kelly. *See* XX.

XVIII.—FERMENTATION INDUSTRIES.

Grain; Method of utilising the component substances of —— *for the maximum production of material useful as food or in industry.* A. Sorel. Bull. Assoc. Chim. Sucr., 1922, **39**, 358—362.

The grain is ground to flour and digested with malt at 60°—62° C. to saccharify the starch. Lactic fermentation is allowed to proceed for a brief period in order to render soluble mineral matter ultimately to be used as a yeast food. Excessive production of lactic acid is checked by the addition of vinasse, previously concentrated under reduced pressure below 65° C. Yeast is added and allowed to act for some hours. Alcohol is distilled off at atmospheric pressure. The yields of alcohol and of yeast were 36% and 24% respectively by the Viennese yeast process; and 25% and 35% respectively by the aero-yeast method.—A. G. P.

Glycerol; Fermentation of —— *in presence of sulphur.* H. and L. Müller. Helv. Chim. Acta, 1922, **5**, 628—629.

In presence of sulphur, glycerol is attacked by yeast with the formation of carbon dioxide and hydrogen sulphide. The sulphur probably oxidises or dehydrogenates the glycerol into a fermentable compound, according to the equation $C_3H_8O_3+S=C_3H_6O_3+H_2S$. (*Cf.* J.C.S., Sept.)—E. H. R.

Formaldehyde; "Alcoholic fermentation" of ——. H. Müller. Helv. Chim. Acta, 1922, **5**, 627—628.

The reaction involved in the "alcoholic fermentation" of formaldehyde in presence of osmium (J., 1922, 118 A), $3CH_2O+H_2O=2CH_3OH+CO_2$, can be accounted for by Cannizzaro's reaction. Assuming 4 mols. of formaldehyde to give 2 mols. each of methyl alcohol and formic acid, the latter can behave as an aldehyde and by the same reaction give, from 2 mols. of formic acid, 1 mol. of formaldehyde and 1 mol. of carbon dioxide. The net result corresponds with the above equation. —E. H. R.

Lactic acid; Destruction of —— *by yeast cells.* F. Lieben. Oesterr. Chem.-Zeit., 1922, **25**, 87—90.

Lactic acid being one of the products of the degradation of carbohydrates in muscle, experiments were made *in vitro* to determine the ultimate fate of this substance under the influence of the enzymes of the yeast cell, which appear to be similar, at least, to the muscle enzymes. It was found that lactic acid disappeared to within 3—5% in 7—8 hours, under suitable conditions, and that about two-thirds of its carbon content appeared in the products as carbon dioxide, either liberated as such, or remaining combined with soda; the remainder of the carbon was represented by an increase in weight of the yeast substance, and if calculated as $C_6H_{10}O_5$ practically accounted, together with the carbon dioxide, for the whole of the lactic acid which had disappeared. It appears, therefore, that both synthesis and degradation had occurred simultaneously. No other degradation products than carbon dioxide could be detected. Similar experiments were made with vegetable acids and with amino-acids: the former were not attacked; the latter were in part consumed by the yeast, but no degradation to carbon dioxide could be detected.—G. F. M.

Brandy; Critical study and new contribution to the analysis of ——. G. Bonifazi. Mitt. Lebensmittelunters. u. Hyg., 1922, **13**, 69—95. Chem. Zentr., 1922, **93**, IV., 62—63.

The characteristics of the different kinds of brandy, including artificial brandies, are enumerated and the methods in use for differentiating between them are described. The Micko process for the fractional distillation of the esters after saponification is described in the original, and the results of its application to a number of samples of brandy are given. This method is a very valuable one for the analysis of brandies. It allows of organoleptic tests on the different fractions and also of carrying out other determinations which are necessary for judging the sample. Among these, the appearance of a maximum ester value in the fourth or fifth fraction is of importance, as it appears to be proportional to the ester value. This maximum value only occurs in the case of natural and adulterated brandies, and not in the case of artificial brandies. The ratio ester value/maximum value varies within narrow limits for natural brandies. The higher this ratio the more doubtful is the quality of the brandy.—H. C. R.

Brandy; Detection and estimation of vanillin in ——. T. von Fellenberg. Mitt. Lebensmittelunters. u. Hyg., 1922, **13**, 98—110. Chem. Zentr., 1922, **93**, IV., 63.

100 c.c. of the brandy is distilled, using a fractionating column of glass balls, until only 10 c.c. is left behind. The residue is shaken 300 times with 10 c.c. of ether and the aqueous solution discarded. Any emulsion that forms is broken by centrifuging. The ether solution is shaken twice with 2 c.c. of water, giving 100 shakes each time, and then treated with 3 c.c. of saturated (40%) sodium bisulphite solution and shaken for 5 min. The aqueous layer is washed twice with 2 c.c. of ether, shaking 100 times at each washing, and transferred to a beaker with 3 c.c. of sulphuric acid solution (1:1) and 1 c.c. of water, heated to boiling, and, after cooling, shaken with its own volume of ether. The ethereal solution is washed with water, dried over calcium chloride, and evaporated to 1 c.c. This is transferred to a clock glass which is covered by another one cooled with ice. The ether is evaporated off and the residue sublimed by heating it over a spirit lamp about 15 cm. away. After 10—15 min. the top glass is changed and tested by odour and microscopical examination for vanillin. If a visible sublimate is obtained the clock glass condenser is changed every 10 min. until a sublimate and the odour of vanillin are no longer obtained. The sublimates are dissolved in ether, united in a test-tube, and after evaporating the other, tested colorimetrically by adding bromine water (0·1—0·3 c.c.) until a permanent odour of bromine is obtained, removing the excess by blowing in air, and adding 1% ferrous sulphate solution, drop by drop. The presence of vanillin is indicated by a bluish-green coloration. The quantity may be estimated by comparison with solutions of vanillin of known concentrations. Quantities of vanillin up to 0·1 mg. per litre may come from the wood of barrels. The addition of vanillin is not indicated if less than 0·2—0·5 mg. per litre is found.
—H. C. R.

Samuela carnerosana fruit. Black and Kelly. *See* XX.

Papain. Brill and Brown. *See* XX.

Patents.

Distilling alcoholic and other liquids; Process of and apparatus for ——. H. Wade. From J. Schneible. E.P. 182,069, 13.1.21.

In a sectional column still for the distillation of alcoholic and other liquors, baffle rings and discs, preferably inclined downwards towards their free edges, are arranged alternately, and between the rings and discs are sets of vertical guide vanes, each guide vane being set at an angle to the radius of the still. The guide vanes impart a whirling movement to the rising vapours and descending liquid in the column and thus prevent channelling and promote intimate mixing of the vapours and distillate. Preferably the baffle rings and discs are connected together by means of the guide vanes, and each section of the still contains a baffle ring and disc and a set of guide vanes. The still may be provided with a removable cut-off section adapted to intercept liquid descending in the still and to permit its being drawn off if necessary.
—J. R.

Yeast; Process for drying ——. E. Klein. U.S.P. 1,420,558, 20.6.22. Appl., 24.3.22.

Coarsely subdivided yeast is dried by a current of an innocuous gas at such a low temperature as not to destroy the vitality of the yeast, and is simultaneously subjected to a pulverising action so that the particles of pulverised yeast are carried off in the gas current, from which the yeast is subsequently separated.—J. R.

Dried yeast and method of making the same. A. W. Hixson. U.S.P. 1,420,630, 27.6.22. Appl., 20.12.20

Compressed yeast is subjected to slow gradual drying for a protracted period until a product is obtained containing substantially 10% of moisture.
—J. R.

Yeast; Process of preparing dried ——. E. Klein. U.S.P. 1,420,557, 20.6.22. Appl., 24.3.22.

See E.P. 175,623 of 1922; J., 1922, 605 A.

XIXA.—FOODS.

Ash of foodstuffs; Alkalinity of ——. B. Pfyl. Z. Unters. Nahr. Genussm., 1922, **43**, 313—339.

The most useful values to be determined are the intrinsic alkalinity, the methyl-orange alkalinity, and the total phosphate of the ash. The first may be defined as the excess, expressed in milli-equivalents, of Na', K', Ca'', Mg'', which, after combination with PO_4''', SO_4'', Cl', remains for O'' and the weakly acid anions, $CO_3'', SiO_3'', BO_2', MnO_3'', MnO_4'', AlO_2''$. If the anions are in excess the difference is expressed as intrinsic acidity. The methyl orange alkalinity is the excess, expressed in milli-equivalents, of the same four cations which, after combination with the anions, H_2PO_4', SO_4'', Cl', remains for O'' and the above enumerated weakly acid anions. Excess of anions is indicated as methyl-orange acidity. The total phosphates is expressed in milli-equivalents of PO_4'''. These three values can be obtained by titration first with methyl orange and then with phenolphthalein as indicator. Full details of simple methods of carrying out the above determinations, based on many years' experience, are given. Modifications necessary in special cases and precautions and corrections to be applied where special accuracy is needed are also indicated. The above three values are usually calculated to 100 g. of dry foodstuff or 1 litre of liquid, but occasionally to 1 g. of ash or of ash soluble in hydrochloric acid. In cases of adulteration one or other of these values is affected.—H. C. R.

Benzoic acid; Determination of —— in margarine. O. Köpke and E. Bodländer. Z. Unters. Nahr. Genussm., 1922, 43, 345—350.

50 G. of margarine and 100 c.c. of *N*/10 sodium bicarbonate solution are heated to 60° C. on a water bath in a stoppered flask and shaken for about 2 min. After cooling, 75 c.c. of the aqueous layer is poured off through a filter into a 100 c.c. measuring flask containing about 30 g. of pure ammonium sulphate and when the latter has dissolved, the solution is made up to the mark and again filtered. 80 c.c. of the filtrate is acidified with 3 c.c. of dilute sulphuric acid and extracted five times with 40 c.c. of a mixture of equal volumes of ether and of petroleum ether boiling under 60° C. The ethereal extract is washed three times with 5 c.c. of water to remove traces of sulphuric acid and the solvent evaporated off slowly on a water bath, the last fraction being removed at room temperature in a current of air. The residue is dissolved in water and titrated boiling with *N*/10 sodium hydroxide, using phenolphthalein as indicator; preferably a slight excess of *N*/10 sodium hydroxide is first added to prevent loss of benzoic acid and the solution titrated first with *N*/10 acid till the red colour disappears and then with *N*/10 alkali. The object of the addition of ammonium sulphate is to remove albuminous and other matter which would otherwise lead to the formation of emulsions. The percentage of benzoic acid is given by $a \times 0{\cdot}012208 \times (100 + {}^{w}/_{2})/30$ where a is the number of c.c. of *N*/10 sodium hydroxide used and w the percentage of water in the margarine. The reliability of this method was tested on a number of samples of margarine to which known amounts of benzoic acid had been added.
—H. C. R.

Carbolic acid [phenol]; Formation of —— during putrefaction. J. S. Maclaurin. Analyst, 1922, 47, 294—295.

Sheep's kidneys, both when inoculated with various cultures of organisms causing putrefaction and when untreated, developed phenol in amounts up to 0·028 g. per 100 g. after standing for periods of from 47 to 94 days at the ordinary summer temperature.
—H. C. R.

Utilisation of grain. Sorel. *See* XVIII.

Patents.

Bread; Manufacture of ——. W. Watson, D. W. Kent-Jones, and Woodlands, Ltd. E.P. 182,140, 4.3., 13.3. and 29.3.20.

Flour or dough before baking is incorporated with a small quantity of ammonium hydrogen sulphate and a small proportion of one or more "chlorine-carriers" such as chlorine, hydrochloric acid, ammonium chloride, magnesium chloride, the double chloride of ammonium and magnesium, a chlorate, perchlorate, or hypochlorite, with or without the addition of a pyrosulphate or persulphate. Advantages claimed are that a tough and resilient dough is more readily secured, and there is a considerable improvement in the baking qualities of the flour and in the colour of the resulting bread.—J. R.

Comestibles; Method of preserving ——. P. W. Petersen. U.S.P. (A) 1,420,739 and (B) 1,420,740, 27.6.22. Appl., (A) 28.2.21, (B) 6.10.21.

(A) Meat or other comestible is subjected to the direct action of a pre-cooling liquid substantially of the same osmotic pressure as the initial liquid content of the comestible, and is then subjected to a refrigerating operation. (B) The pre-cooling bath may be a mixture of glycerin and water or a solution of a crystalloid solute of the proper osmotic pressure.—J. R.

Vegetables; Process of treating —— in preparation for canning. W. W. Willison, Assr. to Thermo-kept Products Corp. U.S.P. 1,421,750, 4.7.22. Appl., 30.8.20.

The vegetables are subjected to the action of warm water under a partial vacuum subsequently suddenly released.—J. R.

Flour; Process for ageing wheaten —— to improve its baking qualities. R. Hutchinson. U.S.P. 1,422,102, 11.7.22. Appl., 19.3.21.

See E.P. 164,557 of 1920; J., 1921, 558 A.

Fish and the like; Apparatus for cooling and freezing ——. W. B. Hardy and J. J. Piqué. U.S.P. 1,422,570, 11.7.22. Appl., 12.10.20.

See E.P. 154,669 of 1919; J., 1921, 95 A.

Animal substances; Process of, and apparatus or *plant for, chilling and freezing ——.* J. C. Shaw. U.S.P. 1,422,627–8, 11.7.22. Appl., 5.9.18, and 11.3.20.

See E.P. 130,346 of 1917; J., 1919, 736 A.

Cooling and freezing fish and the like [; Apparatus for ——]. J. J. Piqué, and Imperial Trust for the Encouragement of Scientific and Industrial Research. E.P. 182,214, 30.3.21. Addn. to 154,250 (J., 1921, 94 A).

XIXB.—WATER PURIFICATION; SANITATION.

Water; Precision in the determination of the hardness of ——, and aqueous preparation of the standard soap solution. E. Justin-Mueller. J. Pharm. Chim., 1922, 26, 18—21.

Clark's method as modified by Boutron and Boudet, is recommended, but a standard soap solution of only one-tenth the strength is used. It is prepared by disolving 3·5 g. of white Marseilles soap in 200 c.c. of boiling water and then making the volume up to 900 c.c. This solution is then diluted, if necessary, until 24 c.c. just corresponds to 40 c.c. of a 0·025% solution of calcium chloride or of a 0·059% solution of barium nitrate.—W. G.

Formation of phenol during putrefaction. Maclaurin. *See* XIXA.

Patents.

Sewage disposal. W. Gavett. U.S.P. 1,420,250, 20.6.22. Appl., 11.10.21.

The sewage during digestion is subjected to the pressure of gas generated by digestion in such a manner that the pressure removes the supernatant liquid from the sludge.—J. R.

Insecticide and method of making. H. H. Dow, Assr. to the Dow Chemical Co. U.S.P. 1,420,978, 27.6.22. Appl., 27.1.19.

An insecticidal mixture, prepared by the interaction of arsenic acid and excess of magnesium hydroxide, consists of a dry powder composed of di-magnesium ortho-arsenate admixed with about approximately one-fifth the amount of magnesium hydroxide.—J. R.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Strophanthus extracts; Stability of ——. C. A. Pome[illegible]y and F. W. Heyl. Amer. J. Pharm., 1922, [illegible]4, 479—486.

The decrease in potency of strophanthus extracts was studied using the American official one-hour frog test. Whilst the seeds themselves vary widely in strength, tinctures prepared from them retain their original therapeutic activity after long periods, and no appreciable decline was noticed after 4 or 5 years. Dilute aqueous galenical solutions prepared for hypodermic injection, containing both the crystalline and amorphous strophanthin deteriorate slowly and should be discarded after 1 year, when about 70% of the original activity is retained. Alkalinity or acidity of the solutions was not a factor in these results, as was suggested by Levy and Cullen (J. Exp. Med., 1920, 31, 267). Comparative tests were made on a 0·1% solution of ouabain in physiological salt solution, rendered neutral with buffer solutions of potassium acid phosphate and disodium hydrogen phosphate. It deteriorated to the extent of 86% of its original activity in 12 months.—G. F. M.

Alkaloidal mercuric iodides; Preparation of —— *in a crystalline condition.* M. François and L. G. Blanc. Comptes rend., 1922, 175, 169—171.

The amorphous precipitate obtained by adding potassium mercuric iodide to a solution of an alkaloidal salt can be brought into solution by warming it whilst suspended in the mother liquor with a large excess of hydrochloric acid; on then allowing to cool slowly it is usually re-deposited in a crystalline form. In the actual preparation of these crystals, the initial precipitation may be avoided by slowly mixing equal volumes of warm solutions of the alkaloidal salt containing a large amount of hydrochloric acid, and of potassium mercuric iodide, of suitable concentrations. A clear solution will be thus obtained from which the alkaloidal mercuric iodide is deposited in crystals on slowly cooling. In this way the mercuric iodides of caffeine, theobromine, quinine, morphine, codeine, cocaine, strychnine, pilocarpine, and sparteine, and also of quinoline, were prepared. They form brilliant yellow crystals, containing no chlorine and no water of crystallisation. They show a tendency, well marked in the case of the caffeine compound, but scarcely perceptible with the less soluble compounds, such as that of quinine, to be decomposed by water into mercuric iodide and the alkaloidal hydriodide.—G. F. M.

Samuela carnerosana, Trelease; Examination of the fruit of ——. O. F. Black and J. W. Kelly. Amer. J. Pharm., 1922, 94, 477—479.

The dried fruits of *Samuela carnerosana*, a tree closely related to the yuccas, and growing freely in parts of Mexico, consisted of about 30% of seeds and 70% of pods. From the ground seeds about 20% of their weight of a light yellow oil was obtained by extraction with ether. It had the following characters:—sp. gr. at 22° C., 0·9265; iodine value, 125·6; acid value, 5·13; n=1·4710; ester value, 187·7. A white amorphous saponin was obtained by extraction of the seeds with alcohol. It formed 10% of the seeds and was not highly toxic. The pods contained 4·8% of starch, 62·2% of reducing sugars (as dextrose), and 3·8% of non-reducing sugars (as sucrose). The reducing sugars appear to consist largely of lævulose. As about 50% of the dried fruit consists of fermentable sugars, it might be of value for the production of alcohol.—G. F. M.

Papain; Digestive properties of Philippine ——. H. C. Brill and R. E. Brown. Philippine J. Sci., 1922, 20, 185—193.

Autolysis of papain takes place in the course of a few hours at temperatures as low as 0° C. when the enzyme is kept in water solution with toluene as an antiseptic, and attempts to dialyse papain solutions in the hope of separating papain from any co-enzyme that might be present were unsuccessful. Air-dried samples of the enzyme in sealed glass containers had lost their activity at the end of seven years. The effect of mineral salts and certain acids on the digestive activity of papain on solutions of skimmed milk powder was studied. Sodium chloride showed first a slight activating effect, followed by an inhibiting effect in more concentrated solutions. Sodium carbonate and bicarbonate, calcium chloride, magnesium sulphate, and boric acid had no marked influence. Potassium chloride and sodium citrate showed marked activating influence, whilst acetic acid and lactic acid strongly inhibited the proteolytic activity.—G. F. M.

Autoxidation. Anti-oxygens, and various phenomena, related to anti-oxidising effects. C. Moureu and C. Dufraisse. Comptes rend., 1922, 175, 127—132. (*Cf.* J., 1922, 195 A.)

As previously recorded, the auto-oxidation of many substances is checked by the presence of traces of certain compounds, notably phenols, to which the name anti-oxygens was given. Quantitative experiments with acrolein have now been made to compare the inhibitive effect of proportions varying from 1 in 10 to 1 in 1,000,000 of various phenols on the rate of oxygen absorption. The measurements were made by observing the rate of ascension of the mercury column in barometer tubes, charged with the reagents, and comparing with a "blank" containing only acrolein and oxygen. Quinol was the most effective in suppressing auto-oxidation, as little as 1 in 100,000 having a very marked effect. Slightly less active were pyrogallol and catechol, followed by resorcinol and 1.3.4-trihydroxybenzene. At a concentration of 1 in 400 phloroglucinol has a maximum retarding effect, but at certain concentrations it actually accelerates oxidation. Attention is called to various well-known phenomena which may be attributed to anti-oxygens, *e.g.*, the action of sulphurous gases in preventing the luminescence of phosphorus in dilute oxygen, the action of benzyl alcohol, glycerol, phenol, etc. in retarding the oxidation of sulphite solutions, the prevention of the oxidation of synthetic caoutchouc by phenols, the improved keeping quality of essential oils in their natural condition, compared with that of the auto-oxidisable substances they contain when in a pure condition, etc.—G. F. M.

Saccharic and mucic acids; Methylation of ——. P. Karrer and J. Peyer. Helv. Chim. Acta, 1922, 5, 577—581.

Saccharic and mucic acids were methylated by treating with dimethyl sulphate in alkaline solution, freeing the incompletely methylated product from inorganic salts, and completing the methylation by boiling with methyl iodide in presence of silver oxide. Tetramethylsaccharic acid dimethyl ester crystallises from ether in stout needles or plates, m.p. 68° C., $[\alpha]_D^{18}=+8·88°$ to 10·26°. Tetramethylmucic acid dimethyl ester forms monoclinic or rhombic tables, m.p. 103°. An incompletely methylated mucate, m.p. 165°—166°, was isolated, probably trimethylmucic dimethyl ester. Tetramethylsaccharic diamide forms rhombic plates, m.p. 237°; $[\alpha]_D^{18}=+12·22$; tetramethylmucic diamide, small tabular crystals, m.p. 276°. The barium and silver salts of tetramethylsaccharic acid are very soluble in water.—E. H. R.

Methylenecitric acid; Preparation of ——. C. Gastaldi. Boll. Chim. Farm., 1922, **61**, 353—357.

A yield of methylenecitric acid equal to 74% of the theoretical amount is obtained when 40 grams of crystallised citric acid and 6 grams of paraformaldehyde are heated together at 145° C. in a sealed tube of 90 c.c. capacity; with a larger tube the yield is diminished.—T. H. P.

Urea; Industrial conversion of ammonia into ——. Fertiliser of high concentration. C. Matignon and M. Fréjacques. Chim. et Ind., 1922, **7**, 1057—1070. (*Cf.* J., 1922, 231 A.)

Ammonium carbamate is first prepared either by leading carbon dioxide into liquid ammonia, or by combining the two components, in the gaseous condition, in a special condenser with a suitable cooling device and scrapers. The dehydration to urea is effected in autoclaves at 145°—150° C., and an equilibrium is eventually attained as the result of the five reactions $CO(NH_2)ONH_4 \rightarrow CO(NH_2)_2 + H_2O$; $CO(NH_2)ONH_4 \rightarrow CO_2 + 2NH_3$; $CO(NH_2)ONH_4 + H_2O \rightarrow (NH_4)_2CO_3$; $(NH_4)_2CO_3 \rightarrow NH_4HCO_3 + NH_3$; $NH_4HCO_3 \rightarrow CO_2 + H_2O + NH_3$. Urea formation is favoured by making the gas volume as small as possible, and the attainment of equilibrium is more rapid the higher the temperature, but the pressure rapidly rises, the maximum at 135° C. being 33·14 atm., at 150° C. 55·10 atm. The equilibrium percentages of urea at various temperatures were determined: 130° C. after 39 hrs., 39·2%; 134° C., after 40 hrs., 39·92%; 140° C., after 40 hrs., 41·3%; 145° C., after 4 hrs., 41·0%; after 24 hrs., 43·3%. The higher temperature, therefore, increases also the actual yield, as a consequence of the endothermic nature of the reaction. The influence of catalysts was also studied. At the lower temperatures silica, aluminium silicate, and alumina considerably augment the velocity of the reaction, but at 145° C. their influence is negligible. The effect of dehydrating agents was unsatisfactory, as none could be found which did not also react with other substances in the equilibrium. From the reaction product, which is fluid at high temperatures, and solidifies at 70°—85° C., the urea was isolated in a pure state by simple volatilisation of the carbamate etc. present, and if, on a technical scale, the autoclave is allowed to cool to 60°—100° C., and the gases arising from the dissociation of the unchanged carbamate are then released, only urea remains in the vessel, or alternatively the operations may be made continuous by maintaining the autoclave at the desired reaction temperature, forcing in the requisite proportions of carbon dioxide and ammonia, at say 60 atm., into an annular compartment, and drawing off the fluid reaction product, after treating for the necessary period of time, through the central compartment into a second vessel where the unchanged carbamate volatilises.—G. F. M.

Nessler's reagent; New analytical applications of ——. Characterisation of ketones; estimation of aldehydes. J. Bougault and R. Gros. J. Pharm. Chim., 1922, **26**, 5—11.

Certain ketones, such as acetone, methyl ethyl ketone, cyclohexanone, trimethylcyclohexenone, acetophenone, and *p*-methoxyacetophenone, give with cold Nessler's reagent a yellowish-white precipitate, which dissolves in acid, or on the addition of potassium cyanide, with liberation of the ketone. This reaction may be used for the detection of acetone in urine, by suspending a small capsule, containing 10 c.c. of Nessler's reagent, over 200 c.c. of urine, previously acidified, the whole being covered by a bell jar. The time required for the formation of a precipitate varies inversely as the concentration of the acetone in the urine. Certain aldehydes react quantitatively with Nessler's reagent according to the equation,

$$R.CHO + H_2O + 2I = 2HI + R.CO_2H,$$

the iodine coming from the mercuric iodide. For the estimation, to a known volume of the aldehyde solution, corresponding to 0·01—0·05 g. of aldehyde, is added an excess (about 30 c.c.) of Nessler's reagent and 10 c.c. of sodium hydroxide solution. The mixture is well shaken and after some time is neutralised with hydrochloric acid. A known volume of standard iodine solution is added and then the excess iodine is titrated with standard thiosulphate. It is necessary to make a blank estimation on the sodium hydroxide. Accurate results were obtained with formaldehyde, benzaldehyde, furfural, and piperonal, but the method was not satisfactory for vanillin or acrolein.—W. G.

Acetic acid; Oxidation by chromic acid of the homologues of ——. L. J. Simon. Comptes rend., 1922, **175**, 167—169.

Whilst within certain limits of temperature acetic acid is unattacked by a mixture of sulphuric and chromic acids, it is completely converted into carbon dioxide by silver chromate under the same conditions. The homologues of acetic acid are likewise completely oxidised by silver chromate, but the chromic acid mixture leaves a non-oxidised residue, which for the homologues up to C_9 corresponds approximately to 1 C atom, and which increases slightly with the higher members but never reaches 2. This result is interpreted by supposing that the acids are oxidised atom by atom commencing with the carboxyl group, and the oxidation ceases when acetic acid is reached, thus:—

$$R.CH_2.CO_2H \rightarrow R.CO.CO_2H \rightarrow R.CO_2H + CO_2 \text{ etc.}$$

Confirmation of this hypothesis is found in the oxidation of acetyl compounds and acyclic acids by lead chromate and sulphuric acid, where the evolution of gas accompanying the oxidation occurs in two well-defined stages, viz., at a lower temperature corresponding to the more readily oxidisable part of the molecule, and at about 100° C. the temperature at which acetic acid is oxidised by lead chromate. Methanesulphonic acid is not an intermediate product of chromic oxidation, as it is not oxidised even by silver chromate.—G. F. M.

Terpene compounds; Higher ——. V. Conversion of abietic acid into methylretene. L. Ruzicka and J. Meyer. Helv. Chim. Acta, 1922, **5**, 581—593.

Abietic acid, $C_{20}H_{30}O_2$, when heated with sulphur is converted into retene, 1-methyl-7-isopropylphenanthrene. The methyl ester, dihydroabietic acid, and the corresponding alcohol, abietinol,

$$C_{18}H_{26}(CH_3)CH_2OH,$$

also give retene when similarly treated. When abietinol is dehydrated with phosphorus pentachloride it gives a new hydrocarbon, methylabietin, $C_{20}H_{30}$, which, when heated with sulphur, gives methylretene, m.p. 79° C. When oxidised with chromic acid, this gives methylretenequinone, m.p. 147°, giving with *o*-phenylenediamine a quinoxaline, m.p. 165°. Abietic acid is a methyldecahydroretenecarboxylic acid, but the orientation of the methyl and carboxyl groups is uncertain. Retene styphnate has m.p. 142°. (*Cf.* J.C.S., Sept.)
—E. H. R.

Essential oil from the leaves of Abies Pindrow, Spach. J. L. Simonsen. Indian Forest Rec., 1922, **8**, 368—372.

The essential oil was produced in 2·5% yield by the steam distillation of the leaves of *Abies Pindrow*, a silver fir growing in the Western Himalayas. It is a colourless oil with a strong odour of turpentine, and has the following characters:—sp. gr. at 30°/30° C. 0·8558,

saponif. value 5·3, saponif. value after acetylation 15·44, acid value 0·3. It gave on distillation under 100 mm. pressure 90% up to 120° C., and on fractionation of this at 699 mm. pressure the following fractions were isolated: 154°—158° C. 55·9%, consisting of *d*-*α*-pinene, 158°—160° C. 11·9%, consisting of a mixture of *α*- and *β*-pinene, 160°—164° C. 6·8%, consisting of a similar mixture, 164°—167° C. 4·2%, containing *l*-*β*-pinene, 167°—180° C., 10·3%, containing *l*-limonene, and possibly dipentene, and above 180° C. 10·6 %, from which, together with the fraction boiling above 120° C. at 100 mm., *l*-terpineol, *l*-terpinyl nonylate, and two isomeric sesquiterpene alcohols, $C_{15}H_{24}O$, were isolated.
—G. F. M.

Sandalwood oil; Abnormal solubility of West Australian —— in alcohol. J. L. Somerville. Perf. Essent. Oil Rec., 1922, **13**, 261—264.

West Australian sandalwood oil shows an abnormal type of miscibility with alcohol-water mixtures: when a concentrated solution of oil is diluted with the solvent, oil separates again after the dilution has passed a certain limit. The solubility of the oil is expressed by means of a curve for each strength of alcohol (68—72%), the transition points being plotted against temperature and percentage of oil. A series of similar U-shaped curves is thus obtained, the apex of each occurring at approximately 16·5% of oil. A more fundamental graphing was made by calculating the data into percentages by weight of the three constituents, oil, alcohol, and water, and plotting the transition points for a given temperature. No explanation can be given of the abnormal behaviour, but it follows from the latter graph that a simple statement of the facts is that, at a constant temperature, in a series of mixtures which are just miscible, if the amount of oil is lowered the proportion of water to alcohol present will need to rise at first until a turning point is reached, and then it will need to fall with further decrease in the proportion of oil.
—G. F. M.

Doryphora sassafras (Endlicher); Essential oil of the leaves of ——. A. R. Penfold. Perf. Essent. Oil Rec., 1922, **13**, 273—275.

The leaves of *Doryphora sassafras*, the New South Wales variety of the sassafras tree, yield according to season 0·1—1·05% of essential oil, the former quantity being obtained in May and the latter in November. The oil varies considerably in composition according to the districts from which it is obtained. Leaves from the Monga district gave an oil having the characters: sp. gr. 1·01—1·02, n=1·506—1·509, ester value 4·6, ester value after acetylation 32·97, solubility in 70% alcohol 1 in 8. The principal constituents so far identified are safrole 60—65%, camphor 10—15%, *d*-*α*-pinene 10%, sesquiterpenes 10%, eugenol 1%. Another sample of oil from the Currowan district was lighter than water (sp. gr. 0·9808), and only contained about 30% of safrole, together with a considerable quantity of a substance which was apparently eugenol methyl ether, but which has not yet been satisfactorily separated from admixed sesquiterpenes and alcoholic compounds. The proportion of camphor in this oil was also greater, amounting to about 30%.—G. F. M.

Volatile oil of Mentha aquatica, Linné, and a note on the occurrence of pulegone. R. E. Kremers. J. Biol. Chem., 1922, **52**, 439—443.

The distilled oil of *Mentha aquatica*, Linné, has sp. gr. 0·916 at 24° C., $n^{24}=1·4582$, $[\alpha]_D^{24}=-7·48°$, acid value 7·84, ester value 210·93, ester value after acetylation 224·0, and contains 73·82% of esters, 61·6% of total alcohols, 3·6% of free alcohols. The esters consist mainly of linalyl acetate. There are also present small quantities of another ester, free linalool, a free acid, and an unstable aldehyde. Pulegone is a constituent of the cohobated oil of peppermint (*cf.* J., 1922, 269 A).—E. S.

Patents.

Amino-nitro-compounds; Preparation of aromatic ——. Soc. Chim. de la Grande Paroisse. E.P. 169,658, 12.8.21. Conv., 30.9.20.

Instead of using alcoholic ammonia and operating in an autoclave, the replacement of chlorine atoms by the amino group in chloro-nitro-derivatives may be effected at 125°—130° C. in open vessels by treating with ammonium acetate. This process is applicable to all aromatic chloro-nitro-compounds in which the chlorine is capable of being acted on by ammonia. *Example*: 120 kg. of 80—95% acetic acid is saturated with ammonia gas. The temperature rises to 125°—130° C. and 100 kg. of 1-chloro-2.4-dinitrobenzene is gradually added, ammonia being continuously passed through to replace that which has entered into the reaction. After some hours the product is filtered and pressed, the liquid being returned to the process. Quantitative yields are obtained and the product is purified by simple washing.—G. F. M.

Phosphoric acid; Manufacture of liquid esters of ——. A. G. Bloxam. From Chem. Fabr. Griesheim-Elektron. E.P. 181,835, 22.3.21.

Liquid esters of phosphoric acid are made by forming mixed esters from phenol and its homologues, or from its homologues alone, the parent materials used being either artificial mixtures of phenols, containing at least 25—30% of *o*- or *m*-cresol, or the tar acids, either as a whole, or fractions therefrom, containing mixed monohydric phenols with at least 25% of *o*- or *m*-cresol, obtained from coke-oven, gas works, or other tars. The esters are obtained by heating the mixed phenols with phosphorus oxychloride, or phosphoric anhydride, or alternatively the phosphoric di- or mono-chlorides may be prepared from single phenols, and then converted into neutral esters with another phenol or mixture of phenols. Examples are given of the preparation of a large variety of these mixed esters, and also of certain individual mixed esters, prepared by the latter of the above described methods, as for example *p*-cresyl-di-*m*-cresyl phosphate, a fluorescent oil, b.p. 287°—289° C. at 21 mm., and *o*-cresyl-diphenyl phosphate, b.p. 290°—293° C. at 55 mm.—G. F. M.

Urea; Manufacture of ——. J. Y. Johnson. From Badische Anilin- und Soda-Fabrik. E.P. 182,331, 11.7.21.

In the manufacture of urea by heating ammonia and carbon dioxide (or ammonium carbamate) under pressure, the use of pumps etc. for compressing the gases may be avoided by bringing either the ammonia or carbon dioxide or both to the pressure required for the reaction, either separately or simultaneously, by expelling either or both of them under pressure from suitable solutions by means of heat. For example a highly concentrated solution of ammonium carbonate or carbamate is heated by steam at 180 lb. pressure in a column, whereby a gas mixture comprising ammonia, carbon dioxide, and some water vapour is obtained under pressure and is passed through a cooler kept at a temperature (110°—150° C.) high enough to allow condensation of a melt of ammonium carbonate but no solidification. The melt is then run into the autoclave for conversion into urea, and the mixture of ammonia and carbon dioxide remaining unchanged after equilibrium has been attained is used for the re-saturation of the exhausted liquid running from the column. Instead of generating ammonia and carbon dioxide together, they may be distilled separately, for example by heating in separate columns aqueous ammonia and sodium bicarbonate solutions, or, if desired, one of the two gases may be forced into the autoclave by means of a compressor.—G. F. M.

Acetyl isoborneol; Process of making ——. R. L. Andreau, Assr. to E. I. du Pont de Nemours and Co. U.S.P. 1,420,399, 20.6.22. Appl., 7.7.17.

Acetylisoborneol is obtained by heating camphene with acetic acid in presence of concentrated sulphuric acid at 55°—66° C., until the reaction is practically completed. The sulphuric acid is then neutralised with anhydrous sodium acetate, the resulting acetic acid is distilled off under reduced pressure, and the sodium sulphate formed by the neutralisation filtered off from the residue. —G. F. M.

Esters; Manufacture of ——. J. A. Steffens, Assr. to U.S. Industrial Alcohol Co. U.S.P. (A) 1,421,604 and (B) 1,421,605, 4.7.22. Appl., 5.4.21.

(A) Esters are produced by heating together an alcohol and an acid, without a catalyst, but in presence of a third liquid, miscible with the alcohol, but immiscible with water, the vapours of water, the alcohol, and the third liquid being distilled from the reaction mixture and rectified, and the distillate separated into two layers containing respectively high and low percentages of the third liquid. The latter is washed to remove the third liquid, and the remainder containing water and the alcohol is rectified. (B) The process is similar to the above, except that a catalyst is used in addition to the third liquid.—G. F. M.

Ethylene; Process of producing ——. M. C. Whitaker and A. A. Backhaus, Assrs. to U.S. Industrial Alcohol Co. U.S.P. 1,421,640, 4.7.22. Appl., 11.7.19.

Alcohol is preheated to a temperature of 300°—500° C., and the resulting vapours are passed through a catalyst maintained at a similar temperature in order to form ethylene.—G. F. M.

Hydroquinone [quinol]; Process of making ——. H. Von Bramer, Assr. to Eastman Kodak Co. U.S.P. 1,421,869, 4.7.22. Appl., 28.6.20.

In the manufacture of quinol a *p*-dihalogenbenzenesulphonate is treated with a metal hydroxide, producing the quinol salt of the metal, and quinol is recovered from the reaction mixture.—W. C.

Dichlorethylene; Manufacture of ——. F. Kaufler, Assr. to A. Wacker. Ges. f. Elektrochem. Ind. m.b.H. U.S.P. 1,419,969, 20.6.22. Appl., 18.7.21

See E.P. 156,080 of 1920; J., 1921, 411 A.

Tropinone-monocarboxylic-acid esters and process of preparing the same. O. Wolfes and H. Maeder. U.S.P. 1,420,900, 27.6.22. Appl., 26.8.21.

See E.P. 164,757 of 1921; J., 1922, 436 A.

Diphenylamine; Method of manufacturing ——. A. P. Tanberg, Assr. to E. I. du Pont de Nemours and Co. U.S.P. 1,422,494, 11.7.22. Appl., 31.5.17.

See E.P. 138,372 of 1917; J., 1920, 280 A.

Apparatus for effecting reactions by means of amalgams. Electrolytic reduction and oxidation. Manufacture of oxalate. U.S.P. 1,420,211—3. *See* VII.

Methyl chloride. U.S.P. 1,421,733. *See* VII.

Electrochemical reactions. E.P. 181,848—9. *See* XI.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Colour-sensitising [of photographic plates] by bathing. F. M. Walters, jun., and R. Davis. Brit. J. Phot., 1922, **69**, 416—419 and 430—433.

An investigation of the methods of sensitising ordinary photographic plates by bathing shows that certain precautions must be taken with some of the modern photo-sensitising dyes and not with others. Dicyanine gives much greater sensitiveness, and its influence extends farther into the infra-red when used in dilute alcoholic solution with ammonia than when used with water alone. Pinacyanol gives good results in dilute alcoholic solution with ammonia, but plates bathed in water and stock solution are almost as sensitive and keep much better, provided the plates are thoroughly washed before sensitising, as the soluble salts contained in the emulsion prevent the sensitising action by flocculating the dye. Washing has a favourable action on the colour sensitiveness of panchromatic plates, and, while not so marked as the action of dilute ammonia, it gives no fog, which always follows the use of ammonia. Pinachrome, Pinaverdol, Homocol, and Orthochrome T are much less sensitive to electrolytes than are Pinacyanol and Dicyanine. Ammonia may be added to a staining bath of water and stock solution only, but does not increase the sensitising action appreciably except in the case of Homocol. Certain brands of orthochromatic plates were found to be superior to plates bathed in Erythrosin. As a general rule panchromatic plates compare unfavourably with plates bathed in Pinacyanol.—W. C.

[Photographic] toning with tin salts. J. G. F. Druce. Brit. J. Phot., 1922, **69**, 433—434.

Bromide prints may be toned to a warm brown tint by first bleaching them in a solution of ferricyanide, and then treating them in a bath of sodium hydrogen stannite made up by adding a 10% solution of sodium hydroxide to a 10% solution of stannous chloride crystals until the precipitate first formed is redissolved. The resulting solution is then diluted with rather less than an equal quantity of water. The toned image is stated to consist of silver.—W. C.

Photographic plates; Removal of the film from ——. F. Limmer. Chem.-Zeit., 1922, **46**, 651—652.

The gelatin film may be removed from photographic plates by immersing them for a few seconds in a 1—2% solution of ammonium bifluoride. The film readily peels away, and may be removed from the solution intact and dried, while the glass plate, after washing and drying, may be used again. 200 c.c. of the stripping solution is sufficient for at least 150 plates, 9 cm. × 12 cm. The method is not suitable for films.—A. R. P.

Patents.

Photographs; Process for producing opaque —— *in natural colours.* M. Obergassner. E.P. 182,167, 21.3.21.

A colloidal three-colour screen is employed containing in part dyes which become colourless on treatment with acids or alkalis, or by neutralisation, oxidation, or reduction, and in part colourless substances which become coloured by such treatment. The colloid used for producing the colour screens may be mixed with a substance, *e.g.*, barium chloride, which is precipitated to form an insoluble combination with the dye in order to increase the vigour of the colours. A modified screen may be used which consists of a colloid medium containing colourless diazo- or nitroso-salts which are converted into dyes by suitable treatment, which renders colourless the original screen colours.—W. C.

Light-diffusing medium and method of making the same. L. W. Eberlin and S. E. Sheppard, Assrs. to Eastman Kodak Co. U.S.P. 1,421,924, 4.7.22. Appl., 13.12.20.

The composition consists of a mixture of a water-soluble silicate and amylaceous particles.—W. C.

XXII.—EXPLOSIVES; MATCHES.

Patents.

Explosive composition. L. O. Bryan, Assr. to E. I. du Pont de Nemours and Co. U.S.P. 1,420,364, 20.6.22. Appl., 6.1.22.

An explosive composition consists of more than 25% of nitrocellulose, 1—10% of a liquid explosive, and 0·3—5% of powdered aluminium.—J. R.

High-explosive containers; Method of filling ——. J. P. Madden and L. Fisher, Assrs. to Bethlehem Steel Co. U.S.P. 1,420,637, 27.6.22. Appl., 3.6.21.

A quantity (*e.g.*, 3 pts.) of trinitrotoluene is melted and mixed with a quantity (*e.g.*, 7 pts.) of dry trinitrotoluene sufficient to form a plastic mass, which is packed in the shell or container.—J. R.

Perchlorate explosives; Manufacture of ——. C. Bunge. G.P. 350,563, 31.12.19. Addn. to 303,289 (J., 1920, 208 A).

Mixed crystals containing potassium chlorate, ammonium chlorate, and potassium permanganate, or ammonium chlorate and potassium chlorate, or ammonium chlorate and potassium permanganate, are added to perchlorate explosives instead of the mixed crystals described in the chief patent.
—L. A. C.

XXIII.—ANALYSIS.

Buffer values; Measurement of —— and the relationship of buffer value to the dissociation constant of the buffer and the concentration and reaction of the buffer solution. D. D. Van Slyke. J. Biol. Chem., 1922, 52, 525—570.

A theoretical paper, the object of which is to give quantitative expression to buffer effects. For this purpose, the buffer value, β, of a solution is defined as the number of g.-equivalents of strong alkali or acid which must be added (strictly without change of volume) to one litre to produce unit change in p_H. Formulated mathematically, $\beta = dB/dp_H$ (*cf.* Koppel and Spiro, Biochem. Zeits., 1914, 65, 409, who have given a somewhat similar definition). An increment of strong acid is regarded as a negative increment of strong base; hence the value of β is always positive. Starting from the laws of ionic mass reaction, the following general equation for buffer value has been deduced:

$$\beta = 2{\cdot}3\{(K'[H^{\cdot}]C)/(K'+[H^{\cdot}])^2 + [H^{\cdot}] + [OH']\}$$

in which K′ represents either K_a/γ_s or $K_W\gamma_s/K_b$ according as the buffer is a weak acid or a weak base, and C = the molecular concentration of buffer acid (or base). When the p_H is between 3 and 11 and C is not much less than 0·1 N, $[H^{\cdot}]$ and $[OH']$ may be neglected and the equation simplifies to $\beta = 2{\cdot}3K'[H^{\cdot}]C/(K'+[H^{\cdot}])^2$, an expression which has also been deduced directly from Henderson's equation: $K_a = [H^{\cdot}]\gamma_s[Ba]/[Ha]$ (Amer. J. Physiol., 1908, 21, 169; Ergbn. Physiol., 1909, 8, 254). Under these conditions

$$\beta/C(=\beta_M) = 2{\cdot}3K'[H^{\cdot}]/(K'+[H^{\cdot}])^2,$$

β_M being termed the molecular buffer value of the buffer acid or base. By differentiation of the last equation it is shown that the maximum value of β_M occurs when $[H^{\cdot}] = K'$, and it follows that at this point $\beta_M = 2{\cdot}3/4 = 0{\cdot}575$ for all buffers. Further, when $K' = [H^{\cdot}]$, $[Ha] = [Ba]$; hence at the maximum molecular buffer value half the buffer acid (or base) is present in the free state and half in the form of salt. The above methods have been extended to the calculation of β for solutions of polyvalent, amphoteric, and mixed buffers.—E. S.

Colorimetric and electrometric determinations of hydrogen ion concentrations in solutions containing carbon dioxide; Comparison of ——. G. E. Cullen and A. B. Hastings. J. Biol. Chem., 1922, 52, 517—520.

Contrary to the results obtained by Evans (J. Physiol., 1921, 54, 353), the colorimetric and electrometric methods for the estimation of the hydrogen-ion concentration of solutions containing carbon dioxide yield identical results provided precautions are taken to prevent the loss of carbon dioxide.—E. S.

Modification of the Clark hydrogen electrode vessel to permit accurate temperature control. G. E. Cullen. J. Biol. Chem., 1922, 52, 521—524.

The Clark electrode vessel (J. Biol. Chem., 1915, 23, 475) is provided with an additional opening by means of which a thermometer may be inserted in the solution.—E. S.

Estimation of potassium in the presence of sodium, magnesium, sulphates and phosphates; Investigation of Atkinson's process for the ——. S. J. Watson. Analyst, 1922, 47, 285—288.

The process (J., 1921, 751 A) is considered unsatisfactory because the compensating errors necessary to overcome the loss due to the solution of some potassium perchlorate do not occur to an extent sufficient to balance this loss, and the quantity of methyl alcohol and perchloric acid used is too large to make the process economical. Keeping the contents of the beaker at the boiling point for an hour, whilst perhaps necessary to ensure complete solution of undesirable substances, must also favour the solution of potassium perchlorate itself.—H. C. R.

Magnesium; Colorimetric method for the determination of small amounts of ——. A. P. Briggs. J. Biol. Chem., 1922, 52, 349—355.

The method described is similar to that of Hammett and Adams (*cf.* J., 1922, 612 A).—E. S.

Electrometric titrations with silver nitrate. Determination of chlorides, iodides, and bromides, and of iodides in the presence of chlorides and bromides. I. M. Kolthoff. Z. anal. Chem., 1922, 61, 229—240.

In the titration of chlorides, iodides, and bromides with silver nitrate solution the end-point may be determined electrometrically; the method is particularly useful in the case of coloured and very dilute solutions. In ammoniacal solution, iodides may be titrated in the presence of large quantities of chlorides and small amounts of bromides. The method is also trustworthy for the determination of ferricyanides, thiocyanates, cyanides, oxalates, chromates, tartrates, succinates, and salicylates, but not of ferrocyanides and pyrophosphates.
—W. P. S.

Oxalic acid; Detection and determination of —— and its use in standardising iodine and silver solutions. L. Rosenthaler. Z. anal. Chem., 1922, 61, 219—222.

When potassium iodate solution is heated with the addition of a small quantity of oxalic acid, iodine is liberated; the reaction may be obtained with as little as 3 mg. of oxalic acid. Tartaric and malic acids also liberate iodine from potassium iodate, but so slowly that their presence does not interfere with the reaction obtained with oxalic acid. The reaction serves for the determination of oxalic acid and oxalates; a portion of the sample is heated with a known amount in excess of potassium iodate solution in the presence of dilute sulphuric acid until all liberated iodine has been expelled. The mixture is then cooled, potassium iodide is added, and the iodine liberated from the excess of iodate used is titrated with thiosulphate solution. Pure sodium oxalate may be used in the standardisation of iodine solution and silver nitrate solution; for the latter, a known quantity of the oxalate is treated with a slight excess of the silver nitrate solution, the mixture is diluted to a definite volume, filtered, and the excess of silver in the filtrate titrated with thiocyanate solution.—W. P. S.

Arsenic and antimony sulphides; Iodometric determination of ——. F. Nikolai. Z. anal. Chem., 1922, **61**, 257—272.

The method proposed consists in dissolving the arsenic trisulphide, or antimony trisulphide, in sodium hydroxide solution, adding this solution to an excess of standard iodine solution containing dilute acetic acid and sodium acetate, and then titrating the excess of iodine in the acid solution with thiosulphate solution. Oxidation of the alkaline sulphide solution by atmospheric oxygen may be prevented or retarded considerably by the addition of a small quantity of gelatin. The use of iodine solution containing acetic acid and sodium acetate is also recommended for the determination of arsenites and the corresponding antimony compounds; the arsenite solution is added to an excess of the iodine solution and the excess then titrated with thiosulphate solution.—W. P. S.

Arsenic acid; Determination of ——. L. Rosenthaler. Z. anal. Chem., 1922, **61**, 222—229.

In the iodometric determination of arsenic acid atmospheric oxygen is liable to react with the hydriodic acid formed and yield further quantities of iodine, but this may be prevented by adding sodium bicarbonate (to furnish an atmosphere of carbon dioxide) before the potassium iodide is introduced. At least 16% of hydrochloric acid or 33·3% of sulphuric acid should be present in the solution to be titrated, otherwise the reaction is not quantitative. When sulphuric acid is used, the solution, after the addition of the requisite quantity of the acid, is cooled, 5 g. of sodium bicarbonate is added, followed by concentrated potassium iodide solution, and the mixture is then titrated with thiosulphate solution. A precipitate, consisting mainly of arsenic tri-iodide, may form on the addition of the iodide; this precipitate should be dissolved by adding a small quantity of water before the titration is commenced.—W. P. S.

Carbon dioxide indicator for flue gases; Automatic ——. R. B. MacMullin. J. Ind. Eng. Chem., 1922, **14**, 628—629.

A simple apparatus that can be made with bottles and glass tubing and contained in a wooden case, 8″×20″×20″, is described and illustrated. By means of it the continuous automatic analysis of flue gas for carbon dioxide can be carried out to an accuracy of 0·2%. The apparatus depends on the difference in rate of flow of the gas through a capillary tube according to the percentage of carbon dioxide it contains, the pressure drop and rate of flow of the gases, after absorption of carbon dioxide, through another capillary tube being kept constant.
—H. C. R.

Methane; Determination of small quantities of ——. [*Absorption of carbon dioxide.*] E. Murmann. Oesterr. Chem.-Zeit., 1922, **25**, 90.

The complete absorption in baryta solution of small quantities of carbon dioxide, obtained for example in the determination of traces of methane by combustion has hitherto required two or three absorption flasks in series, owing to the short time the bubbles are in contact with the liquid. One ordinary Erlenmeyer flask is sufficient, however, if the gas is led into the baryta solution through a capillary tube, and 0·5—1·0 c.c. of 1% gelatin solution is added to the liquid so as to produce a foam on the surface which increases the duration of contact of the gas and liquid to at least 30 secs., and thereby renders absorption complete. The capillary tube may conveniently be fixed into the flask through the straight arm of a T-piece, fitted into the neck of the flask with a rubber stopper, and the connexion made gas-tight with a short piece of rubber tube. The device may also be useful in other cases of gas absorption.
—G. F. M.

Nitrate nitrogen in urine etc.; Detection and determination of ——. O. Nolte. Z. anal. Chem., 1922, **61**, 278—282.

Nitrates may be detected in urine etc. by means of the diphenylamine test and the less sensitive ferrous sulphate test; attention is directed to the fact that the diphenylamine test is not characteristic of nitrates, since the reaction is also given by other oxidising substances. The Schlösing-Grandeau gasometric method is the most trustworthy for the determination of the nitrate, but the actual nitric oxide content of the gas evolved must be determined, since small quantities of nitrogen are sometimes present.—W. P. S.

See also pages (A) 622, *Carburettor adjustments by gas analysis* (Fieldner and Jones). 626, *Soap in wool.* 628, *Steam oven.* 629, *Bakelite apparatus for measuring hydrofluoric acid* (Curtman); *Sodium sulphide* (Atkin); *Arsenic-free reagents* (Lockemann). 630, *Arsenic and antimony* (Duparc and Ramadier). 633, *Dry volume of clay briquettes* (Crawford). 635, *Manganese in steels etc.* (Heslinga). 636, *Alloys* (Zahlbruckner). 639, *Separating stearic and palmitic acids* (André). 641, *Chrome leather analysis* (Woodroffe and Green); *Tannin analysis* (Schneider) (Schultz); *Humus in soil* (Gehring). 642, *Sugar cane juice* (Helderman). 643, *Brandy* (Bonifazi); *Vanillin in brandy* (Von Fellenberg); *Alkalinity of ash of foodstuffs* (Pfyl). 644, *Benzoic acid in margarine* (Kôpke and Bodländer); *Hardness of water* (Justin Mueller). 646, *Ketones and aldehydes* (Bougault and Gros).

PATENTS.

Gas; Method of, and apparatus for detecting the presence of one —— in another. C. H. M. Roberts. U.S.P. 1,421,720, 4.7.22. Appl., 3.6.20.

The presence of one gas in another is detected by passing the mixture to be tested between opposed spaced electrodes connected with a suitable source of low voltage direct current electricity. The amount of current passing across the gap is measured by suitable means, and it varies with the amount of the gas to be detected which is present in the mixture.—G. F. M.

Gas-analysing apparatus. O. Rodhe, Assr. to Aktiebolaget Ingeniörsfirma F. Egnell. Reissue 15,409, 11.7.22. of U.S.P. 1,302,224, 29.4.19. Appl., 3.3.22.

See E.P. 103,812 of 1916; J., 1918, 447 A.

Patent List

The dates given in this list are, in the case of Applications for Patents, those of application and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given; they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court, Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Aktiebolaget Ljungströms Angturbin. Air-cooled condensers. 20,604. July 27. (Sweden, Apr. 22.)

Aktiebolaget Ljungströms Angturbin. Regenerative air-preheaters. 20,605. July 27. (Sweden, May 8.)

Aktiebolaget Separator. Cleaning bowls of centrifugal separators. 21,028. Aug. 1. (Sweden, 22.9.21.)

Babcock and Wilcox, Ltd. (Deutsche Babcock & Wilcox Dampfkessel-Werke A.-G.) Furnaces. 21,507. Aug. 8.

Bailey. Apparatus for metering granular material. 20,377. July 25. (U.S., 23.9.21.)

Barnes and Fleming. Grinding-mills. 20,523. July 27.

Bicknell and Honeysett. Means for mixing and treating liquids. 20,696. July 28.

Brandon. Dephlegmators. 21,042. Aug. 1.

Brandon. Apparatus for preheating or vaporising liquids. 21,043. Aug. 1.

Brims. Combination dry and steam heating apparatus. 21,589. Aug. 8.

Broquier y Gautier. Refrigerating-apparatus. 21,345. Aug. 4. (Spain, 5.8.21.)

Bullock, and Sandycroft, Ltd. Crushing-machines. 21,148. Aug. 2.

Christiani. Method for accumulation of heat by means of disintegrated masses. 21,545. Aug. 8. (Germany, 9.8.21.)

Coppée et Cie. Combined washing and sorting apparatus. 20,898. July 31. (Belgium, 1.8.21.)

De Fonblanque and Moeller. Method for producing superheated steam, gases, or air. 21,063. Aug. 2.

Duckham, and Woodall, Duckham and Jones (1920), Ltd. Heating materials. 20,723. July 28.

Grange Iron Co., Ltd., and Hoyle. Centrifugal separators. 21,600. Aug. 8.

Griffin. 20,289. *See* II.

Hamble. Filter. 21,080. Aug. 2.

Hesselman. Liquid-filters. 21,710. Aug. 9. (Sweden, 31.8.21.)

Hider. 21,128. *See* XIX.

Humble. Filtering-device. 21,984. Aug. 12.

Jerrard. Refrigerating-machines and condensing apparatus. 21,663. Aug. 9.

Lake (Tate). Delivering liquids in gaseous condition. 20,248. July 24.

Lea. Apparatus for measuring granular etc. materials. 20,656. 20,665. July 28.

Lehmann Co., Inc. Apparatus for treating finely-divided material. 21,696. Aug. 9. (U.S., June 14.)

Lodge-Cottrell, Ltd., and Lodge. 21,588. *See* XI.

McIntosh and Viccars. Refrigerating-apparatus. 20,646. July 28.

Mangiameli. Obtaining mixture of gases in any desired volumetric proportions. 20,302. July 25. (Germany, 25.7.21.)

Marcotte. Process for utilisation of luminescent and catalytic substances. 21,824. Aug. 10. (France, 13.8.21.)

Marks (Bock Bearing Co.). Grinding-machines. 20,355. July 25.

Metropolitan-Vickers Electrical Co., Ltd. (Westinghouse Electric and Mfg. Co.). Steam-condensing plant. 21,355. 21,356. Aug. 4.

Portas. Grinding etc. mills. 21,000. Aug. 1.

Reid. Steam heating-apparatus. 20,245. July 24.

Sainsbury. Means for removing moisture from materials in grinding and sifting machines. 20,220. July 24.

Sauer. Process for treating liquids. 20,168, July 24. 21,645, Aug. 9. (Germany, 23.7.21, 9.8.21.)

Vulkan-Werk Reinshagen & Co. Furnaces. 21,720. Aug. 9. (Germany, 9.8.21.)

Weight. Method of refrigeration. 20,510. July 27.

Complete Specifications Accepted.

6309 and 13,151 (1921). Reid. Furnaces. (183,508.) Aug. 10.

10,197 (1921). Barrs. Cooling-, condensing-, or heating-apparatus. (183,195.) Aug. 2.

10,963 (1921). Leubli. Grinding-mills. (183,215.) Aug. 2.

11,057 (1921). Morison. Heating and deaerating of liquids. (183,534.) Aug. 10.

11,321 (1921). Chaudière. Shaft furnaces and the like. (161,971.) Aug. 2.

11,466 (1921). Case. Method of and means for treating air. (183,544.) Aug. 10.

11,554 (1921). Aktiebolaget Ljungströms Angturbin. Apparatus for effecting the transfer of heat between liquids and gases. (162,250.) Aug. 10.

11,597 (1921). Lamplough. Generating and superheating of steam. (183,261.) Aug. 2.

12,139 (1921). Fothergill. Steam-condensing plant. (183,271.) Aug. 2.

12,315 and 16,997 (1921). Cooke and Croxon. Apparatus for superheating or preheating fluids. (183,918.) Aug. 16.

16,401 (1921). Erickson. Furnaces. (183,666.) Aug. 10.

19,498 (1921). Webster. Retorts or furnaces. (184,040.) Aug. 16.

19,960 (1921). Perrett. Means for adding reagents to liquids. (183,357.) Aug. 2.

20,062 (1921). Fletcher. Means for separating solids of different specific gravities. (184,049.) Aug. 16.

21,816 (1921). Rigby. Scale-removing composition for boilers. (183,371.) Aug. 2.

25,713 (1921). Hoogbruin, and Naaml. Vennoots. Fabriek van Stoom-en andere Werktuigen Jonker & Zoon. Boilers for heating liquids and generating steam or vapour. (184,092.) Aug. 16.

30,625 (1921). Lodge Fume Co., Ltd. (Möller). *See* XI.

33,202 (1921). McIntyre. Grinding, refining, and mixing machines. (183,399.) Aug. 2.

3770 (1922). Beth. Filter-bag cleaning-devices for air-filters. (175,281.) Aug. 16.

11,787 (1922). Accioly. Filters. (183,784.) Aug. 9.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Babin. Gas-generators. 20,803. July 29. (France, 30.7.21.)

Brandes. Production of coke from inferior fuel. 21,154. Aug. 2.

Brandes. Utilisation of peat etc. 21,015. Aug. 1.

Byrnes. Manufacture of liquid fuel. 21,046. Aug. 1.

Chilowsky. Atomising and gasifying heavy combustibles for internal-combustion engines, furnaces, etc. 20,231. July 24. (France, 27.7.21.)

Consortium für Elektrochem. Ind. Ges. Process for purifying acetylene. 21,051. Aug. 1. (Germany, 1.8.21.)

Davidson. 20,384. *See* XXIII.

De Fonblanque and Moeller. Method of treating peat etc. 21,062. Aug. 2.

De Fonblanque and Moeller. Treatment of peat. 21,462. Aug. 5.

Duckham, and Woodall, Duckham and Jones (1920), Ltd. Method of briquetting fuel. 20,827. July 29.

Erdöl- und Kohle-Verwertung A.-G., and Erlenbach. Process for catalytic cracking of hydrocarbon oils, tars, etc. 21,048. Aug. 1.

Esling. Sweating paraffin etc. waxes. 20,465. July 26.

Gibson and Nicoll. Apparatus for charging furnaces of gas retorts etc. 21,317. Aug. 4.

Griffin. Machine for pulverising coal etc. 20,289. July 25.

Hay. Separating water from coal. 21,871. Aug. 11.

Hiller. Production of charcoal. 21,280. Aug. 3.

Illingworth. Treatment of shale, coal, etc. for removal of sulphur. 21,011. Aug. 1.

Kilburn (Sulzer Frères). Cooling incandescent coke. 21,099. Aug 2.

Macdonald. 20,990. *See* XXIII.

Perry. Apparatus for distilling carbonaceous material. 21,010. Aug. 1.

Rigby. Treatment of peat etc. 20,561. July 27.

Ritte. Production of producer gas for propelling vehicles. 20,482. July 26.

White. Low-temperature carbonisation of coal etc. 21,582. Aug. 8.

Complete Specifications Accepted.

2510 (1921). Davies. Apparatus for use in cooling, cleansing, or scrubbing gases in connection with all types of gas producers. (183,160.) Aug. 2.

5967 (1921). Jones, and Minerals Separation, Ltd. Concentration of coal. (183,504.) Aug. 10.

7712 (1921). Optische Anstalt Goerz A.-G., and Gehlhoff. Electric arc lamps. (183,179.) Aug. 2.

7883 (1921). Thermal Industrial and Chemical (T.I.C.) Research Co., Ltd., and Morgan. Treatment of peat and the like. (183,180.) Aug. 2.

7897 (1921). Marks (Stephens Engineering Co.). Combustion of fuel. (183,512.) Aug 10.

8883 (1921). Colebrooke and Williams. Renewal of the filaments in metal-filament electric lamps. (183,523.) Aug. 10.

9157 and 16,387 (1921). Nesfield. Means for desulphurising oils. (183,527.) Aug 10.

10,831 (1921). Trent Process Corp. Distillation of oils. (171,075.) Aug. 2.

10,919 (1921). Glawe. Method of mixing briquette-forming materials with a fluid binding-agent. (183,212.) Aug. 2.

11,065 (1921). Ferolite, Ltd., and Clapp. Gas-producers, electric furnaces, crucible furnaces, and the like. (183,219.) Aug. 2.

11,134 (1921). Burton. Gas-retort mouthpieces. (183,225.) Aug. 2.

11,712 (1921). Kobayashi. *See* XII.

11,828 (1921). Clewlow. Method of and apparatus for disintegrating, dehydrating, and otherwise treating peat for fuel or distillation purposes. (183,566.) Aug. 10.

11,953 (1921). Ricardo. Fuel for use in internal-combustion engines. (183,577.) Aug. 10.

12,277 (1921). Tabary. *See* IX.

12,398 (1921). Gemayel. Burners for liquid combustibles. (168,853.) Aug. 10.

12,491 (1921). Key. Apparatus connected with an internal-combustion or an oil engine for converting crude oil into fuel. (183,600.) Aug. 10.

16,698 (1921). Burdon, Burdon, and Burdons, Ltd. Preheating of liquid fuel for liquid-fuel-fired furnaces. (183,673.) Aug. 10.

17,701 (1921). Adler. Process for the manufacture of decolorising-charcoal of high activity. (165,788.) Aug. 10.

17,775 (1921). Yeadon. *See* III.

18,379 (1921). Withers (Lanphier). *See* XXIII.

21,103 (1921). Florin. Gas-washers. (184,060.) Aug. 16.

27,512 (1921). Naaml. Vennoots. Metaaldraadlampenfabriek "Holland." Electric incandescent lamps and other electric apparatus in which an incandescent filament requires to be kept stretched. (183,389.) Aug. 2.

13,651–2 (1922). Igranic Electric Co., Ltd. (Cutler-Hammer Mfg. Co.). *See* XXIII.

III.—TAR AND TAR PRODUCTS.

Applications.

Erdöl- und Kohle-Verwertung A.-G., and Erlenbach. 21,048. *See* II.

Thompson (Atack). Process of manufacturing carbazol derivatives. 21,318. Aug. 4.

Thompson (Atack). Process of purifying anthraquinone or its derivatives. 21,319. Aug. 4.

Verein für Chem. u. Metallurgische Produktion. Continuously-working apparatus for distillation of tar etc. 20,364. July 25. (Czecho-Slov., 5.8.21.)

Complete Specification Accepted.

17,775 (1921). Yeadon. Stills for continuous distillation of coal tar, mineral oils, and the like. (183,682.) Aug. 10.

IV.—COLOURING MATTERS AND DYES.

Applications.

Anderson and others. 20,829. *See* VI.

Badische Anilin- und Soda-Fabrik. Process for production of a blue vat dye-stuff of the anthracene series. 21,366. Aug. 4. (Germany, 4.8.21.)

British Dyestuffs Corp., Ltd., and Hodgson. Manufacture of new intermediate compounds for production of colouring matters. 20,830. July 29.

Davies, Scottish Dyes, Ltd., Thomas, and Thomson. Production of colouring matters. 21,276. Aug. 3.

Complete Specification Accepted.

18,892 (1921). British Dyestuffs Corp., Ltd., Perkin, and Spencer. Manufacture of benzanthrone derivatives. (183,351.) Aug. 2.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Anderson and others. 20,829. *See* VI.

Bacon and Hyndman. Treatment of animal and vegetable fibres. 21,262. Aug. 3.

Barrett, Coward, and Tootal Broadhurst Lee Co., Ltd. Cellulosic material and manufacture thereof. 21,889. Aug. 11.

Billwiller. Method of manufacturing fibres etc. 21,398. Aug. 4.

Brandwood and Brandwood. Drying yarns. 21,207. Aug. 3.

Brifco, Ltd., and Macwalter. Method of rendering textile fabrics gas and water tight. 21,998. Aug. 12.

Clavel. Treatment of cellulose derivatives. 20,713. July 28.

Dehn (International Takamine Ferment Co.). Process of treating textile etc. fabrics, thread, yarn, etc. 20,206. July 24.

Dreyfus. Manufacture or treatment of artificial silk, films, etc. 20,556. July 27.

Dreyfus. Manufacture of cellulose derivatives. 20,557. July 27.

Dreyfus. Manufacture of products from cellulose derivatives. 21,915. Aug. 11.

Gruner & Reinhardt Ges. Method of production of tracing-cloth. 20,438. July 26. (Germany, 2.8.21.)

Hawkins. Drying-machines for wool etc. 20,918. July 31.

McIntosh and McIntosh. Processes for treatment of textile fibres. 20,167. July 24.

McIntosh and McIntosh. Processes for drying textile fibres. 20,262. July 25.

McIntosh and McIntosh. Treatment of textile fibres. 21,435. Aug. 5.

Moeller. Waterproofing cellulose or carbohydrates of the cellulose group. 21,049. Aug. 1. (Germany, 12.8.21.)

Moisio and Olander. Manufacture of paper. 20,299. July 25.

Nishina. Method of solidifying fibrous substances. 21,400. Aug. 4. (Japan, 1.9.21.)

Raitt. Extracting cellulose or paper-pulp from fibrous vegetable materials. 21,690. Aug. 9.

Shaw. Fabric or material, and manufacture thereof. 21,955. Aug. 12.

Ubbelohde. Process of manufacturing spinning fibres. 21,282. Aug. 3. (Germany, Feb. 16.)

Underwood, and Underwood, Ltd. Processes for treatment of fabrics, and fabrics obtained thereby. 21,936. Aug. 11.

Zust. Manufacture of cotton fabrics. 21,162. Aug. 2. (Switz., May 18.)

Complete Specifications Accepted.

3320 (1921). Sutcliffe. Preparation of vulcanised fibre. (183,497.) Aug. 10.

3377 (1921). Bloxam. (Akt.-Ges. für Anilin-Fabr.) *See* VI.

4639 (1921). Dreyfus. Manufacture of cellulose derivatives. (183,882.) Aug. 16.

6515 (1921). Trostel. Process for treating animal fibre to improve the spinning and felting properties thereof. (183,885.) Aug. 16.

8395 (1921). Carpmael (Bagley and Sewall Co.). Paper-making machines. (183,185.) Aug. 2.

11,461 and 12,115 (1921). Bloxam (Technochemia A.-G.). Manufacture of new textile products derived from animal fibres. (183,249 and 183,270.) Aug. 2.

12,190 (1921). Plausons (Parent Co.), Ltd. (Plauson). Process for the manufacture of cellulose compounds. (183,908.) Aug. 16.

14,275 (1921). Arent. Fireproofing and/or waterproofing treatment of materials. (164,730.) Aug. 2.

15,249 (1921). Classen. *See* XVII.

15,709 (1921). Smith and Co. (London, E.), Ltd., and Ellis. Process and apparatus for coating fabrics. (183,319.) Aug. 2.

17,813 (1921). British Thomson-Houston Co., Ltd. (General Electric Co.). Gas-impervious materials. (184,012.) Aug. 16.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Anderson, Baddiley, British Dyestuffs Corp., Ltd., and Hill. Process for obtaining new shades on acetyl silk and new dyestuffs for use therein. 20,829. July 29.

Brandwood and Brandwood. Apparatus for continuous dyeing etc. of textile fibres in loose state. 21,962. Aug. 12.

De Blicquy and Callebaut. Dyeing-machines. 21,963. Aug. 12.

Lomax. Treatment of yarns or threads. 21,642. Aug. 9.

McIntosh and McIntosh. Processes for bleaching etc. textile fibres. 20,263. July 25.

Society of Chem. Ind. in Basle. Method of preventing bleeding in degumming raw silk in presence of silk dyed with vat dye-stuffs. 20,229. July 24. (Germany, 13.8.21.)

Talbot. Drying and bleaching machine with sieve combined. 20,425. July 26.

White (Surpass Chemical Co., Inc.). Process of bleaching and dyeing fibre. 20,468. July 26.

Complete Specifications Accepted.

3337 (1921). Bloxam (Akt.-Ges. für Anilin-Fabr.). Process for protecting animal fibres in treating them with alkaline liquids. (183,868.) Aug. 16.

9040 (1921). Jackson and Bro., Ltd., Gass, Hammond, and Fish. Dyeing - apparatus. (183,526.) Aug. 10.

16,491 (1921). Farbw. vorm. Meister, Lucius, und Brüning. Manufacture of stable, dry, and readily-soluble vat preparations for dyeing. (171,078.) Aug. 2.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Calder, Chance and Hunt, Ltd., and Palmer. Process for condensing acid fumes evolved during concentration of sulphuric acid. 21,012. Aug. 1.

Cocksedge. Process for manufacture of a sodium compound etc. 20,492. July 27.

Codd. Production of alkali silicate solutions. 21,436. Aug. 5.

Ephraim. Method of producing sulphides and hydrosulphides of the alkali metals. 21,997. Aug. 12. (Germany, 20.8.21.)

Guggenheim Bros. Manufacture of sodium nitrate. 20,192. July 24. (U.S., Jan. 19.)

Humphries. Ammonia distillation. 20,684. July 28.

Legeler. Process for manufacture of sulphur proto-chloride. 21,401. Aug. 4. (Germany, 29.12.21.)

Scott. Manufacture of hydrogen and oxygen. 20,353. July 25.

Texas Gulf Sulphur Co., Inc. Burning sulphur. 21,261. Aug. 3. (U.S., Jan. 21.)

Complete Specifications Accepted.

10,792 (1921). Mirat and Pipereaut. Manufacture of sulphuric acid. (163,030.) Aug 2.

11,358 (1921). Plowman and Feldenheimer. Process for the grading of alkaline-earth carbonates. (183,243.) Aug. 2.

15,814 (1921). Tyrer. *See* XIII.

16,636 (1921). Wilderman. Process for the production of hypochlorites and chlorates, and apparatus therefor. (183,671.) Aug. 10.

18,333 (1921). Fairweather (Air Reduction Co., Inc.). Method of producing hydrocyanic acid. (183,348.) Aug. 2.

20,708 (1921). Priest. *See* IX.

29,835 (1921). Chem. Fabr. Griesheim-Elektron. Process and apparatus for the production of carbon disulphide from its elements. (174,040.) Aug. 2.

34,252 (1921). Deguide. Continuous process for the manufacture of caustic soda or caustic potash. (176,321.) Aug. 16.

4981 (1922). Farbenfabr. vorm. F. Bayer und Co. Process for the manufacture of hyposulphites. (176,344.) Aug. 16.

VIII.—GLASS; CERAMICS.

Application.

Jackson (Libbey-Owens Sheet Glass Co.). Means for controlling flow of molten glass. 20,573. July 27.

Complete Specifications Accepted.

11,093 (1921). Rigby. Treatment of china clay or like clays. (183,535.) Aug. 10.

11,894 (1921). Stafford. Glass and other furnaces. (183,572.) Aug. 10.

12,020 (1921). Frink. Metallic moulds for forming glass articles. (183,582.) Aug. 10.

19,812 (1921). Bailey. Tunnel ovens or kilns for firing pottery, tiles, and the like. (183,708.) Aug. 10.

20,318 (1921). Mellersh-Jackson (Libbey-Owens Sheet Glass Co.). Method of and apparatus for drawing sheet-glass. (184,053.) Aug. 16.

22,692 (1921). Atkinson, and Stein and Atkinson, Ltd. Glass furnaces. (183,373.) Aug. 2.

25,597 (1921). British Thomson-Houston Co., Ltd. (General Electric Co.). Porcelain. (184,090.) Aug. 16.

IX.—BUILDING MATERIALS.

Applications.

Abbott. Non-conducting linings etc. of heat-retaining etc. chambers. 21,450. Aug. 5.

Chandler and Wilkins. Composition for facing walls etc. 21,375. Aug. 4.

Fraser. Manufacture of artificial stone or marble. 21,337. Aug. 4.

Harris. Composition to be applied to cement work before painting. 20,333. July 25.

Jaques. Manufacture of Portland cement mortars. 20,904. July 31. (Australia, 5.12.21.)

Kleinlogel. Waterproof and dustless concrete compound. 21,290. Aug. 3. (Germany, 18.10.21.)

Kontzler. Production of hydraulic cement. 21,007. Aug. 1. (France, Feb. 20.)

Complete Specifications Accepted.

10,448 (1921). Griffiths. Roof and the like coverings. (183,530.) Aug. 10.

12,277 (1921). Tabary. Manufacture of bituminous compositions suitable for buildings and for forming road or like surfaces. (183,914.) Aug. 16.

14,275 (1921). Arent. *See* V.

15,934 (1921). Ammon. Process of treating wood. (165,784.) Aug. 2.

20,708 (1921). Priest. Vertical gas-fired kilns for burning limestone or the like. (184,057.) Aug. 16.

26,808 (1921). Frankfurter and Jansen. Process for the manufacture of coverings for floors and walls. (183,753.) Aug. 10.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Barron, Halliwell, and Hindley. Process of converting finished articles of iron etc. into stainless steel. 21,467. Aug. 5.

Barron, Halliwell, and Hindley. Method of manufacture of stainless steel. 21,468. Aug. 5.

Commin and Snook. Case-hardening of metal. 21,166. Aug. 3.

Field and Petersson. Treatment of sulphide ores and minerals. 20,623. July 27.

Hansgirg. 21,738. *See* XI.

Lysaght, and Lysaght, Ltd. Manufacture of galvanised iron. 21,362. Aug. 4.

Minerals Separation, Ltd., and Tullis. Concentration and preparation for smelting of iron ores. 21,265. Aug. 3.

Western Electric Co., Ltd. (Western Electric Co., Inc.). Treatment of magnetic materials. 20,818. July 29.

Complete Specifications Accepted.

6277 (1921). Basset. Process for the direct manufacture of iron and steel. (159,475.) Aug. 10.

6299 (1921). White (American Smelting and Refining Co.). Treatment of tin. (183,507.) Aug. 10.

8525 (1921). Maurer. Joining together of precious and other metals. (183,188.) Aug. 2.

8530 (1921). Pacz. Method of producing high temperatures and the use thereof for reducing refractory oxides. (160,427.) Aug. 10.

10,182 (1921). Herkenrath. Apparatus for atomising fusible metals. (161,194.) Aug. 2.

10,830 (1921). Trent Process Corp. Process of reducing ores. (169,950.) Aug. 2.

11,049 (1921). British Thomson-Houston Co., Ltd. (General Electric Co.). Methods of refining silicon steel and metals and alloys. (183,217.) Aug. 2.

11,065 (1921). Ferolite, Ltd., and Clapp. *See* II.

11,437 (1921). Danforth, jun. Open-hearth furnaces. (183,247.) Aug. 2.

12,205 (1921). Blei- und Silberhütte Braubach A.-G. Process for the metallurgical treatment of materials containing precious metals. (167,741.) Aug. 16.

12,244 (1921). Koppers. Process of desulphurising iron and steel. (162,618.) Aug. 10.

19,363 (1921). Waldo. Reduction of magnesium compounds. (167,164.) Aug. 10.

19,538 (1921). Nevill and Soanes. Process for the extraction of copper from its ores. (172,926.) Aug. 16.

26,684 (1921). Sahlin. Automatically-charged blast-furnaces. (184,094.) Aug. 16.

30,605 (1921). Teisen. Gas-heated crucible furnaces. (183,394.) Aug. 2.

XI.—ELECTRO-CHEMISTRY.

Applications.

Antonoff. Electric batteries. 21,536. Aug. 8.

British Thomson-Houston Co. (General Electric Co.). Electric heating-units. 20,209. July 24.

Chloride Electrical Storage Co., Ltd. (Ford). Electric storage batteries. 21,837. Aug. 10.

David and Dutt. Electric batteries. 21,520. Aug. 8.

David and Dutt. Electric primary battery. 21,635. Aug. 9.

David and Dutt. Electric cells. 21,636. Aug. 9.

Hansgirg. Electrolysis of zinkiferous materials. 21,738. Aug. 9. (Austria, 30.9.21.)

Lodge-Cottrell, Ltd., and Lodge. Safety device for electric precipitation apparatus. 21,588. Aug. 8.

Reynard. Manufacture of plates of electric storage batteries etc. 20,485. July 26.

Rickets. Electrically inducing chemical action. 21,173. Aug. 3.

Scott. Electrodes and method of manufacturing same. 20,350. 20,351. July 25.

Scott. Electrolytic cells. 20,352. July 25.

Starley, and Van Raden & Co. Electric storage cells. 21,481. Aug 5.

Tapping and Thornley. Manufacture of plates of electric storage batteries etc. 20,485. July 26.

Complete Specifications Accepted.

11,065 (1921). Ferolite, Ltd., and Clapp. *See* II.

13,661–2 (1921). **Burgess Battery Co.** Dry cell and method of manufacturing the same. (163,317–8.) Aug. 10.

16,221 (1921). Genese. Electric storage batteries or accumulators. (183,329.) Aug. 2.

30,625 (1921). Lodge Fume Co., Ltd. (Möller). Method and device for separating suspended particles from electrically-insulating fluids, especially gases. (183,768.) Aug. 10.

XII.—FATS; OILS; WAXES.

Applications.

Golding, and United Alkali Co., Ltd. Manufacture of cleaning-compositions. 20,730. July 28.

Lever Bros., Ltd., and Thomas. Hydrogenation of oils and fats. 21,585. Aug. 8.

Maxted. Distillation of fatty acids etc. 20,386. July 26.

Vijdam. Manufacture of soap. 20,484. July 26. (Holland, 1.8.21.)

Zipser. Extraction of fatty etc matters by volatile solvents. 20,622. July 27. (Austria, 10.9.21.)

Complete Specifications Accepted.

8409 (1921). Schicht A.-G., and Grün. Manufacture of synthetic waxes. (193,186.) Aug. 2.

10,831 (1921). Trent Process Corp. *See* II.

11,712 (1921). Kobayashi. Process of manufacturing liquid hydrocarbons from fish oils. (170,264.) Aug. 2.

17,116–7 (1921). Goslings. Process for the purification of oils and fats. (167,462–3.) Aug. 16.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Alexander (Stokes). Synthetic resins, and process of making same. 21,914. Aug. 11.

Dewey and Almy Chemical Co., and General Rubber Co. Sealing-compositions. 21,823. Aug. 10. (U.S., Apr. 28.)

Edbrook and Edwards. Lacquers for shoe heels etc. 20,445. July 26.

Flurscheim. Plastic compositions. 21,664. Aug. 9.

Harris. 20,333. *See* IX.

Rimmer. Paint etc. 21,307. 21,308. Aug. 4.

Roberts and Schultz. Patent leather imitation paint. 21,416. Aug. 5.

Rosenbaum. Method of rendering coats of distemper and mineral colours washable. 20,334. July 25.

Shawinigan Laboratories, Ltd. Phenolic condensation products, and manufacture thereof. 20,265. July 25. (U.S., 25.7.21.)

Weller. Waterproof distempers and water paints. 21,832. Aug. 10.

Williams. Compositions for coating and decorating plaster, wood, iron, etc. 20,305. July 25.

Complete Specifications Accepted.

5257 (1921). Bakelite-Ges., and Hessen. Manufacture of condensation products from phenols and aldehydes. (159,461.) Aug. 2.

7286 (1921). Günter. Oil and varnish colours miscible with water. (183,177.) Aug. 2.

8608 (1921). De Waele. Inks and other pigmenting and like compositions. (183,513.) Aug. 10.

13,256 (1921). Marks (Ideal Coated Paper Co.). Method of and means for coating an article with waterproof adhesive. (183,617.) Aug. 10.

13,744 (1921). Anderson and Maclaurin. Preparation of synthetic resins. (183,629.) Aug. 10.

15,814 (1921). Tyrer. Manufacture of red oxide of iron. (183,323.) Aug. 2.

13,467 (1922). Carteret and Devaux. Process of preparing pigments from titanium compounds contaminated with sulphuric acid. (184,132.) Aug. 10.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Dewey and Almy Chemical Co., and General Rubber Co. 21,823. *See* XIII.

Steinman-Bezencenet. Deposition of rubber. 21,693. Aug. 9.

Complete Specifications Accepted.

11,515 (1921). Jäggi-Zumbühl. Process and apparatus for vulcanising. (183,254.) Aug. 2.

12,132 (1921). Lambert. Vulcanisation of rubber and apparatus for use therein. (183,590.) Aug. 10.

12,419 (1921). Frood and Alger. Fire-proofing natural and artificial caoutchouc and caoutchouc-like substances and compounds thereof, or compositions comprising same. (183,922.) Aug. 16.

XV.—LEATHER; BONE; HORN; GLUE.

Application.

Roberts and Schultz. 21,416. *See* XIII.

Complete Specifications Accepted.

1640 (1921). Burger. Process for the impregnation and currying of leather. (157,929.) Aug. 2.

5860 (1921). Beretta. Tanning-arrangement for hides and skins. (159,215.) Aug. 10.

14,948 (1921). Abrey. Plastic material made from caseine. (183,972.) Aug. 16.

XVII.—SUGARS; STARCHES; GUMS.

Complete Specifications Accepted.

15,249 (1921). Classen. Process for the manufacture of sugar from wood and other cellulose-containing substances. (164,329.) Aug. 10.

17,701 (1921). Adler. *See* II.

18,148 (1921). Rak. Diffusion apparatus for the extraction of sugar from beet and like purposes. (166,527.) Aug. 10.

XVIII.—FERMENTATION INDUSTRIES.

Application.

Distillers Co., Ltd., and Meyer. Production of strong alcohol. 21,940. Aug. 11.

Complete Specifications Accepted.

15,249 (1921). Classen. *See* XVII.

19,177 (1921). Van Ruymbeke. Dehydration of alcohol. (184,036.) Aug. 16.

4004 (1922). Klein. Process of drying yeast. (175,622.) Aug. 10.

4006 (1922). Klein. Apparatus for drying yeast. (176,340.) Aug. 16.

8367 (1922). Van Ruymbeke. Dehydration of alcohol. (184,129.) Aug. 16.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Ardern and Huebner. Treatment of sewage etc. sludges. 20,417. July 26.

Bolton and Mills. Apparatus for aerating and circulating sewage etc. 21,500. Aug. 8.

Dehn (International Takamine Ferment Co.). Bread-making. 20,207. July 24.

Endo. Process of manufacturing foodstuffs from fish. 21,027. Aug. 1.

England and Oldham. Sewage filtering and purifying plant. 20,537. July 27.

Golding. Treatment of whey. 21,786. Aug. 10.

Hider. Feed-water heater and purifier for steam-boilers etc. 21,128. Aug. 2.

Lecomte. Purification of water. 20,996. Aug. 1. (Belgium, July 5.)

Melhuish. Food for poultry. 20,807. July 29.

Melhuish. Compressed milk-like food for cattle. 20,806. July 29.

Navarre and Pointe. Manufacture of paste or dough from grain or fruit. 20,749. July 28. (France, 12.12.21.)

Nishina. Method of drying and solidifying articles of food. 21,406. Aug. 4. (Japan, 3.9.21.)

O'Donnell. Volatile disinfectants, deodorants, etc. 20,915. July 31.

Quine. Antiseptics. 20,223. July 24.

Sauer. 20,168. *See* I.

Schoen. Process for manufacture of alimentary flours. 21,843. Aug. 10. (France, 15.9.21.)

Segal. Preservation of perishables. 21,704. 21,725. Aug. 9.

Segal. Means for preservation of matter. 21,722. Aug. 9.

Segal. Means for preserving cereals etc. in storage receptacles. 21,730. Aug. 9.

Thomas. Food for infants. 20,902. July 31.

Willey. Process for preparing food. 21,949. Aug. 12.

COMPLETE SPECIFICATIONS ACCEPTED.

11,057 (1921). Morison. *See* I.

12,791 (1921). King. Apparatus for separating iron and other magnetically permeable metals from flour, grain, and the like. (183,940.) Aug. 16.

21,039 (1921). Lamy. Apparatus for the treatment of sewage water. (167,504.) Aug. 2.

23,583 (1921). Beylik and Schwartzlose. Process of making pectin-containing material and resulting product. (184,081.) Aug. 16.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Barr, and British Oxygen Co., Ltd. Capsules or containers for compressed or liquefied gas impregnated with emanations from radio-active substances. 20,210. July 24.

Boehringer Sohn, and Wieland. Method of preparing acetylene for anæsthetising. 20,241. July 24.

British Dyestuffs Corp., Ltd., and Hodgson. Process for manufacture of dichlorfluorane. 20,831. July 29.

Distillers Co., Ltd., and Meyer. 21,940. *See* XVIII.

Farbw. vorm. Meister, Lucius, und Brüning. Manufacture of thiohydrins. 21,717. Aug. 9. (Germany, 27.8.21.)

Imray (Farbw. vorm. Meister, Lucius, u. Brüning). Manufacture of alkylated acids and derivatives thereof. 22,006. Aug. 12.

Ramage. Hydrocarbon peroxide and process of producing same. 21,734. Aug. 9.

COMPLETE SPECIFICATIONS ACCEPTED.

8302 (1921). Barrett Co. Manufacture of formaldehyde. (163,980.) Aug. 2.

9927 (1921). Haddan (Zollinger-Jenny). Process of converting organic acids into esters. (183,897.) Aug. 16.

12,867 and 29,896 (1921). Fitzgerald. Process for preserving the fluidity of blood. (183,943.) Aug. 16.

17,710 (1921). Hoffmann-La Roche & Co., A.-G. Process for the manufacture of allyl-arsinic acid. (167,157.) Aug. 10.

19,177 (1921) and 8367 (1922). Van Ruymbeke. *See* XVIII.

23,391 (1921). Soc. Chim. Usines du Rhône. Process for the production of silver alcosols with the aid of organic bodies. (173,733.) Aug. 10.

29,872 (1921). Stockholms Superfosfat Fabriks Aktiebolag. Method of manufacturing acetone from acetic acid. (171,391.) Aug. 16.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

Dewey. Kinematographic etc. screens. 20,851. July 31.

Edbrook and Edwards. Manufacture of non-inflammable films for kinematographs etc. 20,444. July 26.

Miller. Photographic films. 20,373. July 25.

COMPLETE SPECIFICATIONS ACCEPTED.

8590 (1921). Lage. Method of producing photographic plates for indirect tri-colour photography. (183,189.) Aug. 2.

13,524 (1921). Christensen. Multi-colour screens for photography. (163,311.) Aug. 2.

XXII.—EXPLOSIVES; MATCHES.

APPLICATIONS.

Du Pont de Nemours and Co. High explosives. 21,946. Aug. 11. (U.S., 11.8.21.)

Eschbach. Process for manufacture of blasting detonators. 20,249. July 24.

XXIII.—ANALYSIS.

APPLICATIONS.

Davidson. Means of regulating gas flow to gas calorimeters. 20,384. July 26.

Macdonald. Apparatus for analysis of coal gas etc. 20,991. Aug. 1.

COMPLETE SPECIFICATIONS ACCEPTED.

18,379 (1921). Withers (Lanphier). Method of and apparatus for measuring the calorific value of gas. (184,025.) Aug. 16.

13,651–2 (1922). Igranic Electric Co., Ltd. (Cutler-Hammer Mfg. Co.). Gas-calorimeters. (183,408–9.) Aug. 2.

I.—GENERAL; PLANT; MACHINERY.

Patents.

Liquids under gaseous pressure; Devices for the withdrawal of ——. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. E.P. 175,958, 21.12.21. Conv., 23.2.21.

The conduit by which a liquid is withdrawn from a high-pressure storage cylinder is provided with two separate means of choking to create the necessary loss of pressure, a pressure gauge being provided between the two devices. The first throttle may be an adjustable valve and the second a pipe coil of narrow bore and great length. —B. M. V.

Grinding mills; Method of grinding, and attachment for ——. H. F. Winslow. E.P. 182,730, 24.10.21.

In a series of rolls grinding viscous material, the coarser material has a tendency to work towards the ends of the rolls. One of the later rolls is therefore provided on the circumference, near its ends only, with a pair of scraping devices which return the material to the middle portion of an earlier pair of rolls.—B. M. V.

Mixing and/or disintegrating machines. C. E. Gardner. E.P. 182,850, 1.3.21.

An inner and outer set of helical blades rotate in opposite directions in a casing, the adjacent edges of each set of blades being serrated. The blades of the inner set run at a higher peripheral speed but have a smaller pitch than those of the outer set, and the former alone are stopped during discharge of a batch. The inner blades may be provided only near the outlet, or they may extend nearly the full length of the machine. For continuous work the outlet may be at one end of the casing and above the level of the axis, and the radial arms of the blades may be arranged to scrape the ends of the casing to diminish the pressure thereon and may be provided with wings to deflect the material to the outlet. Alternatively the outlet may be in the bottom of the casing at about the middle of its length; in this case the helical blades are of right-hand pitch on the side of the outlet and of left-hand pitch on the other side.—B. M. V.

Refrigerating apparatus; Concentration of brine and similar solutions used as the circulating medium in ——. Heenan and Froude, Ltd., and G. H. Walker. E.P. 182,982, 3.5.21 and 25.5.21.

Brine that is used as the circulating medium in refrigerators becomes gradually diluted. To rectify this it is heated (in a heat interchanger) by means of the hot high-pressure gas from the compressor of the plant and concentrated by exposing it to air in a device such as a spray cooling tower or while still flowing over the heating coils.—B. M. V.

Heating and boiling liquids; Means for ——. W. B. Briggs and S. H. Buxton. E.P. 183,039, 19.7.21.

A steam heater for placing in tanks, such as wort-coppers, is constructed of a horizontal ring pipe, with inlet and outlet for steam and condensed water at about opposite ends of a diameter; the ring may be shaped as a hexagon and may be built up of six straight pieces each with a 120° bend near one end. Upstanding from the ring pipe are a number of vertical pipes with closed upper ends, the steam being diverted into and out of the upright pipes by means of diaphragms partly obstructing the ring pipe and extending some distance up the vertical pipes.—B. M. V.

Dry kiln. N. H. and H. L. Henderson. U.S.P. 1,422,202, 11.7.22. Appl., 14.5.21.

A drying room is situated above a heating chamber and circulating chambers, the latter communicating with the bottom of the drying room and, through automatic pressure-operated dampers, with the heating chamber. Chimneys provided with dampers can draw air from the circulating chambers, and a steam injector can supply air to the heating chamber from either the external atmosphere or from the circulating chambers.—B. M. V.

Drying kiln and process. M. L. Mueller, Assr. to Northwest Blower Kiln Co. U.S.P. 1,423,136, 18.7.22. Appl., 20.7.21.

A steam engine drives a fan which circulates air through the kiln, and the exhaust steam from the engine is delivered in advance of the fan to the air currents thus circulated.—H. H.

Dehydrator or dryer. D. P. Power, Assr. to E. P. Babcock and F. Delano. U.S.P. 1,422,620, 11.7.22. Appl., 21.6.21.

Ante-chambers, arranged one at each end of the drying chamber, each communicate on one side with the exterior of the drying chamber and on the other with the outer air through ports provided with controlling gates. Fans cause heated air currents to traverse the ante-chambers and the drying chamber. Automatic devices are provided to operate the gates and to control synchronously the action of the devices for effecting the movement of the air through the drying chamber. The movement of the air is reversed at predetermined intervals.—H. H.

Dehydrator. W. O. Cardin, Assr. to J. W. Freeman. U.S.P. 1,423,188, 18.7.22. Appl., 23.11.20. Renewed 21.12.21.

A casing containing means for supporting the material to be dried is situated above and communicates with a heating chamber. The latter comprises a flue leading from the source of heat, an air intake, a number of staggered baffles, and above these a pair of plates, the lower one with relatively large holes and the upper one with relatively small holes, to distribute the heated air. —B. M. V.

Dryer. E. B. Ayres and T. H. Rhoads, Assrs. to Proctor and Schwartz, Inc. U.S.P. 1,423,298, 18.7.22. Appl., 1.7.21.

A casing is divided into three longitudinal chambers in each of which is a conveyor for the material to be dried. Heating pipes are provided in the upper part of the casing, and in the upper part of the central chamber is a row of fans which circulate the air up the central and down the two outer chambers.—B. M. V.

Drying process and apparatus. C. Field, Assr. to Chemical Machinery Corp. U.S.P. 1,423,928, 25.7.22. Appl., 21.1.19.

A heated drying medium is supplied to a conduit into which the material to be dried is sprayed. A primary collector for the dried material is disposed in the conduit, and a secondary collector, connected with the conduit, is spaced from the primary collector. Means are provided for re-circulating the drying medium through the conduit and the primary collector or alternatively directing it through the secondary collector.—H. H.

Centrifugal machine. S. H. Hall, Assr. to De Laval Separator Co. U.S.P. 1,422,852, 18.7.22. Appl., 6.8.21.

A top disc is arranged above the separating space of the bowl of a convertible centrifuge, and alternative means are provided, the one affording a free flow for heavy liquid from the peripheral part of the separating space to the space above the disc, and the other obstructing the flow to that space. —H. H.

Centrifugal machine. C. H. Hapgood, Assr. to De Laval Separator Co. U.S.P. 1,422,856, 18.7.22. Appl., 5.5.21.

A liner within the bowl of a convertible centrifuge is formed of a series of discs for dividing the liquid into layers, and openings are provided for the escape of liquid constituents of different specific gravities. A removable annular gasket when inserted in the bowl is confined in non-adjustable position between a removable bowl cover and the liner so as to block the escape of liquid through one of the openings.—H. H.

Heat exchanger or condenser. P. St. Clair, jun., Assr. to The Nitrogen Corp. U.S.P. 1,423,695, 25.7.22. Appl., 9.10.19.

A heat exchanger comprises a number of units connected in series, each unit having a spiral ribbon both inside and out and surrounded by a larger tube, so that two helical passages are formed, one for each fluid.—B. M. V

Catalysing material; Process of preparing ——. E. Weintraub, Assr. to General Electric Co. U.S.P. 1,423,978, 25.7.22. Appl., 26.3.18.

Fibrous material is impregnated with gaseous nickel-carbonyl at a pressure less than atmospheric, and the nickel-carbonyl is subsequently decomposed by heat.—L. A. C.

Filter beds; Process and apparatus for continuously washing ——. H. Jung. G.P. 348,197, 2.4.19. Addn. to 340,183.

In a process carried out in accordance with the previous patent (*cf.* E.P. 176,495; J., 1922, 399 A), the washing fluid passes through the filter plates into the washing region, and in the washing process flows in the direction of rotation of the filtering elements into the pressure chambers where it is filtered. A rotary or oscillating brush, pendulum, or strip is disposed in the washing region, in order to obtain a high velocity of the washing fluid in that region.—J. S. G. T.

Introducing solid matter at the foot of a tall column of liquid, without occasioning loss of liquid; Apparatus for ——. J. Fahrni. G.P. 349,084, 9.12.19.

Solid matter is introduced through one side into a chamber not containing liquid, disposed at the foot of the column, and is then pushed from below by a piston through the upper part of the chamber into the liquid. Normally the chamber is closed above by a sliding cover. The device may be applied to introduce material for removing boiler scale, without interrupting the working of the boilers etc.—J. S. G. T.

Retorts; Apparatus for charging and discharging ——. W. D. Scott-Moncrieff. E.P. 182,888, 18.8.21.

Centrifugal machines; Apparatus [plough] for removing accumulation of sugar or cake from the filtering walls of ——. E. Daniels, G. McKinlay, and E. Kopke. E.P. 183,028, 23.6.21.

Dehydrating plastic materials. E.P. 183,097. *See* V.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Carbonisation; Is the —— *of coking coals endothermic?* K. Sieben. Brennstoff-Chem., 1922, 3, 209—211.

Widely differing results have been obtained by various investigators as to the heat requirements of the coking process. The work of Otto, Mahler, Wilczek, Simmersbach, Euchene, and Hollings and Cobb is reviewed. Rau (unpublished communication), as the result of a critical survey of the available literature, states that the heat required for the decomposition of cellulose is 14%, for wood, 12%, for peat, 8%, for lignite, 3—7%, and for coal, 0—3% of the heat of combustion, and that the average distribution of the heat units available in the original coal is divided between the coke, tar and gas in the following proportions:—Coal with 60% coke yield: coke, 60%, gas, 27%, tar, 9%, and 4% evolved exothermically; coal with 85% coke yield: coke, 80%, gas, 16%, tar, 3%, and 1% evolved; peat: coke, 63%, gas, 19%, tar, 12%, and 6% evolved; wood: charcoal, 61%, gas, 6%, tar, 20%, and 13% evolved. The heat losses in actual practice can be set down as follows: loss due to radiation and conduction, 40 cals./kg., loss due to evaporation of moisture in the coal and superheating of the resulting steam, 100 cals./kg. (for 10% moisture), loss due to quenching coke, 270 cals./kg., loss in gases of distillation, 75 cals./kg., chimney losses, 145 cals./kg., making a total of 630 cals./kg. These results are theoretical losses, and could not be reproduced in practice. In spite of this, coke-oven firms are giving guarantees of about 600 cals./kg. for the heat losses on their ovens, and values of 630 cals./kg. have been recorded in practice. If the reactions involved in coking were endothermic, this would not be possible, but an exothermic reaction will account for the partial balance of such losses.—A. G.

Lignite coke; Ignition temperature of ——. F. Plenz. Gas- u. Wasserfach, 1922, 65, 478.

Lignite coke was placed in one arm of an iron U-tube, the other arm of which was heated and was filled with aluminium foil, which served to heat a current of air passing through the U-tube. Slow oxidation takes place at low temperatures, and this increases in amount as the temperature rises. This increase in oxidation can be measured by the percentage of carbon dioxide given off per unit of time with a constant current of air. The U-tube was heated in a metal bath which was kept in constant agitation. The carbon dioxide evolved increased from 0·6% at 204° C. to 17·4% at 248° C., and increased quite suddenly from 2·0% at 239° C. to 17·6% at 246° C. Cokes prepared at a low temperature ignited at a lower temperature than those prepared at higher temperatures.—A. G.

Tar recovery from by-product coke-oven gas; Distribution of ——. F. M. Washburn and G. E. Muns. Chem. and Met. Eng., 1922, 27, 119—120.

An investigation was made of the proportion and composition of tar condensed at different points in the circuit of a by-product recovery plant. It was found that over 90% of the tar (anhydrous) was condensed in the suction main and primary coolers, 2% in the exhausters, and only 7% in the tar extractors. The successive condensates show a fall in sp. gr. and increase in the content of more volatile constituents, corresponding to the fall in temperature along the circuit.—C. I.

Benzene; Recovery of —— from illuminating gas by means of active carbon. A. Engelhardt. Gas- u. Wasserfach, 1922, **65**, 473—477.

The carbon used for the absorption of benzene from gas should take up at least 25% of its weight of benzene from air containing 25 g. per cub. m. at 20° C. The crude gas is passed into a main leading to two filter-boxes containing the active carbon and arranged in parallel, so that whilst one is being used for the remoal of benzene, the other may be subjected to a current of superheated steam which vaporises the benzene, the steam and benzene vapour being passed through a condenser, from which the benzene is withdrawn on separation. The first box is connected at its outlet with a gas cooler, in which the residual steam is condensed, and the water withdrawn through a siphon. The boxes have a capacity of 10 cub. m. and contain about 195 kg. of active carbon. Each filter will yield, on treatment with steam, about 35 kg. of benzene. By arranging the boxes in series, the first box can be made to yield up to 50 kg. per charge, and the heavier hydrocarbons then also condense in the first box, and this leads to increased absorption of benzene. The carbon should not break down on steaming and should not be brittle, otherwise clogging of the boxes is liable to occur. The average figure obtained was an absorption of 37 g. of crude benzol per cub. m. of gas, the smallest weight being 30 g. and the highest being 42 g. The crude benzol recovered had sp. gr. 0·885 at 15° C., as against a product of sp. gr. 0·900—0·930 at the same temperature, obtained with the use of scrubbing oil. It contained only about 2% of constituents boiling above 140° C., whilst with oil-scrubbing of the same gas, the product contained 29% boiling above 180° C. A thermal balance is given for the process.—A. G.

Montan wax; The acids of ——. H. Tropsch and A. Kreutzer. Brennstoff-Chem., 1922, **3**, 177—180, 193—198, 212—215.

When lignite is treated with benzene or benzene-alcohol mixtures, crude humic acids are extracted, from which three acids were isolated. The crude acid was esterified with methyl alcohol, and the ester distilled at 5 mm. pressure. An acid $C_{27}H_{54}O_2$, was isolated from the fraction boiling at 265°—267·5° C. This acid, named carboceric acid, has m.p. 82° C., and is probably identical with an acid extracted from Chinese wax by Gascard (*cf.* J., 1920, 495 a). It crystallises from alcohol in dendritic needles. Montanic acid was prepared and the formula, $C_{29}H_{58}O_2$, was confirmed. Another acid, of formula, $C_{25}H_{50}O_2$, occurred in small amounts. (*Cf.* J.C.S., Sept.)—A. G.

Montan wax; The colouring constituents of ——. J. Marcusson and H. Smelkus. Chem.-Zeit., 1922, **46**, 701—702.

The portion of montan wax soluble in ether contains a waxy substance of low melting-point and a dark brown resin which yields insoluble compounds with nitric acid and sulphuric acid. It has an acid value of 16, iodine value 51, and saponification value 68. The ether-insoluble portion of the original wax contains a brownish-black unsaponifiable substance, soluble in benzene, and a mixture of esters of hydroxy acids. The acids themselves form a dark-coloured, friable powder which yields about 70% of saturated fatty acids on reduction. It contains 3·1% of sulphur and is soluble in benzene, chloroform, and amyl alcohol, but not in alcohol, ether, or acetic anhydride. (*Cf.* J.C.S., Sept.)
—A. R. P.

Viscosimeters; Fuel oil ——. W. H. Herschel. Chem. and Met. Eng., 1922, **26**, 1175.

The Saybolt "Furol" viscosimeter has been designed for the testing of bunker fuel oils, for which purpose the Saybolt "Universal" instrument is unsuited. The dimensions are similar to those of the "Universal" instrument, except for the internal and external diameters of the outlet tube. The relationship between c.g.s. units and "Furol" time in seconds is, kinematic viscosity $= 0{\cdot}022t - 2{\cdot}03/t$, whilst the corresponding relationship for the Redwood No. 2 (Admiralty) viscosimeter is, kinematic viscosity $= 0{\cdot}0293t - 0{\cdot}403/t$. Tables giving conversion factors for the Universal, Furol, and Admiralty (Redwood) instruments are given.
—H. M.

Effluent liquors from distillation of ammoniacal liquor. See XIXb.

Patents.

Peat and similar material; Process and apparatus for pressing ——. K. Maus. E.P. 182,503, 1.2.21.

Wet peat is slowly subjected to pressure within a chamber the walls of which are provided with wire netting or other metallic filtering medium. Movable transverse partitions, also provided with a permeable covering, are arranged within the chamber. The pressing faces of the piston, the partitions, and the bottom of the chamber are so shaped that the resulting pressed blocks are thinner in the middle than at the edges.—H. Hg.

Peat; Plant for the continuous decomposition and dehydration of ——. E. Laaser and C. Birk. G.P. 348,472, 21.5.20.

The raw peat is fed into one arm of a V-shaped tube, in which it is preheated by waste heat, and is continuously forced forward and upward into the other arm of the apparatus, where it is heated in a special heater; the water which separates drains through the mass and is withdrawn at the lowest part of the tube. The resulting pulp is fed through a valve into a dryer operated at reduced pressure, the vapour evolved being compressed and utilised for heating the dryer.—A. G.

Artificial fuel; Process and apparatus for the production of ——. R. Bowen. E.P. 182,578, 8.4.21.

A mixture for producing a laminated fuel such as is described in E.P. 109,995 (J., 1917, 1173) is delivered from a hopper on to an inclined oscillating plate and thence into a mould. The bottom plate of the mould is oscillated vertically by means of adjustable rotating cams. After the mould is filled, continuous pressure is applied from the top by means of a weighted plunger or other device, while the material is consolidated by the oscillations of the bottom plate. Vertical knives, capable of being oscillated by the bottom plate, may be placed in the mould whilst it is being filled.
—H. Hg.

Fuel; Means for continuous predrying of ——. O. Nordström and A. Mörck. U.S.P. 1,423,728, 25.7.22. Appl., 10.11.20.

A tower-shaped trellis work is arranged centrally within a vertical tower with perforated walls, which is surrrounded by a gas-tight casing. The fuel is fed in at the top of the tower, and hot gases are introduced at the base of the trellis work. The conical base of the tower rotates, and is provided with ribs arranged spirally, to facilitate the continuous discharge of the dried fuel.
—A. G.

Burners for burning metaldehyde. Elektrizitätswerk Lonza, and A. Busch. E.P. 182,582, 11.4.21. Addn. to 181,512 (J., 1922, 607 a).

A retainer is provided for the block of metaldehyde and is adjustable relative to the outer sheath. A perforated cup-shaped carrier for supplementary supplies of metaldehyde is attached to the sheath and is thermally insulated therefrom.—H. Hg.

Coking retort ovens. Coking retort oven heating flues. E. H. Warden. E.P. (A) 182,697, 19.7.21, and (B) 182,702, 26.7.21.

(A) IN connexion with coke ovens having two series of vertical triangular heating flues between each pair of ovens (*cf.* E.P. 155,316; J., 1921, 112 A; 1919, 710 A), a separately controlled gas supply is provided either for each series of flues or for the two series of flues which are nearest each oven, in order that the temperature of each oven may be independently regulated. (B) The interior partitions forming the triangular flues are disposed alternately normal to both walls and as diagonals, which may or may not be parallel to one another, of the spaces formed by the normal partitions. Parts of the diagonal partitions are integral with bricks forming part of a normal partition, and all the bricks are laid so that they break joint in adjacent courses.—H. Hg.

Coke; Process and apparatus for cooling —— with inert gases on the counter-current principle, with simultaneous recovery of the sensible heat. Zeche de Wendel, and H. Schwenke. G.P. 348,654, 29.3.19.

THE separate charges of a battery of coke ovens are introduced into separate cooling units, so that the new hot charge is placed at the end of the cooling installation, where the cooling medium leaves the plant, whilst the cooling gas is introduced where the coke is withdrawn. The cooling chambers are so connected that while gas is being drawn through some of them, one is being filled with a fresh charge and another is being emptied.—A. G.

Water-gas plant; Enriched ——. R. Maclaurin. E.P. 182,648, 1.6.21.

A GENERATOR and combustion chamber are placed alongside of each other and are so operated that during the blow the primary air always enters the generator below the level of the fresh coal, and passes downwards before entering the combustion chamber. During the run, the steam, or mixture of steam and oil, enters at the top of the combustion chamber and passes down through highly heated material before entering the ash zone of the generator chamber. The resulting gases leave through the fresh fuel at the top, and the distillation gases thus produced mix with the water-gas.—A. G.

Coking chamber for [gas] generators. P. Jaworski. U.S.P. 1,422,206, 11.7.22. Appl., 26.8.21.

A CASING is provided with an internal feed hopper and is supported some distance above a bottom plate so as to leave an unrestricted annular space serving as an inlet for the generator gases and outlet for the coke.—B. M. V.

Gas and ammonia yield in carbonisation of coal; Process for increasing the —— with the introduction of protecting gases in the carbonisation chamber. Bunzlauer Werke Lengersdorff u. Co. G.P. 349,908, 23.4.19.

THE protective gases to be passed through the charge, *e.g.*, coal gas, carbon monoxide, water-gas, or the like, are first moistened by passing them through a bath of boiling water, the supply of heat to which is carefully controlled. Dry gas may be also used in conjunction with steam. The ammonia yield increased from 2·08% (calculated as sulphate) with dry gas to 3·08% with moistened gases. Cracking of the tar is also reduced.—A. G.

Gas; Production of a —— of high calorific value, similar to water-gas, with recovery of tarry by-products. Dellwik-Fleischer Wassergas Ges. m. b. H. G.P. 350,443, 14.2.20.

THE products of the blow are taken off through a central pipe extending halfway down the shaft of the producer, whilst the products of the run are separately withdrawn through a port, high up in the side of the producer. It is claimed that the presence of cores of raw fuel in the lower part of the producer is thus avoided, and the tar yield is increased.—A. G.

Gas; Apparatus for and process of purifying ——. A. L. Stevens. U.S.P. 1,423,696, 25.7.22. Appl., 22.9.19.

A RESERVOIR containing a purifying liquid is provided with a by-pass between the top and bottom and with a grate supporting a packing material which provides voids for subdividing the gas into minute currents. The gas is supplied by a conduit below the grate and taken away by another conduit above the cleansing zone.—B. M. V.

Montan wax; Production of solid colloids from crude ——. E. Last, and H. T. Böhme A.-G. G.P. 350,622, 23.10.17.

CRUDE montan wax is treated at high temperature, and if necessary, under pressure, with a small quantity of concentrated caustic alkali solution until the product is completely miscible with liquid hydrocarbons to form a colloidal solution. In place of caustic alkalis, alkaline-earth hydroxides may be used or compounds of the type of sodium aluminate. In contrast to the original material, the product is miscible with water to give a homogeneous emulsion or colloidal solution, which can be precipitated by acids, salts of heavy metals, and acid salts. By using only a small quantity of water, a stiff paste is obtained, which can be diluted with water. With solutions of the crude wax in hydrocarbons viscous oils to semi-solid pastes are obtained by the process.—A. G.

Montan wax; Production of solid colloids from crude ——. H. T. Böhme A.-G., Chem. Fabr., and E. Last. G.P. 352,506, 17.4.18. Addn. to 350,622.

SOLID alkalis are used in the process described in G.P. 350,622 (*cf. supra*), avoiding excess over what is required for combination.—A. G.

Montan wax; Production of —— from lignite. A. Riebeck'sche Montanwerke A.-G. G.P. 352,902, 15.5.19. Addn. to 325,165 (J. 1920, 814 A).

TOLUENE is used instead of benzene in the process described (*loc. cit.*)—A. G.

Lubricating oils; Production of —— of low setting point. Galizische Naphtha A.-G. "Galicia," and H. Burstin. G.P. 352,010, 15.7.19.

THE fraction obtained between the lamp oil and lubricating oil fractions in the distillation of crude petroleum is passed through a tube heated to redness. The vapours are condensed and the light fraction removed by distillation, the amount removed varying according to the character of the lubricating oil desired.—A. G.

Lubricants; Production of —— of high viscosity or consistency. E. Last, and H. T. Böhme A.-G. G.P. 352,727, 25.10.17.

ONE of the solid colloidal products described in G.P. 350,622 (*cf. supra*) is dissolved in ordinary lubricating oils, preferably at high temperatures. An addition of 0·5% of colloid to a mineral oil of sp. gr. 0·9 increases the viscosity at 50° C. to twice the figure for the oil alone, and addition of 1%

gives a figure 4 times that of the original viscosity, whilst 2% of added colloid gives a viscosity 10 times as great as that of the lubricating oil alone. By the addition of still greater quantities of colloid, lubricants of high viscosity can be produced. —A. G.

Paraffin; Process for the direct production of —— from bituminous earths. W. Scheffer and S. Herzberg. G.P. 352,919, 20.11.17.

The earth is placed at the head of a slightly inclined bench, and is then strongly heated, so that the paraffin is liquated from the earth and runs down the hot inclined plane, at the foot of which it is collected. The paraffin obtained is almost white in colour and is free from earthy matter.—A. G.

Petroleum-like products; Production of ——. F. Leibbrandt. G.P. 353,286, 10.5.19.

Acetone and dihalogen compounds of ethylene are heated at high temperatures with zinc dust in a closed vessel. Aluminium or magnesium may be used instead of zinc. For example, acetone, ethylene dibromide, and zinc dust may be heated for 3 hrs. in a closed vessel to 150° C. The clear yellow, strongly fluorescent product of the reaction is filtered from excess zinc dust, shaken with dilute caustic soda solution, so that zinc bromide goes into solution, and the oily portion is separated and dried. The final product, free from halogen and oxygen, is very similar to the higher boiling fractions of Russian petroleum. Small quantities of terpenes are produced as by-products. The refined products can be used for the same technical purposes as the higher boiling fractions of mineral oil, *e.g.*, as lubricating oils.—A. G.

Gas; Process for making ——. J. U. McDonald. E.P. 159,886, 8.3.21. Conv., 10.3.20.

See U.S.P. 1,367,321 of 1921; J., 1921, 207 A.

Hydrogen. E.P. 175,605. *See* VII.

Increasing the decolorising power of silicates. G.P. 339,919. *See* XII.

Hydrocarbon mixtures. U.S.P. 1,422,182–4. *See* XX.

Calorific value of gas. E.P. 182,573. *See* XXIII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Patents.

Carbonising furnaces or retorts. L. H. Bonnard. E.P. 182,542, 31.3.21.

The retort consists of a horizontal stationary cylinder, along the axis of which revolves a shaft, bearing spiders at right angles to its length, the spiders being attached to scrapers parallel with the sides of the retort and almost touching the inside of the chamber. The gases of combustion from a furnace are caused to pass spirally round the exterior of the retort, and the products of distillation or carbonisation are withdrawn midway along the retort through an orifice in the crown of the cylinder. Arrangements are made for the temperature at the outlet end to be limited to any desired temperature by the disposition of the burners. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 9550 of 1886, 19,310 of 1896, 106,084 and 106,636; J., 1897, 750; 1917, 863; 1918, 84 A.)—A. G.

Distillation of carbonaceous materials; Apparatus for the ——. P. M. Salerni. E.P. 182,601, 25.4.21.

The material is distilled at a low or moderate temperature in a stationary horizontal cylinder, which is externally fired, and within which is a rotating horizontal shaft. The shaft bears spiders or arms, which carry scrapers at their extremity, the scrapers being arranged so as to agitate the the mass without propelling it through the retort. The depth of the charge in the retort is regulated by means of a baffle-plate placed at or near the end of the retort. The products of carbonisation are withdrawn through a number of openings in the crown of the retort.—A. G.

Distilling coal; Method of and means for ——. A. W. Helmholtz, Assr. to Continuous Process Coke Co. U.S.P. 1,422,706, 11.7.22. Appl., 18.9.19.

A charge of coal is heated, with evolution of by-products, until it becomes plastic, then oil is added to control the content of volatile matter and the mass heated to a higher temperature and finally compressed to form a firm coke.—B. M. V.

Incandescence mantle bodies; Process for making strong, impregnated ——. R. and E. Süssmann. G.P. 352,652, 10.11.16.

In order to prevent the "running" of the salts used for strengthening the fabric, the mantles are exposed to ammoniacal vapours without subsequent washing. The excess ammonia can be transferred to untreated mantles, or to mantles not yet saturated with ammonia.—A. G.

Arc lamp; Inclosed —— and method of starting the same. E. Friederich, Assr. to General Electric Co. U.S.P. 1,422,553, 11.7.22. Appl., 28.1.16. Renewed 7.12.21.

Refractory metal electrodes which remain substantially intact when supporting an arc discharge are arranged within a sealed envelope, and colour is imparted to the arc by the vaporisation of a halogen salt.—J. S. G. T.

Distillation; Low-temperature ——. A. C. Michie and E. G. Weeks, Assrs. to C. H. Merz and W. McLellan. U.S.P. 1,423,134, 18.7.22. Appl., 12.11.19.

See E.P. 136,868 of 1918; J., 1920, 150 A.

Tungsten alloy filaments. E.P. 182,699. *See* X.

III.—TAR AND TAR PRODUCTS.

Cresols; Separation of m- and p- —— from coal tar crude carbolic acid. A. F. Campbell. J. Ind. Eng. Chem., 922, 14, 732—737.

By the fractional distillation of crude cresylic acid, a fraction consisting of approximately 60% of *m*-cresol and 40% of *p*-cresol can be obtained. The isomers may be separated by partial sulphonation at 40° C., at which temperature the *m*-compound is sulphonated three times as quickly as the *p*-compound. 37·5 g. of 96% sulphuric acid is added to 100 g. of the mixed cresols and warmed at 40° C. for 6 hrs. The product is poured into water, the non-sulphonated cresols extracted with benzene, the sulphonic acid (containing 80% of the *m*-compound) converted into its ammonium salt and the latter fractionally crystallised (the solubility of the *p*-salt is 19·17 and that of the *m*-salt 10·84 g. per 100 g. of water at 20° C.). The crystalline salt is decomposed with half its weight of sulphuric acid and the *m*-cresolsulphonic acid decomposed by steam, yielding 98—100% *m*-cresol. The residue from the first sulphonation is re-sulphonated with its own weight of 96% sulphuric acid, yielding in the sulphonated portion a mixture similar to the original one, and in the residue an 80% *p*-cresol from which hydrocarbons are removed and the *p*-cresol frozen out *in vacuo*.—C. I.

Cresols; Formation of addition products between —— on the one hand and ether, alcohol, acetone, benzene, etc. on the other. C. and W. von Rechenberg. Z. angew. Chem., 1922, 35, 397—398.

As mixtures of cresols with ether, alcohol, acetone, benzene, etc. give viscosity curves which are perfectly smooth and show no maximum, and the vapour pressure curves likewise show no minimum, the authors conclude that, contrary to the opinion of Berl and Schwebel (J., 1922, 399 A), no molecular addition compounds can be formed between these substances.—G. F. M.

Cresols; Formation of addition products of —— with ether, alcohol, acetone, benzene, etc. E. Berl and W. Schwebel. Z. angew. Chem., 1922, 35, 398. (*Cf. supra.*)

THE authors maintain their view that molecular compounds are actually formed between cresols and alcohol, ether, etc. In the first place the vapour pressure of the more volatile substance in the mixtures is notably less than theoretically required, and, if dissociation occurs at all, a vapour pressure minimum is not necessarily to be expected when molecular compounds are formed. Further, in regard to viscosity, the formation of molecular compounds does not necessarily cause a maximum in the viscosity curve, as the viscosity of the compound may be less than that of its components, and lastly the substitution of anisole for cresols in the above mixtures, removed the abnormality in behaviour of the latter.—G, F. M.

1.6-*Dimethylnaphthalene; Hydrogenation of* ——. F. Mayer and T. Schulte. Ber., 1922, 55, 2164—2167.

1.6-DIMETHYLNAPHTHALENE is reduced by sodium and boiling amyl alcohol to Δ^{67}-5.8-dihydro-1.6-dimethylnaphthalene, b.p. 118° C. at 10 mm., sp. gr. 0·9700 at 16° C. If the dihydro compound is reduced with hydrogen in aqueous alcoholic solution in the presence of palladium, 5.6.7.8.-tetrahydro-1.6-dimethylnaphthalene, a colourless liquid, b.p. 110°—111° C. at 10 mm., sp. gr. 0·9487 at 16° C., is obtained, which is stable towards bromine and is oxidised by nitric acid to benzene-1.2.3-tricarboxylic acid. On the other hand, if 1.6-dimethylnaphthalene is reduced at 240° C. and 20—25 atm. pressure in the presence of a nickel catalyst it gives a mixture of 1.2.3.4-tetrahydro-1.6-dimethylnaphthalene and 5.6.7.8-tetrahydro-1.6-dimethylnaphthalene, which is oxidised by nitric acid to a mixture of benzene-1.2.3- and 1.2.4-tricarboxylic acids.—H. W.

1.5-*Dihydroxynaphthalenedicarboxylic acid.* F. Hemmelmayr. Monatsh., 1922, 43, 61—65.

THE dicarboxylic acid which is formed when 1.5-dihydroxynaphthalene is heated with potassium bicarbonate under pressure is probably the 2.6-dicarboxylic acid, since it gives a dinitro-derivative from which the carboxyl-groups are easily displaced by reagents. (Cf. J.C.S., September.)—C. K. I.

Calcium sulphate; Solubility of ——in presence of calcium benzenesulphonate. E. Mameli. Giorn. Chim. Ind. Appl., 1922, 4, 293—296.

WHEN milk of lime or chalk or marble is used as a means of separating sulphonated products from the sulphonating mixture the products are sometimes contaminated with calcium sulphate to a greater extent than would be expected. Experiments showed that in presence of increasing quantities of calcium or sodium benzenesulphonate the solubility of calcium sulphate in water increases up to a certain point, beyond which no further change is produced. Thus, in this direction, calcium benzenesulphonate behaves in the same way as salts having no ion in common with calcium sulphate. This behaviour may be explained by assuming that calcium benzenesulphonate undergoes dissociation into intermediate ions, such as $C_6H_5SO_3Ca^+$ and $C_6H_5SO_3^-$, both different from those of the sulphate. The solubility of pure calcium benzenesulphonate in water in g. per 100 c.c. of solution is 1·766 at 0°, 2·001 at 10°, 1·968 at 15°, 1·844 at 20°, 1·211 at 30°, and 0·410 at 40° C.—T. H. P.

Benzol recovery. Engelhardt. *See* IIA.

Phenols from low-temperature tar for wood preservation. Peters. *See* IX.

Phenol in trade liquors. *See* XIXB.

Nitration of aromatic substances. Davis. *See* XXII.

PATENTS.

Coal tar; Method of and apparatus for separating water from ——. Bismarckhütte. E.P. 163,011, 6.5.21. Conv., 6.5.20.

A VERTICAL cylinder of greater length than diameter is provided with a conical bottom having an outlet valve at its apex, and contains in the lower portion a cylindrical tar container spaced from the outer vessel and provided with conical ends. The apex of the bottom cone opens directly into the outer vessel, and the apex of the top cone is connected with a short, upright open tube. The tar in the container is heated by a heating coil, and is forced thereby through the tube at the top and projected against a plate, inclined slightly to the horizontal, at the top of the outer vessel. Water present in the tar creeps up the plate, flows over the higher edge, which is spaced from the wall of the outer vessel, and drains out of the apparatus, while the tar flows down the walls of the vessel and returns to the container through the opening at the bottom. After heating tar in the apparatus for 20—24 hrs. at 50°—65° C., the water content is reduced to about 3—4%.—L. A. C.

Naphthalene; Process for the purification of ——. The Barrett Co., Assees. of D. F. Gould. E.P. 172,937, 15.11.21. Conv., 15.12.20.

CRUDE naphthalene is agitated at about 85° C. with water or other immiscible liquid until an intimate mixture is obtained, and the mixture is then agitated slowly, with gradual cooling, *e.g.*, by the addition of cold water or other means, to about 65° C., whereupon the water and oily impurities are removed by filtration.—L. A. C.

[*Aromatic*] *hydrocarbons; Oxidation of* ——. F. W. Atack. E.P. 182,843, 9.2.21.

CATALYSTS consisting of or containing titanium compounds, *e.g.*, the oxide, are used in the oxidation of aromatic compounds, *e.g.*, of naphthalene to phthalic acid, and of anthracene to anthraquinone. A mixture of the hydrocarbon vapour and a large excess of oxygen, or gases containing it, is passed over the catalyst at 400°—500° C. The addition of, *e.g.*, 2% of oxides of nitrogen, to the gases promotes oxidation, while the addition of up to 20% of steam diminishes charring and facilitates the regulation of the supply of the hydrocarbon.—L. A. C.

Phthalimide; Manufacture of ——. British Dyestuffs Corp., Ltd., A. G. and S. J. Green. E.P. 183,044, 29.7.21.

α-Nitronaphthalene is directly oxidised by air or oxygen in the presence of a suitable catalyst, such as pumice impregnated with an oxide of vanadium or molybdenum, and heated to 300°—400° C., the main product of the oxidation being phthalimide in a yield upwards of 50% of that theoretically possible. The operation may be conducted by passing hot air over nitronaphthalene heated at 120°—130° C., and thence through an iron tube containing the catalyst. Phthalimide is condensed in small colourless needles in a large well-cooled receiver, and a small quantity of phthalic anhydride which is also formed, being more volatile, may be collected in a second receiver.—G. F. M.

Sulphonating carbon compounds; Process for ——. A. R. Grob and C. C. Adams, Assrs. to E. I. du Pont de Nemours and Co. U.S.P. 1,422,564, 11.7.22. Appl., 30.6.20.

Organic compounds are sulphonated by treatment with sulphur trioxide in a medium of liquid sulphur dioxide.—L. A. C.

9.10-*Dihalogenanthracene-β-monosulphonic acid; Manufacture of* ——. K. Schirmacher, Assr. to H. A. Metz. U.S.P. 1,422,889, 18.7.22. Appl., 23.10.20.

9.10-Dihalogenanthracene-β-monosulphonic acids are prepared by treating a 9.10-dihalogenanthracene with fuming sulphuric acid in the presence of an indifferent agent.—L. A. C.

Thionaphthene; Production of —— from coal-tar. Ges. f. Teerverwertung m.b.H. G.P. 350,737, 8.7.19.

Naphthalene obtained from coal-tar is treated with sodamide, with sodium in the presence of ammonia, or with sodium alone, and the sodium compound of thionaphthene formed thereby is separated from naphthalene and hydrolysed by treatment with water.—L. A. C.

sym.-Octohydroanthracene; Preparation of ——. *Preparation of sym.-octohydrophenanthrene.* G. Schroeter, and Tetralin G.m.b.H. G.P. (A) 352,721, (B) 352,719, 5.9.20.

(A) Pure anthracene in the form of colourless crystals of m.p. 214 C., prepared by twice recrystallising commercial anthracene from solvents, such as tetra- or decahydronaphthalene, cyclohexanol, or isopropyl alcohol, which have been treated to remove catalyst poisons, and subsequently washing the crystals with alcohol, is treated, either molten or in solution, with hydrogen in the presence of a catalyst. For example, a solution of pure anthracene in tetrahydronaphthalene is treated with hydrogen, with agitation, at 180°—200° C. under a pressure of 10—15 atm., in the presence of a small quantity of reduced nickel precipitated on fuller's earth, until 4 mols. of hydrogen has been absorbed. After separation of the catalyst, *sym.*-octohydroanthracene, m.p. 72°—73° C., b.p. 160°—162° C. at 11 mm., is separated from the solvent by distillation under reduced pressure. (B) Commercial phenanthrene is purified by agitation for 1—2 hrs. at 180°—190° C. with finely divided or low-melting metals or metal compounds, such as sodium, potassium, copper filings, pyrophoric iron or nickel (prepared by reducing the corresponding oxides in a current of hydrogen), sodamide, or calcium carbide, with subsequent distillation *in vacuo*. It is then converted into sym.-octohydrophenanthrene by treatment with hydrogen in the presence of reduced nickel as catalyst at 180°—220° C. under a pressure of 15—20 atm. until 4 mols. has been absorbed. The product is purified by sulphonation, recrystallisation of salts of the sulphonic acid produced, and subsequent decomposition of the sulphonic acid by heating with dilute hydrochloric acid. sym.-Octohydrophenanthrene, m.p. 16·7° C., b.p. 167·5° C. at 13 mm., and sp. gr. at 20° C. 1·026, can be used for the preparation of morphine alkaloids and similar compounds.—L. A. C.

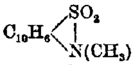
Tars or oils; Process and apparatus for the distillation of ——. E. Blumner. E.P. 182,868, 29.3.21.

See G.P. 340,991 of 1920; J., 1922, 407 A. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 8336 of 1909, 116, 304, and 141,223.)

Catalysts for hydrogenation: G.P. 352,439. *See* XX.

IV.—COLOURING MATTERS AND DYES.

Coupling reactions; Mechanism of ——. *II.* 1.8-*Naphthosultam and its N-methyl derivative as azo components.* W. König and K. Köhler. Ber., 1922, 55, 2139—2149.

The power of aromatic acylamines to couple with reactive diazo compounds with the formation of normal azo compounds has been attributed to their ability to react in the enolic form, Ar.N:C(OH)R and Ar.N:SR(:O).OH (*cf.* J., 1921, 428 A). This hypothesis is now abandoned since the methyl ether of 1.8-naphthosultam,  $C_{10}H_6\left\langle\begin{matrix}SO_2\\ |\\ N(CH_3)\end{matrix}\right.$ couples with diazo compounds in much the same manner as 1.8-naphthosultam. (*Cf.* J.C.S., Sept.)—H. W.

1.8-*Naphthosultam-4-sulphonic acid and certain of its derivatives.* W. König and J. Keil. Ber., 1922, 55, 2149—2155.

1.8-Naphthosultam-4-sulphonic acid, prepared by the action of phosphoryl chloride on potassium α-naphthylamine-4.8-disulphonate at 145° C. or from sulphuric acid monohydrate and naphthosultam alone or in the presence of glacial acetic acid, is much less reactive towards diazo compounds than the unsubstituted naphthosultam or α-naphthol-4-sulphonic acid. The tendency towards the formation of *o*-sulphamino dyes is considerably less than towards the formation of the analogous *p*-derivatives and very much less than towards the production of *o*-hydroxyazo dyes. (*Cf.* J.C.S., Sept.) —H. W.

Pyrazoleanthrone Yellow; Constitution of ——. F. Mayer and R. Heil. Ber., 1922, 55, 2155—2164.

Analyses of Pyrazoleanthrone Yellow (G.P. 255,641; J., 1913, 356), which is obtained conveniently in an ash-free condition by the hydrolysis of its dibenzoyl derivative with sulphuric acid, agree with the formula, $C_{28}H_{12}O_2N_4$ or $C_{28}H_{14}O_2N_4$, according to which two molecules of pyrazoleanthrone are united with loss of four or two atoms of hydrogen. The formation of a potassium salt, of mono- and dibenzyl (or substituted benzyl) derivatives and of a dibenzoyl compound proves that the replaceable hydrogen atoms of pyrazoleanthrone are retained in the new dye. The latter is extraordinarily resistant towards oxidation and only yields anthracene when distilled with zinc dust. Substituted pyrazoleanthrones can be converted into derivatives of Pyrazoleanthrone Yellow if substituents are present in positions 2 or 4, but when the substituent is present in position 8 either a dye is not produced or the substituent is removed during the process. The tinctorial properties of the dye indicate that it is allied to Flavanthrene. (*Cf.* J.C.S., Sept.) —H. W.

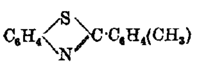
[Anthraquinone series;] Double decomposition [in the ——] catalysed by copper. E. Kopetschni and H. Wiesler. Monatsh., 1922, **43**, 89—92.

When 1-chloro-2-aminoanthraquinone is boiled with an excess of dimethylaniline with the addition of a small amount of copper powder or cupric acetate, a good yield of 2-aminoanthraquinone is produced, but, if potassium carbonate be added in addition to the copper powder or cupric acetate, or, if the dimethylaniline be replaced by monomethylaniline, 2-aminoanthraquinone is not obtained, although indanthrene and flavanthrene can be recognised amongst the products. (*Cf.* J.C.S., Sept.) —C. K. I.

Thiazole derivatives of the anthraquinone series; New mode of formation of ——. E. Kopetschni and H. Wiesler. Monatsh., 1922, **43**, 81—87.

Both 2-amino-1-mercaptoanthraquinone and 2.2′-diaminodianthraquinone-1.1′-disulphide, on heating with aqueous or alcoholic ammonia, give 2-aminoanthraquino-1-thiazole, which does not give a vat with hydrosulphite. Anthraquino-1-thiazole and 3-chloro-2-aminoanthraquino-1-thiazole were prepared in a similar way.—C. K. I.

Thiazoles. 2-p-Tolylbenzothiazole, dehydrothio-p-toluidine, and some related compounds. M. T. Bogert and M. Meyer. J. Amer. Chem. Soc., 1922, **44**, 1568—1572.

2-*p*-Tolylbenzothiazole, 

$C_6H_4{<}^{S}_{N}{>}C{\cdot}C_6H_4(CH_3)$

m.p. 85° C., is obtained by fusing *p*-tolanilide with sulphur or (preferably) by the oxidation of thio-*p*-tolanilide in alkaline solution with potassium ferricyanide. In contrast to the phenyl derivative, it is practically odourless when dry. The corresponding nitro and amino compounds are described, as well as various azo dyes from the latter. Dehydrothio-*p*-toluidine readily yields a benzylidene derivative, m.p. 193° C. (corr.); it is converted by Skraup's reaction into 6-methylbenzothiazolyl-2.6-quinoline, m.p. 147° C. (corr.). Diazotised Primuline couples on the fibre with benzoyleneurea (2.4-dihydroxyquinazoline), giving on unmordanted cotton yellowish-brown shades of good fastness to acids, alkalis, or bleach, but quite fugitive in daylight. (*Cf.* J.C.S., Sept.)—H. W.

Patents.

Azo dyestuffs; Manufacture of new copper compounds of substantive ——. Farbenfabr. vorm. F. Bayer und Co. E.P. 165,083, 13.5.21. Conv., 14.6.20.

The dyestuffs described in E.P. 144,310 (J., 1921, 688 A) formed by combining 1 mol. of 5.5′-dihydroxy-2.2′-dinaphthylamine-7.7′-disulphonic acid with 1 or 2 mols. of *o*-aminobenzoic acid or its derivatives, such as 4-chloro-2-aminobenzoic acid, are treated with compounds of copper, whereby new substantive dyestuffs having a greater affinity for cotton, and giving clearer shades, of excellent fastness to light and ironing are obtained. For example, 757 pts. of the dyestuff obtained from 2 mols. of 2-aminobenzoic acid and 1 mol. of 5.5′-dihydroxy-2.2′-dinaphthylamine-7.7′-disulphonic acid is dissolved in hot water and treated with a hot solution containing 499·4 pts. of copper sulphate, and after neutralising with sodium carbonate, the copper lake formed is separated and dried. It yields red-violet shades on cotton.—A. J. H.

Disazo dyestuffs; Manufacture of secondary ——. Kalle und Co., A.-G. G.P. 352,354, 12.6.14.

Compounds prepared by the action of aromatic hydrazines and sulphites on *p*-aminoazo- or *p*-hydroxyazo compounds are treated with alkalis and then with oxidising agents, whereby the hydrazo groups are oxidised, yielding dyestuffs containing at least 2 azo groups, $R.N_2.Ar.NH.NH.R' \rightarrow R.N_2.Ar.N_2.R'$ (R and R′ = the residue of a diazo compound and an aromatic hydrazine respectively, and Ar = an aryl group). Oxidation, by treatment with the calculated quantity of a persulphate or hypochlorite, can be effected on the fibre, oxidation being finished when spotting with acids has no effect on the shade. —L. A. C.

Cotton dyes. H. Jordan, Assr. to The Grasselli Chemical Co. U.S.P. 1,422,866, 18.7.22. Appl., 27.9.19.

See G.P. 339,183 of 1915; J., 1921, 731 A.

Oil-soluble dyestuffs. E.P. 182,497. *See* XIII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Wood cellulose and cotton cellulose; Comparison of ——. S. A. Mahood and D. E. Cable. J. Ind. Eng. Chem., 1922, **14**, 727—731.

A large number of samples of wood cellulose and cotton cellulose, varying from the raw material to severely cooked and highly bleached pulps, were tested for matter soluble in water and in alkali, acetic acid by hydrolysis, ether-soluble matter, pentosans, furfural, lignin, α-, β-, and γ-cellulose, etc. It was found that the wood-cellulose most nearly approaching cotton-cellulose is obtained by re-cooking "easy bleaching" sulphite pulp with soda, and bleaching with 2% of bleach. Such treatment, however, is uneconomic owing to the low yield. To prepare wood cellulose suitable for esterification it seems probable that acid cooking is preferable to alkali cooking, and that bleaching is a very efficient method of removing non-cellulose material. It is questionable whether wood cellulose for this purpose should be expected to conform to specifications for cotton cellulose in view of radical differences in chemical composition.—C. I.

Jute half-stuff and beaten pulp; Changes during storage of ——. E. W. L. Skark. Papierfabr., 1922, **20**, 881—886, 917—922, 957—962.

The colour and character of jute half-stuffs differ considerably according to whether the bagging has been boiled with lime or with caustic soda and according to the degree of digestion. Bagging boiled with lime bleaches to a bright yellow colour, whereas that boiled with caustic soda has a dull brownish-yellow colour unless the degree of digestion has been so complete that a full white is obtained. The behaviour of the different types of half-stuff in the beating operation may be influenced by the length of time the material has remained in the drainer chests. This influence has been studied by determination of the rates of draining of the beaten stuff by the author's method (J., 1913, 1103; 1922, 9 A). Taking half-stuffs prepared by boiling with lime, whether boiled for a short time with a little lime or a long time with a large quantity, little or no difference could be detected in the behaviour of the pulps in beating, and prolonged storage in the drainers had little influence. In the case of half-stuff lightly boiled with caustic soda, the colour of the bleached pulp, already duller than that of the jute boiled with lime, tended to become still duller during storage. In this case the influence of prolonged storage on the beating was perceptible. With jute boiled for a longer time and with a more concentrated caustic soda solution, the influence of storage on the beating qualities was pronounced, in that the half-stuff became more "mellow" and worked much "softer" in the beating. This beneficial influence of storage, however, reaches a maximum after 2—3 weeks, and no further mellowing is obtained by more prolonged storage. Jute boiled with caustic soda with the addition of sodium sulphide is capable of being bleached to a full white; the mellowing influence of storage is observed also in this case. Storage of the fully beaten pulps in the stuff-chest in the presence of a large excess of water was also found to have a powerful "softening" influence, such that the pulps became progressively slower in draining on the wire until destructive putrefaction set in. This change was more rapid the greater the original degree of beating.—J. F. B.

Rushes as material for board making. C. Uhlemann. Papierfabr., 1922, **20**, 962—965.

Bulrushes (*Typha*) and common reeds (*Phragmites*) in the mixed condition, as harvested, are being utilised at Freiberg, Saxony, as raw material for millboards and various types of cardboards. Photomicrographs of the pulps show that the digestion and separation of the ultimate fibres and vessels are complete, and with a yield of over 30% of useful pulp the economic conditions are stated to be favourable. The manufacture of white printing papers has not yet been undertaken, but the possibilities are promising.—J. F. B.

Lignin and lignosulphonic acid; Oxidation of methyl ethers of ——. E. Heuser and S. Samuelsen. Cellulosechem., 1922, **3**, 78—83.

By repeated treatments with methyl sulphate and 10% sodium hydroxide at 65°—70° C. the methoxyl value of lignosulphonic acid was raised from 13·07 to 25·43% and that of lignin isolated by Willstätter and Zechmeister's method (*cf.* J., 1913, 822) from 14·15 to 26·05%. These methoxylated products were oxidised by alkaline permanganate cold and at 90° C., also by alkali peroxide at 45° C., in the hope of obtaining some oxidation product having a constitutional relationship to the original lignin. Nothing characteristic, however, could be isolated. In the oxidation of methyl-lignin by alkaline permanganate, only 55·65% of the original carbon could be accounted for, 44·76% in the form of carbon dioxide and 10·69% in the form of oxalic acid. Volatile acids calculated as acetic acid amounted only to 0·9% of the material taken. (*Cf.* J.C.S., Sept.) —J. F. B.

Unfermented sugars in spent washes from saccharified wood. Pringsheim. *See* XVIII.

Patents.

Kapok and other fibres; Method to render —— incombustible. R. C. Valls. U.S.P. 1,422,242, 11.7.22. Appl., 1.6.20.

Kapok and other fibres having an impermeable outer cuticle are rendered permeable by treatment with a volatile solvent of low boiling point, such as alcohol, and are then rendered fireproof by treatment with ammonium phosphate.—A. J. H.

Cellulose material [plastic masses]; Manufacture of ——. Köln-Rottweil A.-G. E.P. 156,095, 22.12.20. Conv., 30.12.19.

Nitrocellulose is mixed with tri-orthocresyl ester (phosphate) and *p*-toluenesulphonic acid amyl ester, with the addition of materials, such as cork, sawdust, peat and suitable colouring or filling substances, and the whole is pressed or rolled while hot into an integral mass which can be used for floor covering etc. (Reference is directed, under Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 154,157.)—J. F. B.

Bast fibres; Retting process for ——. A. Herzog and P. Krais. G.P. 346,828, 22.1.21.

In a warm water retting process with slow circulation of the retting water, alkali carbonate or bicarbonate or a mixture of the two is added to the retting water so that this is kept neutral or faintly alkaline.—H. C. R.

Artificial threads, films, and plastic material; Process for manufacturing ——. R. J. Löffler. G.P. 346,832, 16.10.19.

The lignoproteins obtained from proteins and sulphite-cellulose waste lye are added to solutions of cellulose compounds and the mixture spun or moulded, precipitated, and hardened. Alternatively, one component of the lignoprotein may be added to the cellulose solution and the other to the precipitating bath. Fats, oils, dehydrating agents, or filling materials may be incorporated with the lignoproteins. To obtain a patent leather finish by means of the lignoproteins they are dissolved in ammonia and if necessary coloured. —H. C. R.

Millboard and similar substances; Manufacture of —— [using tanyard refuse]. A. T. Masterman. E.P. 182,884, 6.4.21.

Waste wattle bark or other tanyard refuse is crushed for 20 to 30 mins. in an edge runner in the presence of a solution of sodium carbonate or other alkali, and then, after admixture with about 20—30% of waste paper pulp, is beaten for about 2 hrs. with water at 45°—50° C. Engine size and alum, or gelatin alone, are added to the pulp during the beating process, and after leaving the beater the pulp is manufactured into board by hand or in machines. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 1994 of 1871, 2619 of 1872, 2672 of 1881, 1004 of 1883, and 9571 of 1900.) —L. A. C.

Dehydrating plastic and other materials [e.g., paper]; Method of ——. R. J. Marx. E.P. 183,097, 1.3.22.

A sheet of the material, *e.g.*, paper, is passed over a series of suction boxes, each providing a different degree of suction and together comprising a continuous zone of uninterrupted suction. The amount of suction is sufficiently low to avoid the formation of any moisture-impeding layer in the material, and preferably increases in successive boxes, so that superposed layers of the material are successively dehydrated.—H. H.

Paper; Process for sizing —— in the hollander. G. Muth. G.P. 349,595, 15.10.14.

Coumarone- and indene-resins or similar products are emulsified with alkali resin soaps, or are melted with natural resins and the mixture emulsified with alkali. For example, 1 pt. of colophony is melted with 10 pts. of coumarone-resin and heated until foaming ceases. The mixture is emulsified with alkali, ammonia, or sodium silicate solution to form a resin-size. The resin soap obtained is considerably purer than one obtained direct from pine resin, and is so readily soluble in water that it can be introduced into the hollander without being first dissolved.—H. C. R.

Sulphite-cellulose waste liquor; Process for treatment of ——. F. Gössel. G.P. 352,624, 25.4.20.

The neutralised and clarified liquor is evaporated under reduced pressure, with simultaneous oxidation, objectionable constituents of the lye being thus rendered harmless. The process may be applied to the residue obtained after treatment of the lye for the production of alcohol, and the product is suitable for use as fodder.—A. G.

Fibrous substances [paper pulp] and the like; Apparatus for pressing liquid out of ——. Aktiebolaget Karlstads Mekaniska Verkstad. E.P. 162,648, 8.4.21. Conv., 30.4.20.

Dyeing cellulose acetate. E.P. 182,830 and 182,844. *See* VI.

Bleaching. G.P. 352,845. *See* VI.

Fermentable sugar from wood. G.P. 351,681 and 352,773. *See* XVIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Mordants. Alumina. W. D. Bancroft. J. Phys. Chem., 1922, **26**, 501—536.

From a critical review of the literature, the following conclusions are drawn:—The actual hydrolysis of aluminium salts is greater with salts of weak acids, but the apparent hydrolysis may be abnormally large in sulphate solutions owing to the coagulating effect of the sulphate ion on the colloidal alumina. Different fibres adsorb alumina to different degrees, wool having a much greater adsorbing power than cotton, and silk being slightly inferior to wool. Owing to this difference in specific adsorption, wool decomposes aluminium salt solutions which are distinctly acid, whilst cotton is effective only in more basic solutions. The substance adsorbed and held firmly is colloidal alumina. Coagulated alumina may be adsorbed to some extent, but it easily rubs off the material. It is probable that in all cases alumina is adsorbed and not a basic salt. The phenomena may be complicated by the fact that the alumina itself will adsorb some sulphuric acid, for example, and that the wool also adsorbs sulphuric acid. If to cotton is added some substance, such as tannin, which adsorbs alumina strongly, then the mordanted cotton is able to take alumina from solutions of aluminium salts which are not decomposed by cotton alone. The increase in the adsorbing power of mercerised cotton is due to a structural difference of the cotton fibre. There is no evidence of the formation of any definite compound between alumina and silk, cotton, or wool.—J. F. S.

Textile fibres; Colour absorption from dye liquors by ——. R. Auerbach. Kolloid-Zeits., 1922, **31**, 37—40.

In view of the difference between the states of dispersion of a dyestuff when in aqueous solution and when deposited within a textile fibre, the colour of the dye liquor and that of cotton or wool fabric dyed by means of it, have been compared in the case of about sixty basic, acid wool, and direct cotton dyestuffs. The determination of the shade of the dyed fabric was carried out after drying, but it was shown that the wet dyed fabric could have been used with but small error. In nearly all cases, the fibre had a bathochromic influence, but in the case of Chicago Blue R W and Wool Blue 5 B, its influence was hypsochromic. —A. J. H.

Patents.

Bleaching fibres, textiles, and the like with hypochlorites; Process for ——. Zellstoff-fabr. Waldhof. G.P. 352,845, 11.5.18.

Fibrous material, *e.g.*, sulphite-cellulose, is bleached by treatment, first with acid and then with alkaline, solutions of hypochlorites.—L. A. C.

Dyeing, bleaching and analogous treatment of textile fibres; Process of and apparatus for ——. J., T., and J. Brandwood. E.P. 182,575, 8.4.21.

Textile material in the loose form is conveyed through the machine between two open-woven or meshed, endless travelling belts, which may consist of brattice cloth strengthened by transverse flat stiffening rods. On entering the machine, the conveyor passes around two cylinders having perforated surfaces and arranged within a tank containing dye-liquor. By means of pumps, the liquor is drawn inward through the textile material at one cylinder and forced outward through the material at the other cylinder. The conveyor then carries the material over the perforated top of another tank, where it is subjected to a current of air or suitable liquor passing in either direction, and then into a third tank where it passes over the perforated surfaces of two chambers, and is further subjected to a current of wash water in either direction. Beyond this tank, the two belts diverge and the treated textile material is removed by means of rotary brushes. This machine is suitable for dyeing with sulphur, oxidation, azo, or basic dyestuffs.—A. J. H.

Cellulose acetate or products made therewith; Treatment [dyeing] of ——. *Treatment [dyeing] of union or mixed fabrics [containing cellulose acetate].* R. Clavel. E.P. (A) 182,830, 12.1. and 30.8.21, (B) 182,844, 9.2. and 8.11.21.

(A) Dyestuffs of any class containing hydroxyl, amino, imino, imido, nitro, nitroso, isonitroso, acidylamino, or azo groups, and either no sulphonyl groups, or not more than one sulphonyl group together with two or more of the above groups, are suitable for the direct dyeing of cellulose acetate products, such as artificial silk, films, and the like, which have been prepared by processes in which depolymerisation of the cellulose molecule has been avoided as far as possible. In dyeing with basic dyestuffs, the addition to the dye-bath of salts such as magnesium chloride, stannous chloride, or zinc chloride, which are capable of forming double salts with the dyestuffs, or the use of the dyestuffs in the form of these double salts, gives even dyeings fast to light and washing. Dyestuffs insoluble in water, such as water-insoluble Induline, can be applied in aqueous suspension, *e.g.*, in an aqueous foam bath prepared as described in E.P. 102,310 (J., 1917, 80). After dyeing, the material is treated in a bath containing formic acid or acetic acid and an oil emulsion consisting of olive oil and olive oil soap. (Reference is directed, in pursuance of Sect. 8, Sub-sect. 2, of the Patents and Designs Acts, 1907 and 1919, to E.P. 176,535; J., 1922, 325 A.) (B) The cellulose acetate present in mixed fabrics containing cellulose acetate fibres and other natural or artificial fibres is dyed as described in (A), and if the dyestuffs employed are not appropriate for the other fibres present, the fabric is also dyed with another dyestuff appropriate for the other fibres. The two dyestuffs may be applied in separate baths, or both may be present in the one bath.—L. A. C.

Dyeing skins, hairs, and the like; Process for ——. A. G. Bloxam. From Akt.-Ges. für Anilin-Fabr. E.P. 183,078, 31.10.21.

See U.S.P. 1,416,646 of 1922; J., 1922, 543 A.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitric acid; Manufacture of ——. *The U.S. Government explosives plant C, Nitro, West Virginia.* M. F. Chase. J. Ind. Eng. Chem., 1922, **14**, 677—681.

This plant, erected in 1918, comprised 96 3-ton retorts for the decomposition of sodium nitrate. The nitre was mechanically handled throughout and was dried, before use, in gas-fired rotating steel cylinders. " Bleach pots " packed with rings were interposed between the pots and condensers, in which the condensed acid met the ascending vapours, these and all the condensers and connexions being made of acid-resisting iron. The condensers consisted of a series of return bends cooled with sprays. To each set of 24 retorts was connected a series of 18 stoneware towers, 15 ft. high and 30 in. diam., fed with water for absorbing the uncondensed gases. The time of working off one charge was 12 hrs., the maximum temperature obtained in the retorts 250° C., and the mean overall efficiency 92%.—C. I.

Nitric acid solutions; Concentrating dilute ——. C. D. Carpenter and J. Babor. Chem. and Met. Eng., 1922, **27**, 121—124.

A DETAILED series of determinations of the composition of a boiling nitric acid solution and of the distillate therefrom during concentration from 5% HNO_3 to 68% HNO_3 in an apparatus from which any fractionation is excluded, is given. The quantity of acid passing over into the distillate on simple distillation from 20% up to 55% concentration is 33·3% of the quantity originally present, but on further distillation up to 65% concentration, 69% of the acid passes over. While two distillations to 55% give a recovery of 90% of the acid, two distillations up to 65% give a recovery of only 52%. It is therefore concluded that in the pre-concentration of nitric acid by fractionation it is not advisable to go above 55—60% concentration, the extra fractionation required to reach 65% being out of all proportion to the gain. From the curves which summarise the above-mentioned data the composition of the vapour above a boiling nitric acid solution of any strength is deduced. Results so obtained are compared with those of Pascal (J., 1921, 506A) and of Berl and Samtleben (J., 1922, 461 A), and the apparatus and methods of calculation of these observers are criticised.—C. I.

Barium sulphuric acid and barium selenic acid. J. Meyer and W. Friedrich. Z. physik. Chem., 1922, **101**, 498—503.

SULPHURIC acid of 97·86% concentration dissolves 14·91 g. of barium sulphate per 100 c.c. at 25° C., and from the solution crystals of barium sulphuric acid, $H_2[Ba(SO_4)_2]$, separate. Similarly a concentrated solution of selenic acid dissolves barium selenate and deposits crystals of barium selenic acid, $H_2[Ba(SeO_4)_2]$. (*Cf.* J.C.S., Sept.)—J. F. S.

Nitrogen fixation by the cyanide process. F. E. Bartell. J. Ind. Eng. Chem., 1922, **14**, 699—704.

INVESTIGATIONS on cyanide synthesis by the Bucher process were carried out with 4-in. retorts holding 8 lb. of briquettes and with 10 ft. by 8 in. continuous retorts capable of making 7—8 lb. of cyanide per hr. It was shown that Bucher's claim that serious chemical difficulties did not exist and that the precise nature of the coke used made little difference was justified. Producer gas is, however, inadmissible as a source of nitrogen, owing to the harmful effect of carbon monoxide. The difficulty consists in the close correlation of the mechanical treatment with the progress of reactions which are easily reversible. A temperature of 1050° C. is best in the retort. The formation of cyanide is most active in the lower portion of the retort, but it gradually distils upwards, while in the upper part the carbon monoxide generated tends to reverse the reaction. For success it is therefore necessary to maintain such a supply of nitrogen that the partial pressure of carbon monoxide is as low as possible. The mixture briquetted consisted of 50% of petroleum coke, 38% of sodium carbonate, and 12% of iron, previous to the oxidation of the last. The nitrogen used was obtained by the slow combustion of coke and removal of carbon dioxide from the combustion products. A series of cost estimates based on U.S. prices in 1918 give the cost per lb. of NH_3 by this process at 27—37 cents. —C. I.

Sodium bicarbonate; Preparation of ——. E. Toporescu. Comptes rend., 1922, **175**, 268—270.

A STUDY similar to that originally made at 15° C. (J., 1922, 325 A) of the equilibrium of the four salts, sodium chloride, sodium bicarbonate, ammonium chloride, and ammonium bicarbonate, with their saturated solutions has been made at 35° C. and 50° C. The geometrical representation of the results obtained by means of a Le Chatelier diagram enables a calculation to be made of the theoretical yield, that is to say, the proportion of sodium chloride transformable into bicarbonate for a solution of any given initial composition. The course of the industrial preparation of sodium bicarbonate does not run parallel with this owing to the varying temperature of the salt solutions, but nevertheless the results will indicate whether it is necessary to add water to the original sodium chloride solution in order to avoid precipitation of ammonium bicarbonate, or whether more solid salt must be added in order to obtain the theoretical yield. —G. F. M.

Calcium cyanamide; Formation of —— from calcium ferrocyanide. H. Pincass. Chem.-Zeit., 1922, **46**, 661.

ON heating hydrated calcium ferrocyanide steadily for an hour to a maximum temperature of 690°—700° C., a black, magnetic, friable mass is obtained which contains no ferrocyanide but about 80—90% of the theoretical quantity of calcium cyanamide that should be formed according to the equation: $Ca_2Fe(CN)_6 = N_2 + FeC_2 + 2CaCN_2 + 2C$. With higher temperatures and longer heating the yield is greatly reduced. No calcium cyanamide is formed by heating an intimate mixture of 1 molecule of potassium ferrocyanide and 1 molecule of lime at temperatures up to 1000° C.; the reaction product contains, in this case, only cyanide.—A. R. P.

Calcium; Determination of —— in natural phosphates. R. Meurice. Ann. Chim. Analyt., 1922, **4**, 198.

THE phosphate is treated with mineral acid, the silica is removed and the iron and aluminium are separated by precipitation as phosphates in acetic acid solution. The filtrate is then neutralised with ammonia, treated with 20 c.c. of 20% hydrochloric acid and 30 c.c. of 4% ammonium oxalate, warmed, and 10% ammonium acetate added at a rate of about 30 drops per minute. A granular precipitate of calcium oxalate is thus obtained and this is collected, washed and ignited as usual. Test analyses carried out on known quantities of calcium in the presence of phosphates and magnesium sulphate in large excess gave very accurate results. —H. C. R.

Calcium arsenate manufacture. H. W. Ambruster. Chem. and Met. Eng., 1922, **27**, 159—160.

IN all plants in the United States at present making calcium arsenate, and in those likely to be erected in the immediate future, the process used consists in oxidising arsenic trioxide with nitric acid and neutralising with lime. Earlier plants working with small units employed earthenware pots with hand agitation and an earthenware absorption tower for absorbing nitrous fumes. The more modern plants have large silicon-iron nitrating vessels with mechanical feed of arsenic and mechanical stirrers, and acid-proof brick absorption towers. The earlier filter-press and oven for drying the arsenate are replaced by a rotary drum dryer which saves much labour while using no more steam.—C. I.

Solubility of gases in liquids. B. S. Neuhausen. J. Phys. Chem., 1922, 26, 553—557. (*Cf.* J., 1922, 249 A.)

The solubility of ammonia, carbon dioxide, sulphur dioxide, and hydrogen chloride in methyl alcohol and ethyl alcohol as well as in water can be represented by the formula $V = K(P\sigma/P_0)^{1/n}$, where V is the volume of liquefied gas dissolved per gram of water, P the equilibrium pressure, σ the surface tension, and P_0 the vapour tension of the liquefied gas at the temperature of measurement. The values of K for the three solvents water, methyl alcohol, ethyl alcohol are: NH_3, 0·49, 0·205, 0·108; HCl, 1·05, 1·23, 0·979; SO_2, 0·012, 0·04, 0·04; CO_2, 0·006, 0·0126, 0·0103; and the corresponding values for 1/n are: NH_3, 0·69, 0·69, 0·71; HCl, 0·12, 0·062, 0·065; SO_2, 0·91, 1·20, 1·00; CO_2, 0·33, 0·07, 0·055. —J. F. S.

Sodium silicate solutions; Electrolysis of ——. J. F. Spencer and K. Proud.. Kolloid Zeits., 1922, 31, 36—37.

Orthosilicic acid may be prepared by the electrolysis of a 50% solution of sodium silicate in a divided cell using a heavy anode current density. The cathode employed was a platinum dish of 7·5 cm. diam. and this contained a small porous pot which held the anode, a coil of platinum wire of 1·80 sq. cm. surface. A current of 9 amps. was used and this fell rapidly until no current passed, due to the formation of an insulating layer of orthosilicic acid on the anode. On bending the wire the deposit fell away and the current again passed. The product is glass-like in appearance, entirely insoluble in water, and stable in the air.—J. F. S.

Reactions in fused salt media. Solvolysis. J. F. G. Hicks and W. A. Craig. J. Phys. Chem., 1922, 26, 563—576.

Lead, silver, and barium chromates and lead oxide when dissolved in molten sodium chloride or an equimolecular mixture of sodium and potassium nitrates, undergo solvolysis in the same way that lead chromate undergoes hydrolysis in water. In the nitrate fusion the solvolysis of lead chromate occurs to the greatest extent and that of silver chromate to the least. The solvolysis of lead oxide in fused sodium chloride is practically complete at 850°—870° C.; that of silver chromate is complete at this temperature and proceeds more rapidly. (*Cf.* J.C.S. Sept.)—J. F. S.

Selenium dioxide; Preparation of ——. J. Meyer. Ber., 1922, 55, 2082—2084.

Selenium in quantities of 60—75 g. is heated to its melting point in a porcelain boat placed in a wide hard glass tube; a very rapid current of oxygen which has been passed through fuming nitric acid is led over it, causing the molten selenium to burn with a brilliant blue flame and to give a sublimate of selenium dioxide, the purity of which increases with increasing rate of flow of oxygen. The product, which contains small quantities of oxides of nitrogen, is purified by being sublimed in the same tube in a current of pure oxygen. To avoid loss of material, the tube is connected with a doubly tubulated vessel of two litres capacity in which the final traces of the dioxide are deposited. The combustion of 60—70 g. of selenium can be effected in about 1¼ hours. (*Cf.* J.C.S., Sept.)—H. W.

Carbon suboxide; Preparation of —— on a larger scale and the properties of pure carbon suboxide. E. Ott and K. Schmidt. Ber., 1922, 55, 2126—2130.

Carbon suboxide is prepared in 41% yield by leading the vapours of diacetyltartaric anhydride, boiling under diminished pressure, over a platinum wire heated to bright redness. The apparatus, which permits the manipulation of a charge of 250 g. of the anhydride in 6—8 hrs., is fully figured and described. As regards yield and cost of material the process is superior to that of Stock and Stoltzenberg (J., 1917, 645) and has the further advantage that the carbon suboxide so prepared can be preserved for long periods without change in sealed tubes, whereas the product obtained with the help of phosphorus pentoxide rapidly polymerises, probably owing to the presence of traces of phosphorus oxide. (*Cf.* J.C.S., Sept.) —H. W.

Ozone. E. H. Riesenfeld and G. M. Schwab. Ber., 1922, 55, 2088—2099.

By the use of micro-methods the isolation of pure ozone has been effected by condensing ozonised oxygen in small glass bulbs surrounded by liquid air and subsequent fractionation of the dark blue condensed liquid (which contains initially about 30% of oxygen). It has m.p. −250° C., b.p. −112·3° C., critical temperature −5° C., density 1·784 at −182° C. Liquid ozone is not completely miscible with liquid oxygen at all temperatures, the critical temperature of solubility being −158° C. The explosive decomposition of ozone is extremely sensitive to catalytic influences, but if these are excluded it is unexpectedly stable. According to Warburg's calculation, the half-life period of pure ozone at 16° C. is 167 hrs., whereas it is found that under certain conditions a period of several weeks elapses before decomposition has proceeded to this extent. No evidence of the existence of Harries' oxozone has been obtained. (*Cf.* J.C.S., Sept.)—H. W.

PATENTS.

Sulphuric acid; Method of and apparatus for the manufacture of ——. A. Helbronner and P. Pipereaut. E.P. 157,281, 10.1.21. Conv., 29.4.18.

The cooling action of the chamber walls in the usual lead chamber process is essential for the normal reaction in this process, which consists of the formation and decomposition of nitrosylsulphuric acid. Intensive working, however, involves the formation of nitrogen peroxide and nitric acid and for the reaction with these compounds as oxygen-carriers cooling is not required. An apparatus designed for intensive working consists of a series of cells of volvic lava arranged in an ascending cascade, with the hot burner gases entering at the bottom. The lower ones serve simply as a concentrator. Nitric acid is introduced into the sixth, and nitrous vitriol, dilute acid and water into the eighth cell. After passing through 22 cells the gases pass up water-cooled vertical lead pipes to a series of 6 towers of small diameter in which condensation is completed and thence to a Gay Lussac tower.—C. I.

Chlorosulphonic acid; Method of making ——. T. L. Briggs (I. M. Briggs, extrix.), Assr. to General Chemical Co. U.S.P. 1,422,335, 11.7.22. Appl., 4.10.21.

Controlled volumes of hydrochloric acid and "contact gas" (gas from the contact process of making sulphuric acid) are passed through a mixing chamber and thence through a long passage of restricted diameter. The liquid chlorosulphonic acid is withdrawn.—A. G. P.

Phosphoric acid; Process of producing ——. E. W. Guernsey and J. Y. Yee. U.S.P. 1,422,699, 11.7.22. Appl., 28.6.21.

Phosphate rock, silicious material, and carbonaceous material are intimately mixed in such proportions that the molecular ratio of the combined

calcium oxide to the silica will be 1:1. The mixture is made into briquettes and heated at a temperature not exceeding that of incipient clinkering until all the phosphorus has been expelled. The phosphorus is recovered in the form of oxides.
—H. R. D.

[Hydrochloric acid; Manufacture of —— in process for the] extraction of potassium compounds. W. Glaeser, Assr. to Potash Extraction Corp. U.S.P. 1,422,848, 18.7.22. Appl., 7.6.18.

CALCIUM chloride is heated with alunite in the presence of steam, and the hydrochloric acid evolved is collected.—L. A. C.

Nitrogen oxides; Recovery of ——. Farbw. vorm. Meister, Lucius, und Brüning. G.P. 298,845, 22.9.15.

NITROGEN oxides are recovered from the gases produced by the catalytic oxidation of ammonia by passing the gases through coolers; the gases pass through the coolers in less than 1 second.—A. B. S.

Ammonia; Process for manufacture of ——. Norsk. Hydro-Elektrisk Kvaelstofaktieselskab. E.P. 159,878, 1.3.21. Conv., 9.3.20.

IN the synthesis of ammonia, using iron, nickel, cobalt, chromium, or manganese, as contact substances, alkali cyanides are employed as activators.
—H. R. D.

Ammonia; Synthesis of ——. L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. E.P. 160,811, 29.3.21. Conv., 30.3.20.

THE reacting gases are preheated by contact with the wall of the chamber containing the catalyst, the thermal conductivity of the wall being of such value that under normal working conditions the gases reach the catalyst at the lowest temperature permitting of the normal maintenance of the reaction. To attain the desired object the tube containing the catalyst is made of material of low thermal conductivity or of steel covered with heat-insulating material. The process is especially applicable when very high pressures are used.
—H. R. D.

Magnesium chloride; Manufacture of ——. V. M. Goldschmidt. E.P. 161,165, 9.3.21. Conv., 29.3.20.

MAGNESIUM oxide is chlorinated in the presence of sulphur or sulphur chlorides free from oxygen at 200°—500° C., according to the following equation:

$$2MgO+2Cl_2+S=2MgCl_2+SO_2.$$

—H. R. D.

Aluminium oxide; Process of reducing —— [to form carbide or aluminium alloys]. L. Burgess. E.P. 182,609, 27.4.21.

ALUMINIUM oxide or material containing it, *e.g.*, bauxite, is intimately mixed with a pasty carbonaceous material, such as pitch or tar, with or without the addition of further solid carbonaceous matter, and the mixture is coked, whereby finely divided aluminium oxide is obtained intimately mixed with carbon. This matrix is broken up and packed around carbon electrodes between which an arc is produced, whereby aluminium carbide is formed. Products containing varying percentages of metallic aluminium or aluminium alloys or carbides of other metals may be obtained by varying the quantity of carbon and adding other oxides to the original mixture.—A. R. P.

Caustic soda; Manufacture of ——. Courtaulds, Ltd., and R. O. Jones. E.P. 182,661, 11.6.21.

CAUSTICISING is effected in two stages according to the equations,

$$Ca(OH)_2+Na_2CO_3\rightleftarrows 2NaOH+CaCO_3, \text{ and}$$
$$Ca(OH)_2+2Na_2CO_3+xH_2O\leftrightarrows 2NaOH+Na_2CO_3,CaCO_3,xH_2O$$

In the first stage the concentrations are so chosen that little or no double carbonate is formed, and after completion of this stage the liquor is separated, preparatory to the second stage, when more sodium carbonate and lime are added to the liquor and a further conversion to caustic soda takes place. In this manner a liquor is readily obtained containing about 20% of caustic soda and 6% of sodium carbonate.—H. R. D.

Alkali hydroxides; Production of —— from alkali sulphates. K. Kaiser. G.P. 352,714, 20.4.20.

ALKALI hydroxides are produced by passing a mixture of hydrogen and steam over heated alkali sulphate. A substance, such as calcium hydroxide, which evolves water on heating, or a metallic oxide, such as ferric oxide, which is reduced by hydrogen, may be added to the sulphate. Alkali carbonate may be produced in a similar manner by adding carbon monoxide to the mixture of hydrogen and steam.—A. B. S.

Ammonia-soda process; Method of conducting the ——. E. E. Arnold, and P. St. Clair, jun., Assrs. to The Nitrogen Corp. U.S.P. 1,423,510, 25.7.22. Appl., 11.3.20.

A COMPRESSED gas is expanded in proximity to, but separated from, a body of ammoniated brine, to absorb the heat generated by the reactions in the ammonia-soda process.—H. R. D.

Caliche; Treatment of —— [for extraction of sodium nitrate]. W. Broadbridge, E. Edser, and W. G. Sellers. E.P. 182,859, 9.3. and 6.9.21.

IN existing methods of extraction of caliche an incomplete yield is obtained because it is only possible to crush the crude material coarsely, otherwise slimes are produced which can neither be settled nor filtered. If, however, such slimes are agitated with aeration, especially with addition of a flocculating agent, they are capable of filtration. Suitable flocculating agents are fatty acids, soap, wood tar, glue, and sodium silicate or aluminate, and the quantity required may be no more than 1¼ lb. per ton of finished nitrate. The hot liquor passes down through a mass of caliche, crushed as finely as desired, resting on the false bottom of the extraction vessel, then upwards through the adjacent stirring vessel, to which the flocculating agent is added, and then back to the extractor. The circulation is continued until the bottom liquor is clear, the caliche itself acting as filter. A number of such pairs of apparatus are combined in a set in the usual way. The residues may be washed as desired if the surplus water introduced is afterwards evaporated.—C. I.

Sulphate of ammonia; Neutralisation and drying of ——. G. Weyman. E.P. 183,089, 1.12.21.

POWDERED dry ammonium carbonate is fed mechanically into the centrifuge during the drying of the acid salt, after the bulk of the mother liquor is removed. The greater part of the free acid is to be found on the inner surface of the mass of crystals and distribution of the neutralising agent is assisted by the carbon dioxide evolved, which also dries the hot crystals. To avoid corrosion of the basket the salt should be discharged before neutralisation is complete, and neutralisation completed during discharge. By this process a neutral salt containing over 25·50% NH_3 can be made without special drying.—C. I.

Calcium hypochlorite; Process for production of stable compounds of ——. Chem. Fabr. Greisheim-Elektron, H. S. Schultze, G. Pistor, and H. Reitz. E.P. 182,927, 13.4.21.

CALCIUM hypochlorite compounds produced by chlorinating calcium hydroxide in water are stabilised by removing the calcium chloride from the crystals of basic calcium hypochlorites or mixed basic and neutral calcium hypochlorites, and drying the crystals at a temperature up to 110° C. either *in vacuo* or at ordinary pressure. The crystalline products thus formed contain over 40% of available chlorine.—H. R. D.

Calcium carbide; Method of manufacturing ——. W. B. Rogatz, Assr. to Farmers Standard Carbide Co. U.S.P. 1,422,135, 11.7.22. Appl., 5.5.21.

The material is fed through the wall of the furnace and the side crust, above the already molten material, but below the top crust.—H. R. D.

Sulphur dioxide; Process of gassing liquors with ——. F. M. Allen, Assr. to General Chemical Co. U.S.P. 1,422,327, 11.7.22. Appl., 29.4.20.

Air is introduced under a pressure not much greater than that of the atmosphere into a relatively small chamber containing molten sulphur. By controlling the velocity of the inflowing air the temperature of the mixed gases leaving the chamber is maintained at about 550° F. (287° C.), and these gases are led into a body of liquid, the dimensions of the chamber, plus all the air and gas conduits, being such that the gases from the chamber are propelled with sufficient force to enable them to overcome the resistance of the liquid into which they are introduced.—H. R. D.

Oxysalt composition. C. Catlett. U.S.P. 1,422,337, 11.7.22. Appl., 3.8.21.

Solid lime and solid calcium chloride, both in a finely divided condition, are mixed together " under reacting conditions."

Aluminium chloride; Process of making ——. H. D. Gibbs, Assr. to E. I. du Pont de Nemours and Co. U.S.P. 1,422,560, 11.7.22. Appl., 19.5.21.

Aluminium chloride is prepared by treating aluminium with chlorine below 0° C.—L. A. C.

Aluminium chloride; Manufacture of ——. F. W. Hall, Assr. to The Texas Co. U.S.P. 1,422,568, 11.7.22. Appl., 20.9.21.

Chlorine, sulphur, and powdered alumina are caused to react under conditions suitable for the production of aluminium chloride.—L. A. C.

Potassium salts; Method of extracting —— *from bitterns.* I. F. Harlow, Assr. to The Dow Chemical Co. U.S.P. 1,422,571, 11.7.22. Appl., 27.11.16.

A bittern, containing potassium carbonate, other potassium salts, and sodium salts, is concentrated approximately to saturation point, and a quantity of calcium chloride chemically equivalent to the potassium present is added. The solution is heated to about 95° C., whereby calcium carbonate is precipitated and the potassium salts are converted into chloride. The residual solution is concentrated to about ¾ of its former volume, whereupon the sodium salts crystallise out while the solution is still hot, and are separated from the mother liquor. The liquor is then cooled to about 20° C., and practically pure potassium chloride crystallises out from the solution.—L. A. C.

Retort [for production of alkali cyanide]. F. G. Metzger, Assr. to Air Reduction Co. U.S.P. 1,422,878, 18.7.22. Appl., 11.10.17.

An iron retort suitable for the manufacture of alkali cyanides is protected from the effect of oxidising gases at high temperature by an external skin coating of a " base metal alloy."—C. I.

Alkali cyanides; Production of ——. H. Koppers. G.P. 350,628, 3.1.18.

In the production of alkali cyanides by heating a mixture of carbon, alkali salts (chlorides), slag-forming material, and iron or manganese compounds, by means of hot air in a gas producer, the decomposition zone is heated above the b.p. of the alkali cyanide. A portion of the gases is drawn off from this zone, and treated for the recovery of alkali cyanide, while the remainder of the gas, which contains hydrogen chloride, is drawn off from the top of the producer.—L. A. C.

Hydrogen; Manufacture of —— *by partial liquefaction of mixtures of gases containing the same.* L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. E.P. 175,605, 23.12.21. Conv., 17.2.21.

Water-gas illuminating gas, coke-oven gas, or like gases may be treated by the process. The fraction of the compressed gas utilised for feeding the liquefier is withdrawn from the heat interchanger at a point situated at a distance from the cold end of the interchanger, so that the temperature attained by the hydrogen immediately before subjecting it to expansion is raised to the maximum degree compatible with the attainment of the low temperature, after expansion, necessary to ensure purity of the hydrogen, and at the same time the temperature of the main portion of the gases to be treated, admitted to the separating column, is considerably lowered. If the presence of nitrogen is not undesirable, a certain proportion of cold compressed nitrogen may be added to the compressed hydrogen in the expansion chamber. Hydrocarbon gases may also be added, provided they do not solidify at the temperature obtaining in the expander.—A. G.

Carbon; Method of purifying ——. V. Lenher and F. M. Dorsey, Assrs. to General Electric Co. U.S.P. 1,423,231, 18.7.22. Appl., 18.9.20.

Carbonised material is subjected to the action of selenium oxychloride, then washed with carbon tetrachloride, and the remaining carbon tetrachloride evaporated.—H. C. R.

Arsenical compounds; Manufacture of ——. K. B. Edwards. U.S.P. 1,422,945, 18.7.22, and 1,424,006, 25.7.22. Appl., 22.10.21.

See E.P. 162,747 of 1920; J., 1921, 470 A.

VIII.—GLASS; CERAMICS.

Patent.

Kiln; Gas-fired pottery ——. A. McD. Duckham. U.S.P. 1,423,408, 18.7.22. Appl., 29.12.21.

See E.P. 176,419 of 1920; J., 1922, 328 A.

IX.—BUILDING MATERIALS.

Cement mortars; Relations between voids and plasticity of —— *at different relative water contents.* F. E. Richart and E. E. Bauer. Amer. Soc. Testing Materials, June, 1922. [Preprint.] 20 pp.

Minimum voids in a mortar are determined by taking known volumes of sand and cement (the sp. gr. of both being known), mixing with varying increments of water, and tamping into a counterpoised mould of known volume. The weight of the same volume of mortar for varying amounts of water is thus found, and from the greatest weight the minimum voids can be calculated by a formula (*cf.* Talbot, Proc. Amer. Soc. Testing Materials, 1921, 21, 944). About the same number of determinations are required as for the Vicat test. Tables and curves of Vicat and mortar-void tests on neat cement show an approximation of basic water content (amount of water producing minimum voids) and water of normal consistency. From results of a number of tests on sand mortars and neat cements, basic water content appears to coincide in general with water content giving maximum strength (compression and tensile). Basic water content is suggested as a standard for comparative strength tests on mortars. Curves are plotted showing the close relation between water values obtained from a basic water-content curve and from Feret's and Taylor's formulæ for normal consistencies. Under certain conditions the values from the first appear to be more applicable than those from the older formulæ. The results of "slump" and "flow" tests (*i.e.*, workability) in relation to minimum void are also shown graphically.—J. B. P.

Plaster; Dispersoid chemistry of ——. Investigation on anhydrite. H. Neugebauer. Kolloid-Zeits., 1922, 31, 40—45.

The dehydration of the various hydrates of calcium sulphate was never complete at 115° C. or slightly above, and in no case could the water of crystallisation be reduced below 4%. The common dihydrate loses its water of crystallisation at 102° C. considerably more slowly and less completely than the other forms, probably because of the size of the crystals. The commercial product, anhydrasite, prepared by the hydration of natural anhydrite exhibits on dehydration, a behaviour analogous to that shown by van't Hoff's plaster (Z. physik. Chem., 1903, 45, 3), prepared in the form of fine needles, by hydration of plaster of Paris with about 20 times its weight of water, with occasional agitation, and it is affected in the same way as plaster of Paris by the addition of alum. A further technical product, leucolith, from its viscosity measurements shows no combination with water. The behaviour in this case is analogous to that of flooring plaster, the setting of which is due to the presence of free lime. (*Cf.* J.C.S., Sept.)—J. F. S.

Phenols from low-temperature tar; Utilisation of —— for wood preservation. F. Peters. Brennstoff-Chem., 1922, 3, 198.

The phenols from low-temperature tar consist for the most part of xylenols and higher homologues. A low-temperature tar was freed from constituents boiling below 210° C. by distillation, and the residue was mixed with an equal quantity of neutral impregnating oil prepared from ordinary coal tar. Pine wood chips were then soaked in a solution of this mixture in acetone. Varying concentrations were used and after evaporation of the acetone the chips were exposed to the action of *Coniophora cerebella* in suitable glass vessels under conditions favourable to putrefaction. Similar experiments were carried out with the impregnating oil alone, free from tar acids. After several months the chips were removed from the vessel and examined for decay. A mixture of 1 pt. of low-temperature phenols and 1 pt. of impregnating oil had the same fungicidal action as the impregnating oil alone.—A. G.

Patent.

Cementing and protecting composition. L. E. Barringer, Assr. to General Electric Co. U.S.P. 1,423,985, 25.7.22. Appl., 18.11.19.

See E.P. 159,421 of 1920; J., 1921, 266 A.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Chromium; Rapid method for the determination of —— in nickel-chromium steels. W. Hild. Chem.-Zeit., 1922, 46, 702—703.

The steel is dissolved in nitric acid and the solution evaporated with sulphuric acid. The chromic sulphate is oxidised to chromic acid with an excess of potassium permanganate, and the excess is destroyed by heating with manganese sulphate. The filtered solution is treated with an excess of standard ferrous sulphate and eventually titrated with permanganate. As a control the iron may be removed from a chloride solution by means of ether, the chromium precipitated with ammonia, the precipitate dissolved in sulphuric acid, and the assay finished as above.—A. R. P.

Ferrotungsten; Rapid analysis of ——. L. Losana and E. Carozzi. Giorn. Chim. Ind. Appl., 1922, 4, 299—301.

The following method, occupying less than two hours, gives accurate results, and is especially suitable for the rapid industrial control of the proportion of tungsten in iron alloys and tool steels. The alloy is powdered and 0·5 g. heated carefully in a platinum dish with 10 c.c. of nitric acid (sp. gr. 1·2) and about 2 c.c. of hydrofluoric acid until solution is complete, 5 c.c. of concentrated sulphuric acid being then cautiously added and the dish heated on asbestos card until dense white fumes have been evolved for some minutes. The hydrofluoric acid having been removed in this way, the liquid and the adherent precipitate are transferred to a porcelain basin and there boiled briskly for 10 mins. with 15 c.c. of concentrated hydrochloric acid. After filtration, the precipitate is washed with hot 5% hydrochloric acid solution until the filtrate ceases to contain iron, the wet filter paper and precipitate being then calcined in a platinum crucible and the residual WO_3 weighed. Alternatively the latter may be washed with potassium chloride solution until neutral and then titrated with alkali solution. The filtrate may be used for the estimation of the iron, manganese, phosphorus, calcium, aluminium, etc., in the usual way.—T. H. P.

Molybdenum in tungsten; Estimation of small amounts of ——. D. Hall. J. Amer. Chem. Soc., 1922, 44, 1462—1465.

Small amounts of molybdenum in tungsten may be determined as follows: One gram of the alloy is dissolved in a mixture of nitric acid and hydrofluoric acids and the solution evaporated with sulphuric acid. The yellow oxides are dissolved in sodium hydroxide and the solution transferred to a 200 c.c. separating funnel, acidified with sulphuric acid, and diluted so that 1 c.c. contains about 0·1 mg. of molybdenum. The volume is made up to 150 c.c., 0·5 g. of solid potassium xanthate and a few drops of 1:3 sulphuric acid added, and the mixture shaken thoroughly. About 10 c.c. of chloroform is added and the whole shaken for several minutes. The highly coloured chloroform layer settles at the bottom and is run into a second funnel for washing. The original solution is repeatedly treated with potassium xanthate, acid, and chloroform until the chloroform layer is colourless, each portion of the chloroform solution being added to the first. The chloroform solution of molybdenum xanthate is washed several times with water, run into a 150 c.c. beaker, and evaporated to dryness. The residue is heated and converted into a mixture of oxide and sulphide. This is dissolved in nitric acid, evaporated with sulphuric acid and molybdenum sulphide precipitated by passing hydrogen sulphide into the hot solution, made alkaline with sodium hydroxide. The solution is then slowly acidified with dilute sulphuric acid, the precipitate filtered off, washed with hot water, and ignited to trioxide. The method is extremely good for small quantities of molybdenum.—J. F. S.

Chromium; Determination of —— in metals. W. Löffelbein. Chem.-Zeit., 1922, **46**, 679.

Small quantities of chromium, such as remain in the alloy after deoxidising nickel bronzes, may be accurately determined as follows:— 3—5 g. of the turnings is dissolved in *aqua regia,* the solution is evaporated to dryness, the residue treated with dilute hydrochloric acid, and the liquid saturated with hydrogen sulphide and filtered. The filtrate is boiled, oxidised with bromine, and treated with a slight excess of ammonia. The precipitate is collected, ignited, and fused with sodium peroxide. The melt is leached with water and the chromium determined iodometrically in the solution after filtration.—A. R. P.

Osmiridium; Notes on ——. J. R. Thurlow. J. Chem. Met. Soc. S. Afr., 1922, **22**, 209—210.

Osmiridium occurs in the gold ores of the Eastern Rand (Transvaal) to the extent of 1 oz. to 5000—15,000 tons, and during treatment of the ores it accumulates in the " black sands," which consist chiefly of pyritic minerals with some ilmenite and chromite. These concentrates are treated on a batea to obtain a product containing about 40% of osmiridium, which is further concentrated to 90—95% by careful hand-panning. All the tailings are further treated on small canvas tables, and the concentrates are finally cleaned by treatment with acids. Analyses of a number of concentrates and of a typical " black sand " are given.—A. R. P.

Copper-zinc alloys; Electrolytic separation of ——. P. Weise. Z. Elektrochem., 1922, **28**, 327—341.

Copper may be prepared from bronze, containing up to 20% of tin, by electrolysing, at 75° C., a solution of 15% of copper sulphate in 5% sulphuric acid, using a copper cathode, 34×34 cm., between two bronze anodes, 36×36 cm., and a direct current of 150 amps. per sq. m. The copper is deposited quite pure and the tin falls as a powder to the bottom of the cell, but still contains some copper. This is recovered by heating the sludge with copper oxide and some of the electrolyte from the cell and eventually concentrating to the point of crystallisation. After copper sulphate has separated the mother liquor is poured off and discarded, the copper sulphate is extracted with water and used in the electrolysis.
—J. F. S.

[Tin;] Primary and secondary recrystallisation [of ——]. G. Masing. Wiss. Veröffentl. Siemens-Konzern, 1922, **1**, [3], 31—34.

In the case of tin, the author shows experimentally that the secondary crystallisation following a secondary deformation is characteristic of that deformation and does not take place if the metal, after casting, is subjected to a similar deformation without being subjected to a primary deformation (*cf.* J., 1922, 256 A). Thus, a sheet of tin which after being cast, was pierced, and then subjected to recrystallisation showed a ring of comparatively small crystals around the hole, whereas a similar sheet that had been rolled before piercing, showed, after recrystallisation at the same temperature, extremely large secondary crystals spread evenly around the hole and gradually merging into the original primary crystals.—A. R. P.

Calcium amalgam; Electrolytic preparation of ——. B. S. Neuhausen. J. Amer. Chem. Soc., 1922, **44**, 1445—1447.

Calcium amalgam is best prepared by electrolysing a 1·75 *N* solution of calcium chloride in a crystallising dish (25 cm. diam.) between a thin layer of mercury which just covers the bottom of the dish and serves as cathode and a platinum plate (2×4 cm.) placed parallel to the surface of the mercury and at a distance of 4 cm. A current of 3·5 amps. at 4—6 volts is passed for 30 mins. This arrangement prevents heating, foaming, and the formation of a black deposit. The amalgam is washed by pouring into 2 litres of distilled water in a fine stream and stored in a bottle filled with carbon dioxide. It contains 0·069—0·075% Ca.
—J. F. S.

Corrosion of metals by water in a closed system; Prevention of ——. P. West. J. Ind. Eng. Chem., 1922, **14**, 601—607.

Metals rust to an appreciable degree only when in contact with both water and free oxygen. Where water is confined in a closed system the dissolved oxygen in it is the principal cause of corrosion. The removal of this will practically stop corrosion in most cases and materially reduce it in others. Free carbon dioxide promotes corrosion in the presence of oxygen but is practically inactive in its absence, except at extremely high temperatures. Other acids, such as nitric, hydrochloric or sulphuric acid, also, when present in a highly diluted condition, have little corrosive action except in the presence of dissolved oxygen. Calcium and magnesium carbonates may retard corrosion by depositing a protective coating on the metal. At very high temperatures these carbonates may give off carbon dioxide or give rise to alkaline solutions, thereby promoting corrosion, especially in the presence of free oxygen. Some chlorides, especially magnesium chloride, are hydrolysed with formation of free acids, which are highly corrosive in the presence of free oxygen, but not otherwise except in high concentration. Carbonates and chlorides are both scale-forming and therefore provide some protection against their own corrosive action. This, however, does not prevent pitting. Sulphates and nitrates are rather scale-forming than corrosive. Commercial processes for the elimination of dissolved oxygen depend on two principles. In the de-oxidising method the hot water is brought into contact with thin sheets of specially prepared metal in a de-activating tank. The water exerts its corrosive activity on the cheap and easily replaced metal rather than on the piping system. In the de-aerating process the water is sprayed over baffles in a de-activator and the free dissolved gases are removed by heating, by vacuum, or by a combination of the two. The latter process removes nitrogen, carbon dioxide, etc., as well as oxygen. By the use of gas-free water the scoring of engines, turbines, etc. is prevented as a result of elimination of the "dirt" due to corrosion. It also increases condenser efficiency 20—25% by eliminating the air blanket round the tubes. The prevention of corrosion by the removal of dissolved oxygen applies to brass as well as to iron and steel. The plant used for these processes is illustrated by diagrams.—H. C. R.

Tellurium poisoning. Adolphi. *See* XIXb.

Patents.

Case-hardening iron and steel; Composition for —— and method of and apparatus for manufacturing such composition or the like. T. A. Goskar and H. B. Hitch. E.P. 182,527, 24.3.21.

Peat in a moist condition is reduced to a homogeneous mass by grinding or pugging and formed into granules, which are dried and carbonised. The peat may be pulped in a pug-mill or in a "Werner-Pfleiderer" mixer, and powdered leather, wood, or barium carbonate may be incorporated at this stage. A convenient method of granulating the plastic mass is to force it through a die-plate and cut off the extruded material in short lengths. —C. A. K.

Iron and steel; Method of producing ——. W. E. F. Bradley. U.S.P. 1,422,733, 11.7.22. Appl., 17.7.18.

A MIXTURE of finely powdered ore and flux is passed through a rotary drum furnace into an electric furnace and a current of a reducing gas is passed through the two furnaces in the opposite direction. —C. A. K.

Carbonising method [*for ferrous metals*]. W. Bonsor, Assr. to W. C. Steenburg. U.S.P. 1,422,530, 11.7.22. Appl., 6.3.22.

"HUMUS soil" containing less than 15% of moisture, and when dried, more than 30% of carbon, more than 3% of nitrogen, and not less than 4·4% of lime, is used as a carbonising agent for ferrous metals.—C. A. K.

Annealing malleable cast iron; Process of ——. C. T. Holcroft. U.S.P. 1,422,710, 11.7.22. Appl., 20.1.21.

THE metal is heated at a rate proportional to its thermal conductivity to a predetermined point of reaction, maintained at that temperature for a predetermined time, and then cooled to a point where sudden cooling will no longer injuriously affect it.—B. M. V.

[*Metal*] *tools and the like; Manufacture of very hard, but ductile* —— *adapted to resist mechanical stresses.* H. Lohmann. E.P. 157,769, 10.1.21. Conv., 7.12.18.

METAL, such as tungsten, titanium, molybdenum, chromium, or iron, is cast, then, in order to break up its coarsely crystalline structure, thoroughly worked by intensive rolling, hammering, forging, or pressing, until a fibrous structure is obtained; it is then case-hardened by any suitable method. —A. R. P.

Electric induction furnaces [*for melting and refining steel, etc.*]. O. Frick. E.P. 174,084, 14.1.22. Conv., 15.1.21.

THE effect of corrosion of the walls of the melting channel in electric induction furnaces having a ring-shaped hearth is reduced by inclining the inner side wall of the channel at a smaller angle to the horizontal than the angle of repose of magnesite, so that this repairing material can be applied to and sintered on corroded parts of the wall during working.—J. S. G. T.

Smelting furnace; Vertical ——. F. Fiechtl. U.S.P. 1,422,684, 11.7.22. Appl., 28.1.21.

VERTICAL retorts extend through a furnace chamber and are provided at both ends with removable covers, the lower covers being operated mechanically. Arrangements are made to introduce air under pressure into the furnace around the retorts. —C. A. K.

Magnetic separator. S. Percival. From L. B. Woodworth, S. T. Tregaskis, The Central Mining and Investment Corp. Ltd., and The Transvaal Consolidated Land and Exploration Co., Ltd. E.P. 182,539, 31.3.21.

IN a magnetic separator of the Wetherill type, having one or two pairs of poles, an auxiliary pole is provided attached to one of the main poles but, preferably, having its own energising coil and means for independent adjustment. Tapping devices are located between the sets of poles to cause rearrangement of the particles of ore before the latter passes between the next set of magnets. —A. R. P.

Tungsten alloys; Methods of manufacturing bodies of —— [*e.g., filaments for incandescence electric lamps, discharge tubes, etc.*]. British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 182,699, 19.7.21.

A TUNGSTEN body of desired shape, *e.g.*, filament, wire, sheet, etc., is heated to 1000°—1300° C. in a protective atmosphere and coated with the alloying metal, *e.g.*, iron, electrolytically or otherwise. Excess of electrolyte is removed and the composite body heated to at least 1600° C., whereby a homogeneous alloy is produced.—J. S. G. T.

Alloy for medical and dental purposes. Metallwerk M. Brose und Co. G.P. 352,028, 19.10.20.

AN alloy which is chemically resistant and is easily worked consists of 75 pts. of copper, 9 pts. of nickel, 10 pts. of silver, and 6 pts. of aluminium.—A. G.

Gases; Process of discharging smelter —— [*into the atmosphere*]. W. H. Howard, Assr. to American Smelting and Refining Co. U.S.P. 1,422,575, 11.7.22. Appl., 8.3.21.

FURNACE gases which are obnoxious or harmful to vegetation or animal life are discharged into a high chimney simultaneously with an unobjectionable gas having a temperature higher than that of the atmosphere. The second gas is added in such a manner that it mixes thoroughly with the obnoxious gases, and in such volume that the mixture formed readily diffuses into the atmosphere, whereby before the mixture comes in contact with the vegetation in the neighbourhood the objectionable properties are reduced owing to the extreme dilution of the obnoxious gases.—L. A. C.

Metallurgical process. W. E. F. Bradley. U.S.P. 1,422,734, 11.7.22. Appl., 4.9.18. Renewed 5.12.21.

IN a process in which ores are reduced by means of a hydrocarbon gas, a metallic oxide and free carbon are added to the molten reduced charge.—C. A. K.

Electrotinning [*; Electrolyte for* ——]. L. Schulte. U.S.P. 1,423,686, 25.7.22. Appl., 12.7.20.

DILUTE hydrofluoric acid is added to an aqueous solution of caustic potash until an acid reaction is obtained, the solution is further diluted and metallic tin dissolved in it with the aid of an electric current.—B. M. V.

Electroplating process. N. V. Park. U.S.P. 1,423,815, 25.7.22. Appl., 6.7.21.

BY means of a nozzle with openings of various diameters air currents of different pressures are directed downwards into an electrolytic cell provided with anode and cathode elements. The air currents agitate the electrolyte and effect a continuous washing of metal from the anode for transfer to the cathode.—H. H.

Iron and manganese oxides; Treatment of ores containing ——, *or sludges containing such ores.* O. Johl. G.P. 349,067, 10.7.20.

THE finely divided particles of iron and manganese oxides in sludges containing the same are caused to coagulate into large particles, capable of being easily separated, by the addition of salts of aliphatic or aromatic acid esters, such as salts of amyl- or ethyl-sulphonic acids, or of benzene-, naphthalene-, or terpene-sulphonic acids, with or without the addition of saturated or unsaturated fatty acids, fatty sulphonic acids, picric acid, sulphanilic acid, or the like, or salts of these acids. —L. A. C.

Metals; Separation of —— *from their solutions.* H. Bardt. G.P. 352,783, 22.1.20.

SOLUTIONS of metallic salts are treated with sub-

stances containing polysaccharides, especially sawdust, under pressure at a high temperature.
—A. B. S.

Metals; Process for precipitating —— from solutions. H. Bardt, Assr. to Soc. Hidro-Metalurgica. U.S.P. 1,423,070, 18.7.22. Appl., 17.9.21.

See G.P. 352,783 of 1920; preceding.

Reducing aluminium oxide. E.P. 182,609. *See* VII.

XI.—ELECTRO-CHEMISTRY.

Electrochemistry of non-aqueous solutions. I. Measurement of current density and potential difference in the electrolysis of metallic salts in pyridine. R. Müller. Monatsh., 1922, **43**, 67—74.

A form of electrolytic cell suitable for the measurements in question has been devised, and the preparation of an appropriate standard electrode investigated. The element, Ag/*N*/10 $AgNO_3$ in pyridine, has a potential (measured with reference to the calomel electrode) of +0·28 volt (hydrogen = 0), and the element, Ag/*N*/10 $AgNO_3$ in pyridine /NH_4NO_3 saturated solution in pyridine, has +0·26 volt (hydrogen = 0).—C. K. I.

Electrochemistry of non-aqueous solutions. II. Decomposition potential and electrode potentials of silver nitrate in pyridine and the potential of silver in these solutions. R. Müller and A. Duschek. Monatsh., 1922, **43**, 75—80. (*Cf. supra.*)

The decomposition potentials are: *N*/10, $AgNO_3$, 2·15 volts; *N*/1 $AgNO_3$, 2·05 volts; saturated $AgNO_3$ solution, 1·95 volts; and the silver potentials (invariant with current density) are: Ag/*N*/10 $AgNO_3$, +0·24 volt; Ag/*N*/1 $AgNO_3$, +0·33 volt; Ag/saturated $AgNO_3$ solution, +0·33 volt (hydrogen = 0). The anodic potential differences are functions of the current density.—C. K. I.

Electrolytic dissociation; Relation between adsorption and ——. M. A. Rakusin. Biochem. Zeits., 1922, **130**, 282—285.

When a porous pot is immersed in solutions of sucrose or common salt, the concentration of the solution increases owing to adsorption of water (so-called negative adsorption). The author ascribes this to the adsorption of colloids and the non-adsorption of electrolytes.—H. K.

Electrolysis of sodium silicate solutions. Spencer and Proud. *See* VII.

Actinometer. Athanasiu. *See* XXI.

Patents.

Storage batteries; [Electrolyte for] dry ——. W. Gardiner. E.P. 182,865, 15.3.21.

A mixture of powdered glass with five parts of an acid solution, *e.g.*, sulphuric acid, and one part of a soluble silicate, *e.g.*, sodium silicate, is poured into the battery and allowed to set. Alternatively, the mixture may be allowed to set prior to being introduced into the battery, and is then added in powdered form, and liquid electrolyte added to fill up interstices. A layer of absorbent paper, *e.g.*, Swedish filter paper, is placed on top of the electrolyte and is covered with a perforated rubber plate.
—J. S. G. T.

Insulating and resistant articles and products thereof; Method of manufacturing ——. F. T. Lahey. U.S.P. 1,422,720, 11.7.22. Appl., 11.3.21.

Vegetable fibre is treated with a dilute alkali solution, a vulcanisable oil, and rubber at a temperature such that the fibrous structure is not destroyed. A vulcanising agent is added, and the mixture heated so that oil is precipitated within the structure of the fibre and the material is vulcanised.—J. S. G. T.

Solutions; Electrolysis of —— and apparatus therefor. Hooker Electrochemical Co., Assees. of A. H. Hooker. E.P. 167,469, 22.7.21. Conv., 5.8.20.

See U.S.P. 1,388,466 of 1921; J., 1921, 740 A.

Electrodes; Process for manufacturing ——. H. Bardt, Assr. to Soc. Hidro-Metalurgica. U.S.P. 1,423,071, 18.7.22. Appl., 17.9.21.

See G.P. 325,154 of 1919; J., 1920, 824 A.

Reducing aluminium oxide. E.P. 182,609. *See* VII.

Electric furnace. E.P. 174,084. *See* X.

Saccharin. E.P. 174,913. *See* XX.

Betaine etc. G.P. 348,380—1. *See* XX.

XII.—FATS; OILS; WAXES.

Olive oil; Extraction of —— from olives. H. Mastbaum. Chem.-Zeit., 1922, **46**, 669—672.

Current methods of oil-pressing in Spain are described. They are for the most part very crude and the oil is the only part of the olives which is utilised. As a result of considerable experimental work, J. M. Luque (Primer Congreso Nacional de Ingenieria (Madrid), 1919, Tomo III., p. 21) has suggested the following improvements in the industry. The olive pressing should be concentrated in large factories. The olives should be ground when fully ripe, but as fresh as possible. The kernels should be broken but not pulverised. Rolls would be more suitable for this purpose than the edge-runners used at present. The mixing of the olease of the seed with the oil would thus be reduced and the shells of the kernels would be left in the form of fragments of sufficient size to permit of easy separation from the pulp. Only one pressing is advocated, and that cold. The pulp should be dried and extracted with a solvent as soon as possible. If storage of the pulp is necessary, sulphur dioxide may be used as a preservative. The extracted oil will then be low in free fatty acids and easy to refine, and an edible oil can be obtained from it. The stearine separated from it can be used for soap-making. The extracted pulp should be dried and freed from the shells of the kernels. The aqueous fluid is concentrated, and may be mixed with the dry pulp and other ground vegetable matter to form feeding stuffs, or it may be treated for the recovery of potash by calcination, or used as a binding material for making briquettes. The shells of the kernels give a better yield of tar, wood spirit, and acetic acid than the best hard woods. The high potassium content of all parts of the olive tree points to the need for a large application of potash fertilisers in its cultivation.
—H. C. R.

Arachis oil; Chemical constitution of ——. A. Heiduschka and S. Felser. Z. Unters. Nahr. Genussm., 1922, **43**, 381—382.

The differences in the proportions of the various fatty acids contained in two samples of arachis oil of Spanish and Virginian origin respectively, examined by Jamieson and his collaborators (J., 1921, 740 A) are as great as the corresponding differences between either of them and the commercial oil examined by the authors (J., 1920, 272 A). Considerable differences occur in the per-

centages of saturated and unsaturated acids and also in the percentage of linolic acid in the latter fraction. The constitution of the saturated acids seems, however, to be fairly constant.
—H. O. R.

Fats (glycerides); Synthesis of ——. C. Amberger and K. Bromig. Biochem. Zeits., 1922, **130**, 252—266.

The use of high temperatures is inadmissible for the preparation of mixed glycerides of known constitution. The authors have applied Fischer's methods (J., 1920, 790 a). α-Stearo-βγ-dipalmitin, m.p. 63·5° C., occurs in goose fat and was prepared from α-monostearin and palmitic acid chloride. β-Stearo-αγ-dipalmitin, m.p. 59·1° C., was prepared from αγ-dipalmitin, m.p. 69·5° C. The latter was prepared from βγ-dipalmitin-α-iodohydrin, m.p. 46·2° C. by the action of silver nitrite. α-Palmito-βγ-distearin, m.p. 63·2° C., was prepared from α-monopalmitin and stearyl chloride. The isomeride, β-palmito-αγ-distearin, m.p. 67·9° C., was prepared from αγ-distearin. α-Palmito-βγ-diolein, prepared from α-palmitin and oleic acid chloride, was an oil. From α-olein, a pale yellow oil, α-oleo-βγ-distearin, m.p. 42° C., was prepared.—H. K.

Lipase; Influence of various antiseptics on the activity of ——. L. S. Palmer. J. Amer. Chem. Soc., 1922, **44**, 1527—1538.

Data are presented on the influence of various concentrations of several antiseptics on the hydrolysis of emulsions of milk fat in gum acacia solutions, using commercial steapsin as the source of lipase. Formaldehyde up to concentrations of 1 pt. in 250 had no detrimental effect on the activity of the lipase, 1% solutions being required to produce a retardation of the enzyme action. Chloroform in concentrations from 1·5 to 2·5% retarded the lipase activity 20—60%. Acetone in concentrations of 6% and 12% retarded the lipolysis 12—25%. A freshly prepared 3% solution of iodoform in acetone added so as to give a concentration of 0·3% retarded the lipase activity 25—40%. When using a similar solution of iodoform which had stood for some time, practically complete inhibition was obtained with this and even smaller concentrations of iodoform. Iodoform alone retarded lipolysis in direct proportion to the concentration of the antiseptic present, the effect varying from a 15% retardation with 0·03% concentration of iodoform to a 55% retardation with 0·5% concentration of antiseptic. Old solutions of iodoform in acetone contain free iodine, which has a marked effect on lipase activity. Iodine in concentrations of 0·045% or more inhibited lipolysis entirely. Results similar to those with iodine were obtained by the use of bromine water. Higher concentrations of bromine were found necessary to inhibit the lipase completely, however, a concentration of 0·25% retarding the enzyme activity only 93—94%. Mercuric chloride inhibited lipase activity completely in 0·1, 0·2 and 0·3% concentration. Chloral hydrate not only retarded the lipase action, but also failed as a germicide when using cow's milk as substrate. (*Cf.* J.C.S., Sept.)—H. W.

Catalytic addition of hydrogen. Influence of oxygen on the catalyst. W. Normann. Ber., 1922, **55**, 2193—2197.

Working under conditions which are considered to exclude the presence of oxygen and with hydrogen which is free from any trace of the latter, the hardening of cottonseed oil has been effected in the presence of reduced nickel (from the cyanide or chloride), nickel powder, or palladised kieselguhr. It appears therefore that Willstätter's assumption of the necessity for the presence of oxygen is unjustified.—H. W.

Acid value of fatty acids and fats; Electrometric determination of the ——. R. Kremann and F. Schöpfer. Seife, 1922, **7**, 612—614, 656—659. Chem. Zentr., 1922, **93**, II., 1246—1247, IV., 72—73. (*Cf.* J., 1921, 896 a.)

The electrometric titration of fats and fatty acids in alcoholic solution is possible, but in the case of palmitic acid the titration curve is not of a form agreeing with theoretical considerations, and in the titration of caprylic and capric acids it is impossible to obtain a titration curve owing to the contamination of the platinum electrode surfaces with precipitated soap. Mechanical cleaning of the electrodes appears to be impossible owing to the damage to the platinised surfaces caused thereby. The platinised hydrogen electrodes were therefore replaced by smooth ones, which were arranged half in air and half in the liquid to be titrated, and by this means it was possible to titrate fatty acids. The liquid was titrated with $N/10$ alcoholic alkali at room temperature. The results were as satisfactory as those obtained using phenolphthalein as indicator or by conductivity measurements, and the method has a greater range of application than the latter method. The use of $N/10$ aqueous solutions for the electrometric titration is preferable to that of alcoholic solutions in special cases, such as that of sunflower seed oil, and is useful as a secondary method in cases where with the use of alcoholic solutions the bend in the potential-volume curve is not sufficiently well marked. Titrations with $N/2$ aqueous solutions are not to be recommended in consequence of the more marked disturbance due to the separation of soap, which interferes with the equilibrium of the solution. The chief condition for obtaining satisfactory potential curves is to wait for a steady potential to be reached after each addition of alkali. Disturbances due to the separation of soap on the electrode can be overcome by scraping the smooth electrodes.—H. C. R.

Θι-Decylenic acid; Synthesis of ——. A. Grün and T. Wirth. Ber., 1922, **55**, 2206—2218.

Ethyl undecylenate is reduced by sodium and ethyl alcohol to undecenol, $CH_2:CH.[CH_2]_8.CH_2OH$, b.p. 250° C. at atmospheric pressure, 122° C. at 3 mm., m.p. $-7°$ C., which is converted by chlorosulphonic acid in dry ethereal solution into undecenyl hydrogen sulphate. The ester (or the corresponding acetate) is oxidised by chromic acid or preferably by permanganate to ι-hydroxycapric acid, $CH_2(OH).[CH_2]_8.CO_2H$, m.p. 75° C. The methyl ester of the latter is converted by stearyl chloride into methyl-stearoxycaprate, m.p. 43° C., which decomposes readily when distilled under atmospheric pressure into stearic acid and methyl Θι-decylenate; the latter is hydrolysed to Θι-decylenic acid, b.p. 143° C. at 6 mm., identical with the acid obtained from butter fat (see page 680 a). Alternatively, ι-hydroxycapric acid is prepared by the reduction of potassium ethyl sebacat in ethyl alcoholic suspension by sodium. Th iodine and acid values of Θι-decylenic acid sinl gradually when the substance is preserved, prob ably owing to the formation of a lactone. Deca lactone, b.p. 153° C. at 15 mm., prepared by th action of sulphuric acid (80%) on the acid at 90° C is saturated and neutral; it is converted by hydro lysis into a hydroxy acid, m.p. 44° C. The com pounds are regarded provisionally as γ-decalacton and γ-hydroxydecoic acid. (*Cf.* J.C.S., Sept.)
—H. W.

Θι-Decylenic acid. Grün and Wirth. *See* XIXa

Sodium chaulmoograte. Gardner. *See* XX.

Patents.

Decolorising power of silicates for fatty and mineral oils, etc.; Process for increasing the ——. Pfirschinger Mineralwerke Gebr. Wildhagen und Falk. G.P. 339,919, 21.11.19.

Natural silicates, such as clay and kaolin, are decomposed, for example, with hydrochloric acid of the required concentration, so that they are wholly or partially converted into hydrated silicic acid. —H. C. R.

Sulphonic acids from petroleum; Purification of ——. Oelwerke Stern-Sonneborn A.-G. G.P. 350,299, 26.2.15.

The crude acids, separated from their salts, are washed with dilute mineral acids, *e.g.*, with 40—50% sulphuric acid at about 60° C. The practically ash-free sulphonic acids thus obtained are specially suitable for the hydrolysis of fats; products containing salts of the acids hydrolyse fats only incompletely and slowly, and the ash content of the glycerol produced is undesirably high.—A. G.

Oils and fats; Process for retarding occurrence of rancidity in ——. Gebr. Schubert Chem. Fabr. G.P. 351,566, 4.1.19.

Silica or silicates are added to the oil or fat, and if necessary it is treated with an indifferent gas, *e.g.*, nitrogen.—A. G.

Catalyst; Production of a —— for the hydrogenation of unsaturated organic compounds. C. und G. Müller, Speisefettfabr. A.-G. G.P. 352,431, 27.3.18.

Nickel salts of boric acid are precipitated on an inert base, *e.g.*, kieselguhr, and are then heated in hydrogen. The catalyst is insensitive to the action of air.—A. G.

Alcohols; Process for the production of wax-like —— from wool-fat. W. Schrauth. G.P. 353,048, 26.9.15.

Wool-fat is hydrogenated, the product is saponified, and the soap is treated with an extraction medium, insoluble in water, *e.g.*, carbon tetrachloride, benzene, benzine, etc.—A. G.

Catalysts for hydrogenation. G.P. 352,439. *See* XX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Scammony resin. Deane and Edmonton. *See* XX.

Patents.

Lead chromate pigments; Manufacture of ——. H. Hetherington and W. A. Allsebrook. E.P. 182,693, 13.7.21.

Lead sulphate paste, *e.g.*, 606 pts. by weight of freshly precipitated, well-washed 50% paste, is agitated and a solution of a normal alkali or ammonium chromate, *e.g.*, a 10% solution of sodium chromate, is slowly added to the mass at such a rate that a clear liquor is obtained before any further addition of the solution is made. If 1 mol. of sodium chromate is added per mol. of lead sulphate a deep yellow pigment is obtained, and by reducing the quantity of sodium chromate a paler product of any desired shade can be produced. The product is washed until free from sodium sulphate, and is then pressed and dried.—L. A. C.

Resins and oil-soluble dyestuffs; Manufacture of novel ——. H. Plauson and J. A. Vielle. E.P. 182,497, 7.1.21.

Coloured, oil-soluble "azo resins" are prepared by incorporating a diazo compound with a phenol-formaldehyde or ketone-formaldehyde condensation product, preferably before condensation is complete. For example, 94 pts. of phenol is melted with 7½ pts. of hexamethylenetetramine, and 15 pts. of diazotised *p*-nitraniline is added to the product, with agitation. On cooling, a solid metallic-green or orange coloured azo resin is obtained, which dissolves in oils and fats to form an orange-coloured solution.—L. A. C.

Vapours and gases formed by heating fatty oils, gums, resins and other organic materials; Processes and apparatus for treating the ——. P. W. Webster. E.P. 182,869, 30.3.21.

Air is admitted in regulated quantity to the vessel containing the material during the production of the fumes, and the fumes evolved are collected by surface condensation, scrubbing with water, and treating the uncondensed fumes with an alkaline solution. The apparatus comprises a receptacle having a means for controlling the amount of air admitted, to which is connected a fume condenser, a water scrubbing device, and a chemical treatment apparatus, connected together in series, together with a means for positively passing fumes through the apparatus. The receptacle can be quickly and easily disconnected from the fume-collecting apparatus by removing the lid, which is connected with the fume-collecting apparatus by a flue having a telescopic and a swivel joint. To prevent flame passing through the apparatus a container having fine mesh screens in it is provided.—H. C. R.

Condensation products from phenol and formaldehyde; Process for the manufacture of insoluble ——. F. B. Dehn. From S. Satow. E.P. 182,886, 6.4.21.

Products which can be manufactured without the use of high pressure, and possessing properties which render them capable of being turned, sawn, and polished, are prepared by the addition of organic compounds containing the CH_2OH or CHOH group, for instance, hydroxy-fatty acids such as glycollic acid, lactic acid, and malic acid, or alcohols such as glycerin, butyl alcohol, and cholesterol, or hexoses and the like, to the oily product obtained by reaction between equimolecular weights of phenol and formaldehyde. The products may be heated for several hours at 90°—130° C., or may be diluted with alcohol, acetone or the like, and the solutions used for impregnating paper or other porous material. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 27,096 of 1908, 129,993, and 148,264; J., 1909, 843.)—L. A. C.

Condensation product from naphthalene and glycollic acid; Method for the production of a ——. Elektrochem. Werke G.m.b.H., H. Bosshard, and D. Strauss. E.P. 171,956, 10.1.21. Conv., 4.7.19.

A mixture of 129 pts. of naphthalene, 40 pts. of glycollic acid (or 30 pts. of glycolide), and 10 pts. of phosphorus pentoxide, is heated under pressure for about 15 hrs. at 130°—170° C. with agitation. Carbon dioxide is allowed to escape from the apparatus from time to time. The product, after separation of unchanged naphthalene by steam distillation, is a yellow resin resembling shellac and fusing at 80°—85° C.—L. A. C.

Resin; Polyglycerol ——. L. Weisberg and R. S. Potter, Assrs. to The Barrett Co. U.S.P. 1,424,137, 25.7.22. Appl., 19.2.21.

A mixture of a polyglycerol and a polybasic aromatic acid is heated until a water-resisting product is obtained.—L. A. C.

Paint. A. C. Holzapfel. U.S.P. 1,422,711, 11.7.22. Appl., 2.3.22.

Paints containing residual pitch derived from oils and fats are deodorised by addition of 1—5% of acetone.—B. M. V.

Invisible ink. C. F. Morse, Assr. to The Invisible Process Co. U.S.P. 1,423,246, 18.7.22. Appl., 14.11.21.

An invisible ink is composed of a solution containing basic ferric sulphate, mixed with 25—75% of its weight of phosphoric acid.—L. A. C.

Resins, especially artificial resins; Solvents for ——. W. Schrauth. G.P. 351,688, 25.3.19. Addn. to 349,905 (J., 1922, 425 A).

Cyclohexanol esters and homologues of the same, either alone or mixed with other solvents, are used as solvents for resins instead of cyclohexanol as described in the chief patent.—L. A. C.

Wood; Process for facilitating the cleavage of ——, particularly for lead pencil manufacture. E. Beutel and K. Suchy. G.P. 349,813, 20.3.19. Conv., 1.3.19.

The wood is treated with alkalis or mineral acids, and if necessary with the addition of compounds easily dissociated, *e.g.*, ammonium compounds, in a pressure vessel at a temperature of about 200° C. Ammonium salts may also be used alone. The treated wood is subjected to the usual paraffin bath, using oils boiling above 200° C., such as paraffin, linseed oil, stearic acid, etc., dyestuffs soluble in the oil being added as required.—A. G.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Patents.

Latex; Products obtained from rubber-containing ——. E. Hopkinson. E.P. 157,975, 11.1.21. Conv., 16.1.20.

Rubber products in increased yield and having a tensile strength about 20% higher than those obtained by the usual methods, are obtained by agitating rubber-containing latex with a preservative material to prevent coagulation, and delivering the mixture through an atomiser into a chamber in which it is dried by contact with a stream of air or other gases heated to about 200° F. (93° C.). Coagulation is prevented by the addition of 0·1% of ammonia if the latex is treated alone, or by the addition of 0·1% of saponin, or other substances, such as glue or glycerin, if vulcanising agents or compounding ingredients are mixed with the latex before treatment. The dried product is deposited by passing the gases carrying it through a winding channel and spiral collectors, and the spongy product obtained thereby is formed into a compact mass by compression in a hydraulic press or between rollers.—L. A. C.

Sponge rubber; Manufacture of ——. A. J. Ostberg and A. Kenny, Assrs. to The Standard Rubber Works Proprietary, Ltd. U.S.P. 1,422,884, 18.7.22. Appl., 18.8.20.

See E.P. 172,398 of 1920; J., 1922, 67 A.

Insulating products. U.S.P. 1,422,720. *See* XI.

XV.—LEATHER; BONE; HORN; GLUE.

Patents.

Skins and hides; Mixture for depilating ——. W. Ulke. G.P. 348,413, 31.12.20.

Dextrin is added to a depilating mixture containing alkali or alkaline-earth sulphides and covering material, a suitable mixture containing, *e.g.*, strontium sulphide, maize starch powder, talc, dextrin, essential oils, and "nerolin." The dextrin protects the skin and hair papillæ from the action of the sulphide, and also prevents liberation of hydrogen sulphide.—L. A. C.

Millboard. E.P. 182,884. *See* V.

XVI.—SOILS; FERTILISERS.

Plant indicators of soil types. A. P. Kelley. Soil Sci., 1922, 13, 411—424.

The acidity of a number of soils was determined by colorimetric methods and the characteristic flora examined, with a view to correlate particular plants with definite ranges of soil acidity. A number of plants were found to be indicative of definite degrees of acidity. The acidity of any soil type is influenced by such factors as arrested leaf decay, physiographical features and degree of slope, elevation, and season. Variation in some species of plants may be induced by changes in soil acidity. The carbon dioxide in the soil solutions did not affect p_H values determined by the colorimetric method.—A. G. P.

Acid soil studies. III. Influence of calcium carbonate, calcium oxide, and calcium sulphate on the soluble soil nutrients of acid soils. R. H. Robinson and D. E. Bullis. Soil Sci., 1922, 13, 449—460.

Five acid soils were treated with varying quantities of the carbonate, oxide, and sulphate of calcium, and stored with a maintained optimum water content. Periodical analyses were made of the soluble salts obtained by a 1:5 water extraction. The amounts of calcium added were sufficient to satisfy the lime-requirement determined by the Veitch method. In field trials the soils showed widely different results on treatment with limestone. The chief difference brought out by analysis of the water extracts of the limed soils, was the rapid production of nitrates in those soils which had responded to lime in the field. The content of water-soluble phosphates and sulphates was not appreciably altered by any of the treatments. The soluble potash and magnesium in all soils was increased by treatment with calcium sulphate. In pot experiments, addition of monocalcium phosphate, with or without lime, increased the nitrate production of those soils which did not respond to lime alone; but field trials did not confirm this. —A. G. P.

Soil acidity; Effects of lime, leaching, form of phosphate and nitrogen salt on plant and —— and the relation of these to the feeding power of the plant. F. C. Bauer and A. R. C. Haas. Soil Sci., 1922, 13, 461—480.

The actual acidity of plant juices usually varied with that of the nutrient medium and was in most cases closely related to the growth and feeding power of the plant. Liming reduced, and leaching increased the acidity of both nutrient medium and plant juices. Acid phosphate (superphosphate) increased the acidity more than rock phosphates. Increased soil acidity improved the availability of rock phosphates. Ammonium nitrate produced greater acidity in the soil and juices of maize tops than did sodium nitrate. (*Cf.* J.C.S., Sept.) —A. G. P.

Soils; Further studies on the soluble salt content of field ——. C. E. Millar. Soil Sci., 1922, 13, 433—448.

The soluble salt content of a number of soils was determined at various depths and seasons by the freezing point method. In uncropped soils the soluble salt content of the top 6 in. was low in early spring and late autumn, but rose during the summer. In samples from depths of 6—12 ins. the salt content was low and showed no tendency to reach a maximum in summer. Soluble salts tended to accumulate in the surface ¼ in. of uncropped soils, particularly in dry seasons, but the growth of plants to a large extent prevented this, and also influenced the amount of soluble salts in the samples from a depth of ¼—6 ins. Rainfall is an important factor in the distribution of soluble salts in soils. The hoeing in of organic matter did not affect the rate of solution of virgin soils.—A. G. P.

Azoification in soil; Influence of salts on ——. J. E. Greaves, E. G. Carter, and Y. Lund. Soil Sci., 1922, 13, 481—499.

The effects of salts of sodium, potassium, calcium, magnesium, manganese, and iron on nitrogen fixation in soils are recorded. The toxicity of the individual salts is specific and is not governed by the negative ion. The salts examined have a less toxic action on nitrogen-fixing bacteria than on ammonifying or nitrifying bacteria. (*Cf.* J.C.S., Sept.)—A. G. P.

Displaceable potash in soils; Significance of —— *in plant nutrition.* A. von Nostitz. J. Landw., 1922, 70, 45—72.

Soils, packed in tubes, were leached with 5% ammonium nitrate solution and the extracts examined for other bases. Calcium, magnesium, potassium, and sodium appeared in considerable quantities, and the rate of extraction by successive amounts of ammonium nitrate solution was in the order named. In no case could the total amount of a base present in the soil be removed by this process. A similar basic exchange was shown to occur with mica and felspar. Comparison was made in pot experiments between plants grown in the original soil and in that leached with ammonium nitrate solution, to which was added respectively the amounts of calcium and magnesium, or of calcium, magnesium, and potassium removed by the leaching. Suitable adjustments were made for the increased nitrogen-content of the leached soil. Plants grown in the leached soil with addition of calcium, magnesium, and potassium were only slightly inferior to those in the original soil, but those grown in leached soil with addition of only calcium and magnesium showed every sign of potash-starvation. A second crop on the same soils gave similar results. The germination of seeds in the soil lacking potash was slow and the growth of plants poor from the first. Sand cultures showed that germination of seeds increased with the proportion of potash in the culture solution, as also did the rate of growth of the seedlings, but the optimum potash content depended on the amounts of calcium and magnesium present. In estimating the fertiliser requirements of soils the amount of potash which can be liberated by a process of base-interchange should be taken into consideration.
—A. G. P.

Manganese in plants; Rôle of ——. J. S. McHargue. J. Amer. Chem. Soc., 1922, 44, 1592—1598.

Radish, Alaska garden pea, Canada field pea, cowpeas, lettuce, tomatoes, spinach, carrots, onions, garden beans, cabbage, wheat, oats, clover, and velvet beans when grown in a medium which contained no manganese made a normal growth for 6—8 weeks, but thereafter developed a chlorotic condition and failed to make further growth of any consequence. The normal condition of the plants during the first few weeks of growth is accounted for by assuming that the manganese which the seed contains is sufficient to maintain a normal metabolic process during this part of the plant's growth and that the chlorotic condition is a result of the lack of a further supply of available manganese. Non-leguminous plants appear to be less sensitive than legumes to lack of manganese, thus suggesting that manganese is concerned in nitrogen assimilation and the synthesis of proteins. Apparently manganese plays the rôle of a necessary catalyst in plant metabolism and together with iron functions in the synthesis of chlorophyll.
—H. W.

Superphosphates; Analysis of ——. C. Tibaldi. Giorn. Chim. Ind. Appl., 1922, 4, 303.

The official (Italian) method of estimating the proportion of phosphoric anhydride soluble in water and in ammonium citrate solution may be shortened by omitting the digestion with water. Five grams of the material is ground three times with water, in a basin, transferred to a 500 c.c. flask, digested for 1 hr. with 100 c.c. of ammonium citrate solution at 45°—50° C., and made up to volume, 100 c.c. being taken for the precipitation in the ordinary way.—T. H. P.

Calcium in natural phosphates. Meurice. *See* VII.

Potash. Hazen. *See* XXIII.

Patents.

Manure; Method of extracting fertiliser elements from ——. C. E. Gardan. U.S.P. 1,422,434, 11.7.22. Appl., 1.6.22.

Manure, in aqueous suspension, is heated and then submitted to pressure.—A. G. P.

Lime-sulphur compositions. U.S.P. 1,422,977 and 1,423,605. *See* XIXb.

XVII.—SUGARS; STARCHES; GUMS.

Acetol. I. A new test for carbohydrates. O. Baudisch and H. J. Deuel. J. Amer. Chem. Soc., 1922, 44, 1585—1587.

The test depends on the production of acetol from carbohydrates. An aqueous solution of the carbohydrate (0·1 g. in 100 c.c.) is treated with solid sodium bicarbonate (5 g.), and distilled nearly to dryness. With the carbohydrates which are more readily attacked, the solution in the distilling flask very quickly turns brown and the distillate has a sweet odour. The residue in the flask, after distillation, has a strong typical caramel odour. The distillate is treated with *o*-aminobenzaldehyde (30 mg.) and enough potassium hydroxide solution to give a decidedly alkaline reaction; after addition of a piece of porous plate, it is evaporated over a free flame to ⅓ of its volume, cooled, and acidified with hydrochloric acid. Solid sodium bicarbonate is added till the solution is alkaline to litmus. The presence of acetol is shown by a strong bluish fluorescence which can be seen in daylight but more readily in light of short wave length such as that yielded by the iron arc. To confirm the test, the 3-hydroxyquinaldine is extracted by shaking the solution several times with ether free from alcohol; the extract is dried over sodium sulphate and the solvent is removed. The colourless, needle-like crystals of 3-hydroxyquinaldine which remain dissolve readily in a little alcohol, and the fluorescence shows up strongly after addition of water to the alcoholic solution. The sensitiveness of the reaction has not been determined except for dextrose, with which quantities as small as 5 mg. give a positive result. The test is shown by arabinose, xylose, ribose, lyxose, dextrose, lævulose, mannose, galactose, glucosamine, lactose, sucrose, maltose, and dextrin, but not by acetoacetic acid, glycerol, β-hydroxybutyric acid, lactic acid, starch, or glycogen. The formation of 3-hydroxyquinaldine on treatment with o-aminobenzaldehyde and potassium hydroxide appears to be a specific reaction of acetol; it is not given by pure methylglyoxal, aldol, acetone, acetaldehyde, ethyl acetoacetate, crotonaldehyde, or ethyl alcohol.—H. W.

Xylan; Methyl ethers of ——. E. Heuser and W. Ruppel. Ber., 1922, 55, 2084—2088.

Although xylan is very readily soluble in solutions of alkali hydroxides it cannot be converted by methyl sulphate in these media into methylated products containing more than 1—1·5 methoxy groups for each $C_5H_8O_4$ complex. The products thus obtained are freely soluble in cold water, but the solutions become turbid when they are heated owing to the separation of methyloxylan. Better results are obtained with methyl iodide and silver oxide. Xylan, pre-methylated with sodium hydroxide and methyl sulphate, is almost completely methylated by these reagents boiling under slightly increased pressure and is completely converted into dimethylxylan, softening at 65°—70° C., when similarly heated under pressure at 100° C.—H. W.

Wheat starch. Wallis. *See* XIXa.

Patents.

Grape sugar; Manufacture of ——. P. W. Allen, Assr. to Penick and Ford, Ltd. U.S.P. 1,422,328, 11.7.22. Appl., 17.2.19.

In the preparation of glucose from starch, the sugar liquor, freed from protein impurities, is heated to about 145° F. (63° C.) at a density of 42° B. (sp. gr. 1·41), and subjected to a beating operation in the air, thus giving the mass a frothy porous consistency, and is then allowed to stand until crystallised.—A. G. P.

Fermentable sugar from wood. G.P. 351,681 and 352,773. *See* XVIII.

XVIII.—FERMENTATION INDUSTRIES.

Yeast cells; Action of saponin-substances on ——. F. Boas. Ber. Deuts. Bot. Ges., 1922, 40, 32—38. Chem. Zentr., 1922, 93, III., 64.

There is a great similarity between the action of saponins on blood corpuscles and that on yeast cells. Digitonin and smilacin are very active, and guaiacum saponin very inactive toward blood corpuscles in the Kobert test. Digitonin and smilacin inhibit fermentation by yeast, whereas other saponins examined accelerate fermentation, in solutions containing little or no dissolved salts, by increasing the permeability of the cell without injury. —A. G. P.

Yeast; Action of mercuric chloride, phenol, and quinine on ——. G. Joachimoglu. Biochem. Zeits., 1922, 130, 239—248.

From measurements of the loss of weight due to carbon dioxide evolved, it is found that the growth of yeast is inhibited by mercuric chloride over the range of dilutions, 1 in 66,000 to 1 in 1,200,000; by quinine hydrochloride between 1 in 360 and 1 in 675, but not at higher dilutions; by phenol at 1 in 1000, but not at 1 in 10,000. The so-called Arndt-Schulz law, that small quantities of a poison act in an opposite sense to large quantities is invalid.—H. K.

Lactic fermentation; Action of acids on the course of ——. E. Bachrach and H. Cardot. Comptes rend. Soc. Biol., 1922, 86, 583—586. Chem. Zentr., 1922, 93, I., 1414.

Initial acidification of the substrate only affects the rate of propagation of the bacillus during the first hour of the fermentation. Initial acidity, produced by hydrochloric, nitric, sulphuric, and acetic acids, had no effect on the amount of acid produced by fermentation. Phosphoric acid alone had an unfavourable effect on fermentation.—A. G. P.

Aspergillus niger; Utilisation of the ternary substances in the growth of ——. E. F. Terroine and R. Wurmser. Comptes rend., 1922, 175, 228—230.

The ratio of the dry weight of the mycelium formed to the weight of the nutrient which disappeared during its growth, was determined under various conditions. The results indicate that the fungus exhibits complete indifference towards the composition or structure of the various sugars (dextrose, lævulose, sucrose, maltose, arabinose, and xylose) used as sources of carbon, development proceeding at about the same rate in all cases. The concentration of the nitrogenous nutrient material had likewise no influence on the ratio of utilisation. The nature of the source of nitrogen had a distinct influence, and two well-defined groups were found, the first, comprising ammonium sulphate, guanidine, urea, ammonium nitrate, and nitric acid, giving a ratio of about 0·42, and the second group, comprising sodium and aluminium nitrates, giving a lower ratio of 0·34—0·35. The energy of synthesis, *i.e.*, the energy required for the development of the mycelium, does not depend on either the composition or structure of the sugar, but it is greater when the nitrogen is presented as nitrates than when ammoniacal nitrogen, urea or nitric acid is the starting point.—G. F. M.

Spent washes from saccharified wood; Detection of unfermented sugar in ——. H. Pringsheim. Cellulosechem., 1922, 3, 77—78.

The presence of unfermented hexoses in the spent washes obtained by the fermentation of liquors from saccharified wood is detected by the difference in solubility of glucosazone and pentosazone in hot water. 25 c.c. of the spent wash is neutralised, faintly acidified with acetic acid, treated with 2 c.c. of 50% acetic acid and then with a 2% solution of potassium permanganate, added slowly from a burette until the supernatant liquid is practically colourless. Two portions of 75 c.c. of the spent wash are then treated exactly alike; they are neutralised, slightly acidified, and treated slowly with the previously ascertained quantity of permanganate in the presence of 3·4 c.c. of 50% acetic acid for every 50 c.c. of permanganate used. After standing all night the manganese dioxide is collected on a small layer of kieselguhr spread on paper on a Buchner funnel, and washed. The filtrates are united and concentrated *in vacuo* at 50° C. to a volume of 50—25 c.c. according to the quantity of sugar. Ten c.c. of this solution is made alkaline with sodium carbonate, filtered, very slightly acidified with acetic acid, and heated in a boiling water-bath with 0·2 g. of phenylhydrazine hydrochloride and 0·3 g. of sodium acetate for half an hour. The absence of dextrose is indicated by the absence of a precipitate in the hot liquid. If the result is doubtful, the liquid is cooled, the osazones are allowed to separate out, and their solubility is again tested by heating. All the pentosazone is re-dissolved but the glucosazone, once precipitated, does not go into solution on heating. The limit of sensitiveness is 0·032% of dextrose in the wort.—J. F. B.

Lipase. Palmer. *See* XII.

Patents.

Distilling alcoholic and other liquids; Process of ——. H. Wade. From J. Schneible. E.P. 182,832, 13.1.21.

The liquid is distilled in a column still, comprising a heater surmounted by cooled and uncooled dephlegmating plates, the heat supply to the heater being controlled to produce a constant temperature in the column above the heater and the supply of cooling medium to the cooled plates being controlled to produce a constant temperature at a fixed point in the column, whereby a uniform temperature gradient through the column is produced. The design of the plates is such as to maintain the interior of the still free from accumulations of reflux liquid, and baffles are introduced to impart a whirling or spiral movement to the mixed vapours and condensed liquid within the column. The fresh liquid is preheated and fed into the column at a point where the temperature and composition of the condensed liquid in the still is substantially the same as that of the preheated fresh liquid. The liquid is withdrawn from the still substantially at its boiling point.—H. C. R.

Sugar; Production of —— from wood and other material containing cellulose. Production of readily fermentable sugar solutions from material containing cellulose. A. Classen. G.P. (a) 351,681, 24.5.17, (b) 352,773, 23.3.18.

(a) The yield of fermentable sugar obtained from wood or other material containing cellulose by heating with sufficient hydrochloric acid or sulphuric acid to decompose the cellulose is increased by the addition of a small quantity of a catalyst consisting of another acid, or mixture of acids, or acid salts. Thus, if sulphuric acid or hydrochloric acid is used for decomposing the material, small quantities of hydrochloric acid and/or sulphur dioxide, or sulphuric acid and/or sulphur dioxide, respectively, are also added to the charge. (b) Wood or other material containing cellulose is heated with acids under pressure, steam being admitted into the apparatus until conversion begins, *i.e.*, at 130°—140° C., corresponding to a pressure of 3 atm., after which the supply of steam is regulated so that the pressure rises to about 7 atm. in 20—50 mins., this pressure then being maintained for a short time. A good yield of fermentable sugar is obtained by this procedure.—L. A. C.

XIXa.—FOODS.

Wheat starch; Some characteristics of ——. T. E. Wallis. Brit. Pharm. Conf., July. Pharm. J., 1922, **109**, 82—83.

Wheat starch can be quite definitely recognised in barley starch by the presence of a number of grains measuring 40 microns and over. Starches consisting of large and small grains intermixed cannot, however, be characterised by the number of grains per mg., nor by the number of grains exceeding a certain size, unless they have been prepared by a standard process. In attempting the quantitative analysis of mixed flours microscopically, the pure starches must be prepared by a standardised process, which must also be used for the separation of starch from the mixed flour. For example, if the examination of the crude fibre of a flour has established the presence of barley in admixture with wheat, the amount of each present can be ascertained fairly accurately by preparing specimens of pure wheat starch and of starch from the mixed flour, by the standard process, and then making counts of the numbers of starch grains of 40 microns and over in the two samples. The result may then be checked by the examination of a mixture of genuine flours in the proportions found.—G. F. M.

Phosphates in milk; Volumetric determination of —— and application to the judging of milk. W. Müller. Mitt. Lebensmittelunters. u. Hyg., 1922, **13**, 52—63. Chem. Zentr., 1922, **93**, IV., 69.

Neubauer's modification of Leconte's uranyl nitrate method (Anleitung zur Harnanalyse, 5 Aufl., 152) was used. Different results were obtained by determining the phosphates in the milk serum (inorganic phosphates), to those obtained by incinerating the milk and determining the phosphates in the ash (total phosphates). The serum was obtained by Ambühl and Weiss' method (J., 1920, 464 a). The uranyl nitrate method was found to be simple and rapid and to give accurate results, especially with milk-serum. It can be of great use in judging milk, as the phosphate content of milk is lowered to a greater extent than the content of lactose by abnormalities of secretion, and forms by itself a clear indication of pathological changes in the milk.—H. C. R.

Milk; [Determination of] moisture content of dried ——. G. E. Holm. J. Assoc. Off. Agr. Chem., 1922, **5**, 509—511.

Accurate and concordant moisture determinations can be made on dried milk only if precautions are taken to guard the samples from contact with moisture whilst they are being handled. The samples should be stored in tightly sealed glass jars or metal containers, and weighed out in stoppered weighing bottles. For complete dehydration, drying for at least 1 hr. at 100° C. in a vacuum of about 25 in. is required.—G. F. M.

Milk foods; Analysis of ——. R. H. Crichton. Brit. Pharm. Conf., July. Pharm. J., 1922, **109**, 94.

A simple and rapid method for the analysis of milk foods is described. 5 c.c. of the milk absorbed in absorbent paper, or an equivalent quantity of the solid food is dried in a steam-oven to determine the water and total solids, and the residue is exhausted in a Soxhlet apparatus to obtain the amount of fat and of solids not fat. To obtain the protein and carbohydrate content, 10 c.c. of the milk is mixed with water, and dialysed solution of iron (*Liq. Ferri Dial.*) is added until the supernatant liquid is quite clear. The volume is made up to 200 c.c., the precipitate filtered off, its nitrogen content determined by the Kjeldahl process, and the protein calculated. The filtrate contains the lactose which is estimated by means of Pavy's or Benedict's solution. Starch and cellulose interfere with the analysis by preventing the complete precipitation of the casein by the colloidal iron.—G. F. M.

θι-Decylenic acid, a previously unknown acid from butter. A. Grün and T. Wirth. Ber., 1922, **55**, 2197—2205.

Butter fat is treated with methyl alcoholic hydrogen chloride (1·5%) and the methyl esters are submitted to fractional distillation whereby a portion, b.p. 100°—140° C. at 15 mm., iodine value 9·8, is obtained. The fraction is hydrolysed and a partial separation of the saturated and unsaturated acids is effected by prolonged treatment of the corresponding lead salts in the usual manner. A mixture of approximately equal amounts of decylenic and capric acids is thus produced, which cannot be separated more completely by any of the ordinary methods. It is, therefore, esterified and the methyl esters are brominated in dry chloroform solution. The products are readily separated from one another by distillation under diminished pressure, whereby methyl dibromocaprate, b.p. 185°—186° C. at 7 mm., is obtained. Treatment of the latter with 5*N* methyl alcoholic hydrogen chloride and zinc yields methyl θι-decylenate, b.p. 115°—116° at 12 mm., which is hydrolysed to θι-decylenic acid, $CH_2{:}CH[CH_2]_7.CO_2H$, a colourless, fairly mobile liquid, b.p. 142° C. at 4 mm., m.p. below 0° C. The constitution of the acid is deduced from its conversion by ozone into azelaic acid and formaldehyde. This is the first instance on record of the isolation of an unsaturated acid of such low molecular weight or of one containing a terminal double bond from a natural fat.—H. W.

Soya bean milk. E. Remy. Z. Unters. Nahr. Genussm., 1922, **43**, 380—381.

A sample of soya-bean milk, yellowish-white in colour and having a sickly sweet taste and a faintly acid reaction, gave the following results on analysis: Water, 88·93%; dry matter, 11·07%; fat, 3·06%; non-fatty solids, 8·01%; protein, 2·96%; starch, 0·57%; glucose, 2·48%; mineral matter, 0·63%; alkalinity of ash, 6·44 c.c. of *N*/1 acid; germs per c.c., 4000. The gross energy content was 54 Cals. (cow's milk 70 Cals.). Content of food-units, 27 (cow's milk 34). The price of the soya bean milk at the time of the investigation was the same as that of cow's milk. It cannot therefore be considered to be an economical substitute for cow's milk.—H. C. R.

Chlorides in foodstuffs; Determination of ——. M. Bornand. Mitt. Lebensmittelunters. u. Hyg., 1922, **13**, 67—68. Chem. Zentr., 1922, **93**, IV., 66—67.

The organic matter is destroyed with persulphate and nitric acid. 2—5 g. or 10 c.c. of the sample is treated with 20—30 c.c. of water, 5—20 c.c. of concentrated nitric acid, and 20 c.c. of *N*/10 silver nitrate solution. The mixture is gently heated, and 1—5 g. of potassium persulphate is added in small portions until after boiling for 5—15 mins. the liquid is quite clear. If the sample is very rich in fat the whole of the fat and protein is not destroyed. The residue, however, remains in suspension and does not interfere with the titration. A small quantity of iron alum solution is added to the solution, which is diluted with 100 c.c. of water and titrated with *N*/10 thiocyanate. In order to prevent the oxidation of the chloride to chlorate 5 c.c. of formaldehyde or acetaldehyde is added towards the end of the reaction. This method is suitable for the analysis of urine, bread, milk, wine, meat extract, soup-cubes, and cheese. It is not suitable for butter.—H. C. R.

Phytin content of foodstuffs; Determination of ——. E. Arbenz. Mitt. Lebensmittelunters. u. Hyg., 1922, **13**, 45—52. Chem. Zentr., 1922, **93**, IV., 67.

The volumetric method of Heubner and Stadler (J., 1914, 713) was employed. The sample to be analysed was dried at 36° C. if necessary, finely ground, and freed from fat. A weighed quantity was then treated with a known volume of 0·6% hydrochloric acid, shaken, and filtered after standing for some hours. The residue was again extracted with hydrochloric acid and the extraction repeated until the filtrate was free from phytin. For each 20 c.c. of filtrate 10 c.c. of 3% ammonium thiocyanate was added, the volume made up to 100 c.c. with 0·6% hydrochloric acid, and the solution titrated with a standard solution of ferric chloride (0·05—2% Fe); 1 mg. Fe is equivalent to 1·19 mg. of phosphorus in the form of phytin. A large number of extractions are necessary to remove all the phytin from foodstuffs and the filtrations are tedious. The percentage of phytin, reckoned as anhydrous phytic acid, in the dry matter of various foodstuffs is given as follows: Rice bran, 4·232; rice flour, 0·216; wheat bran, 5·073; whole meal, 0·572; wheat flour, 0·208; maize flour, 0·857; lentils, 0·326; peas, 0·561; oatmeal, 0·506; cocoa, 2·230. No phytin was found in carrots, turnips, cauliflower, brussels sprouts, cabbage, spinach, asparagus, apples, pears, or figs. —H. C. R.

Cocoa; Torrefaction of ——. R. Lecoq. J. Pharm. Chim., 1922, **26**, 96—101.

The torrefaction of cocoa is accompanied by a loss in weight of 5—8% according to the duration of the operation. This loss is not due to a simple elimination of water, which in itself accounts for little more than half, or even less, of the total loss. Chemically, torrefaction involves a series of complex changes, which are manifested by an improvement in the aroma and taste, due to changes in the essential oils, and the destruction or modification of the acids of fermentation, and the tannins, by alterations in the colour resulting from the action of heat on the "cocoa red," and by the gelatinisation of the starch. A variation in the proportion of cacao butter as torrefaction proceeded was observed with certain varieties. At first owing to loss of water the percentage of fat rises, but falls again as the constituents of the cocoa are attacked. Finally a considerable rise again occurs indicating a selective destruction of constituents other than fat. Torrefaction is also accompanied by a notable increase in the proportion of substances soluble in water. The percentages of xanthine bases remain sensibly unaltered unless the heating is somewhat severe and prolonged.—G. F. M.

Proteins and derivatives; Recognition of —— by colour reactions. M. A. Rakusin. Biochem. Zeits., 1922, **130**, 268—281.

The author has examined a large number of vegetable and animal proteins, enzymes, and toxins, in respect of their behaviour to eight colour reactions, viz., the biuret, Millon, xanthoprotein, Liebermann, Adamkiewitsch, Molisch, Pettenkofer, and Ostromyslenski reactions; and the behaviour toward the sulphur reactions of Vohl and Rakusin. Each protein corresponds to a definite complex of reactions.—H. K.

Leucosin; Isoelectric point of the vegetable albumin ——. H. Lüers and M. Landauer. Z. Elektrochem., 1922, **28**, 341—347.

The isoelectric point of leucosin was determined by five different methods, with the following results: from the maximum of coagulation, $2·6\times10^{-5}$; from cataphoresis, $2·8\times10^{-5}$; from the maximum of alcohol precipitation, $2·7\times10^{-5}$; from the minimum of the internal friction, $2·3\times10^{-5}$; and from the maximum of the surface tension, $2·2\times10^{-5}$. The isoelectric point of serum-, vegetable-, and yeast-albumin is therefore the same, as also is the chemical composition; only in the biological properties is a marked difference to be found.—J. F. S.

Synthesis of θι-decylenic acid. Grün and Wirth. *See* XII.

Arsenic content of marine algæ. Jones. *See* XX.

Patents.

Milk; Process of dissolving dried or concentrated ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 182,612, 28.4.21.

Dried milk is treated with 6—7 times its weight of water in a colloid mill (E.P. 155,836; J., 1922, 357 a). Oatmeal or other nutrient substances may be mixed with the milk previous to dispersing in the mill.—A. G. P.

Milk product; Method of producing a condensed- ——. H. S. Mellott, Assr. to The By-Products Recovery Co. U.S.P. 1,423,810, 25.7.22. Appl., 11.4.16.

Milk is subjected for a short time to a "disrupting temperature," the vapours generated being permitted to escape. The hot product is then subjected to the action of a cooling agent.—H. H.

Sulphite-cellulose waste liquor. G.P. 352,624. *See* V.

XIXb.—WATER PURIFICATION; SANITATION.

Water purification; Investigation, by means of the hydrogen electrode, of the chemical reactions involved in ——. R. E. Greenfield and A. M. Buswell. J. Amer. Chem. Soc., 1922, **44**, 1435—1442.

The shape and position of the neutralisation curves of the carbonates of sodium, magnesium, and calcium, using a strong acid, is unaffected by the metallic ion, but the inflection point occurs at a slightly higher p_H value in dilute solutions than in more concentrated solutions. The precipitation of magnesium as hydroxide commences at p_H 9·0 and is complete at p_H 10·6. Calcium carbonate is completely precipitated at p_H 9·5. Aluminium hydroxide commences to precipitate at p_H 4·0 and precipitation is complete at p_H 6·5—7·5; the precipitate commences to re-dissolve at p_H 8·0 and solution is complete at p_H 10·0—11·0. (*Cf.* J.C.S., Sept.)—J. F. S.

Water; Volumetric determination of sulphates in ——. J. Kuhlmann and J. Grossfeld. Z. Unters. Nahr. Genussm., 1922, **43**, 377—381.

This determination is best carried out by precipitating the sulphates with a known quantity of barium chloride, precipitating the excess of barium with a known quantity of potassium chromate, and titrating the excess of chromate iodometrically. Only one filtration is necessary, as the chromate has no action on the precipitated barium sulphate. All precipitations are carried out in cold solutions and the precipitates are retained on special "kieselguhr filter papers," which admit of rapid filtering. The method, which is described in detail, is easy to carry out, rapid, and accurate. —H. C. R.

Bacteria fermenting lactose, and their significance in water analysis. M. Levine. Iowa State Coll. Agric., 1921, **20** [31]. Bull. 62, 127 pages.

The whole of the colon group of organisms are characterised by the following reactions: formation of acid and of gas from monosaccharoses and from lactose; reduction of nitrates; production of acidity in, and clotting of, milk. All other tests vary with varieties of organisms. There is striking correlation in the results from the following tests:—(1) Gas ratio, (2) acidity to methyl red, (3) Vosges-Proskauer reaction, (4) growth in uric acid media, (5) appearance on agar media. These five tests serve to distinguish between members of colon organisms of the type *B. coli* and those of the aerogenes group. Tests (2) or, preferably, (3) may be used for the routine separation of the two subsections. A more detailed scheme is given for the differentiation of *B. coli, acidi-lactici, communior neapolitanum, coscoroba, aerogenes, and cloacae.* The aerogenes group are less indicative of recent pollution than *B. coli*, since they are more common in soil than in fæces and more persistent in water. Spore-forming lactose-fermenting organisms such as *Cl. melchii* and *Cl. enteritidis sporogenes* are considered to be of no value in detecting pollution of water supplies.—A. G. P.

Cresol in cresol soap solutions; Determination of ——. O. Schmatolla. Chem.-Zeit., 1922, **46**, 661—662.

The method previously described by Frank (J., 1922, 433 A) yields erroneous results, as no provision is made for neutralising the soap solution, which, if it contains free fatty acid, yields a portion of this to the ether, and if alkaline retains part of the cresol. Again, the cresol obtained cannot be freed from ether by evaporation of the latter at 100° C., or even at 150° C. Accurate results may be obtained by the following method: the soap solution is made slightly acid with sulphuric acid and distilled up to 250° C. or in a current of steam. The distillate is treated with a large excess of caustic potash, concentrated, and the cresol precipitated by acidifying the solution with hydrochloric acid and saturating it with salt in a graduated tube. The volume of cresol is then read off; it contains 6% of water.—A. R. P.

Hypochlorite solution; The effect of Dakin's —— *on certain organic substances.* N. O. Engfeldt. Z. physiol. Chem., 1922, **121**, 18—61.

The action of Dakin's hypochlorite solution on carbohydrates, fats, soaps and glycerol, proteins, amino-acids, ammonia, and aldehydes has been investigated. Fats, soaps, and glycerol react only to a small extent; most of the other substances investigated react much more completely and rapidly.—W. O. K.

Effluent spent liquors from the distillation of ammoniacal liquor; Treatment of ——. Fifty-eighth Annual Report on Alkali, etc. Works, 1921, 9—20.

Effluent spent liquor from an ammonia still was passed through the usual settling pits and then while still hot was passed down a scrubber, 18 ins. high and 5 ins. diameter, packed with coke. Waste furnace gases containing the equivalent of 1 grain H_2SO_4 per cub. ft. were passed up the scrubber, and it was found that, with a liquor feed of 160 c.c. per min., 85% of the phenols in the liquor could be volatilised and that the liquor could be decolorised as a result of the neutralisation of the alkali. In preliminary trials with a working scale plant, during which the supply of waste gases was inadequate, 56% of the phenols and 7·5% of the thiocyanate were removed, while the amount of oxygen required for the complete oxidation of the liquor was reduced by 31·5%. (*Cf.* J., 1922, 316 R; also *cf.* Skirrow, 1908, 58; Fowler and others, 1911, 174; Frankland and Silvester, 1907, 231.)—H. Hg.

Phenol in trade liquors; Estimation of ——. Fifty-eighth Annual Report on Alkali, etc. Works, 1921, 22—28.

When phenol is distilled from effluent spent liquors from ammonia distillation plants as in the method described by Skirrow (J., 1908, 58), the passage of the vapours through a flask containing a solution of sodium carbonate and lead carbonate maintained at the boiling point prevents the necessity of a second distillation, but leads to low results owing to the retention of phenol by the sodium carbonate solution. The catch flask may be omitted if 35 g. of salt and a slight excess of lead acetate solution are added to 100 c.c. of the liquor, rendered slightly acid if necessary, prior to the distillation. Volatilisation of acid is prevented by the addition of precipitated chalk. Liquors containing basic organic compounds must be evaporated with caustic soda prior to the distillation.—H. Hg.

Tellurium poisoning; A rare case of ——. W. Adolphi. Chem.-Zeit., 1922, **46**, 722.

Three cases of acute poisoning by tellurous acid

occurred during the smelting of some platinum mud which had been obtained as a by-product from Siberian gold ores containing as impurities tellurides of gold and silver. During the melting, the tellurous acid volatilised with the accompaniment of a white fume and a greenish flame. The symptoms observed in the victims were weakness, dizziness, greatly accelerated frequency of breathing and of the pulse, and a foul garlic-like odour of the breath, and in one case lasted 8—10 weeks.
—G. F. M.

Corrosion of metals by water. West. *See* X.

Patents.

Feed water of steam generators; Heating and decanting apparatus for use in purifying the ——. P. Kestner. E.P. 167,142, 7.3.21. Conv., 27.7.20.

Steam from a continuous blow-off from a boiler enters the upper part of a cylindrical settling tank (in which condensed water collects) and passes thence to a decanting tank where it heats incoming natural water. The heated water from the decanting and settling tanks is mixed in an outer vessel below a filter, through which the mixed waters pass in an upward direction to the outlet.
—A. G. P.

Lime and sulphur; Compound of —— *stabilised with an aromatic compound.* M. S. Hopkins. U.S.P. 1,422,977, 18.7.22. Appl., 8.7.21.

A composition is prepared including a calcium polysulphide, and containing 1—10% of the calcium salt of an aromatic sulphonic acid, *e.g.*, calcium naphthalenesulphonate.—A. G. P.

Lime-sulphur composition; Method of making dry soluble ——. E. H. French. U.S.P. 1,423,605, 25.7.22. Appl., 11.8.19.

A lime-sulphur solution is evaporated in an atmosphere of non-oxidising gas.—A. G. P.

Water for softening, sterilising and like purposes; Treatment of ——. H. J. Magrath. U.S.P. 1,423,132, 18.7.22. Appl., 31.8.21.

See E.P. 158,498 of 1920; J., 1921, 366 A.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Quinine and strychnine; Extraction of —— *from solutions of varying hydrogen ion concentration; a method for the separation of strychnine from quinine.* N. Evers. Brit. Pharm. Conf., July. Pharm. J., 1922, **109**, 90—91.

In order to ensure complete extraction of strychnine as alkaloid from aqueous solution by chloroform, p_H must not be allowed to fall below 7, *i.e.*, the solution must be alkaline. Strychnine hydrochloride is dissolved to a considerable extent from acid solution by chloroform, the amount rising with increasing acidity, and 1% of strychnine hydrochloride in 2*N* hydrochloric acid can be completely removed by five extractions with chloroform. In the case of quinine the amount of hydrochloride extracted is diminishingly small with increasing acidity above p_H 3 and in 2*N* hydrochloric acid is practically nil, and hence the two alkaloids may be quantitatively separated by extracting the strychnine as hydrochloride from 2*N* hydrochloric acid solution, and then the quinine as alkaloid after rendering alkaline. For the complete extraction of quinine as alkaloid p_H must not be less than 8; with p_H 6—7 the whole of the quinine is extracted by chloroform, but partially as hydrochloride. At a greater acidity than p_H 4 there is a sudden reduction in the amount of hydrochloride dissolved, corresponding with the formation of the acid hydrochloride, and the quantity extracted rapidly becomes negligible. The above method of separation applied to the estimation of strychnine and quinine in Easton's syrup and iron quinine and strychnine citrates gives results which, although tending to be somewhat on the low side, are sufficiently accurate for ordinary purposes, and probably quite as accurate as those obtained by other more elaborate and tedious methods.—G. F. M.

Quinine salts; Rapid estimation of —— *in tablets.* S. G. Liversedge and F. W. Andrews. Brit. Pharm. Conf., July. Pharm. J., 1922, **109**, 92—93.

Quinine in quinine salts or in tablets can be rapidly estimated by dissolving or extracting the alkaloidal salt with 20 c.c. of *N*/5 sulphuric acid, adding a known excess of *N*/2 sodium hydroxide, removing the liberated quinine with ether saturated with water, and subsequently titrating the excess of alkali with *N*/5 sulphuric acid, using phenolphthalein as indicator. If boric acid is present hæmatoxylin is used as indicator. Sugar, starch, gum, and talc, which may be present in quinine tablets, do not affect the accuracy of the determination.—G. F. M.

Scopoline. VI. Constitution of scopolamine and scopoline. The Hofmann degradation of scopoline. K. Hess and O. Wahl. Ber., 1922, **55**, 1979—2025.

dl-Scopoline can be esterified quantitatively with *r*-desoxytropic (α-phenylpropionic) acid with the formation of two racemic desoxytropylscopoleins, neither of which is identical with the single racemic compound (desoxyscopolamine) prepared by converting scopolamine by loss of water into aposcopolamine and reduction of the latter. The authors therefore consider that King's conception of the partially racemic nature of *l*-scopolamine is no longer tenable (*cf.* Chem. Soc. Trans., 1919, **115**, 476, 974); that scopoline is not present as such in the alcoholic component of *l*-scopolamine but is formed therefrom by structural change during hydrolysis, and that since desoxyscopolamine exists in only a single racemic form it contains only one asymmetric carbon atom and, as this is present in the tropyl group, it follows that the basic component is itself symmetrical in structure. Formulæ are proposed for scopolamine and scopoline respectively. (*Cf.* J.C.S., Sept.)—H. W.

Anhalonium alkaloids. IV. Synthesis of anhalamine. E. Späth and H. Röder. Monatsh., 1922, **43**, 93—111.

6-Hydroxy-7.8-dimethoxy-1.2.3.4-tetrahydroisoquinoline has been prepared synthetically and shown to be identical with anhalamine from the *Echinocactus Lewinii.* (*Cf.* J.C.S., Sept.)
—C. K. I.

Alkaloids; Report on ——. A. R. Bliss, jun. J. Assoc. Off. Agr. Chem., 1922, **5**, 564—573.

In the assay of strychnine in tablets or in liquids the volumetric check obtained by dissolving the isolated alkaloid in alcohol, adding excess of *N*/10 sulphuric acid and titrating back with *N*/50 potassium hydroxide, with methyl red as indicator, gave results in satisfactory agreement with the gravimetric determination. The method already published for the separation of quinine and strychnine (J. Assoc. Off. Agr. Chem., 1921, **4**, 416) was tested and gave much more accurate results than either the oxalate, tartrate, or ferrocyanide methods. The method for the determination of alkaloids in physostigma preparations already published (*loc. cit.*) gives more accurate results than the U.S.P. method. A modification of the official method for the assay of fluid extract of hyoscyamus, in which at least 30 c.c. of water and 5—10 c.c. of *Liq. Ammonia Fortior.* were used, and before titrating, the residue was treated twice with 5 c.c. of ether, evaporating to dryness each time, gave satisfactory results, higher than those obtained by the U.S.P. method. A preliminary report is made on the determination of the alkaloids of ipecacuanha, and attention is particularly drawn to the necessity of avoiding overheating in evaporating the ethereal extracts, otherwise decomposition of the alkaloids, notably of cephaeline, will cause a great discrepancy between the gravimetric and volumetric results. The last portions of ether should be evaporated spontaneously without heat, and the residue dried at a temperature not exceeding 60° C.—G. F. M.

Alkaloidal bismuthic iodides; Method for the preparation of —— in a crystalline form. M. François and L. G. Blanc. Comptes rend., 1922, **175**, 273—274.

Crystalline bismuthic iodides of caffeine, theobromine, morphine, codeine, quinine, atropine, arecoline, pilocarpine, sparteine, nicotine, aniline, pyridine, and quinoline were prepared from potassium bismuthic iodide and acid solutions of the hydrochlorides of the bases by methods precisely analogous to those employed for the preparation of the double mercuric iodides (J., 1922, 645 A). These compounds form extremely well-defined microscopic crystals, and in the bulk are considerably darker in colour than the corresponding amorphous substances. They contain no water of crystallisation, and have the general formula $(BiI_3)_x(Alk.HI)_y$. They appear to be adapted for the microchemical characterisation of the alkaloids.—G. F. M.

Microsublimation of plant products. A. Viehoever. J. Assoc. Off. Agr. Chem., 1922, **5**, 557—559.

The sublimation is conducted in a small beaker-like container with a small cup, about 1×1 cm., extending from the bottom. The cup containing the plant material, is heated in a cottonseed-oil bath to the desired temperature, and a small glass placed over the opening serves as a receiver for the sublimate. In this way santonin was obtained in characteristic crystalline form from *Artemisia cina* and *A. neo-mexicana*, and was identified further by the blue coloration with alcoholic furfural solution and sulphuric acid, and by the greenish precipitate with hydriodic acid—iodine. Caffeine was obtained from the leaves of *Ilex-cassine*, Michx., and was identified by the characteristic crystals produced under the micriscope on addition of mercuric chloride solution. From *Piper cubeba* needle-shaped crystals of cubebin were obtained, and identified by the blood-red coloration with sulphuric acid. Crystals of hydrastine were obtained from *Hydrastis canadensis.*—G. F. M.

Digitonin and its derivatives. A. Windaus and K. Weil. Z. physiol. Chem, 1922, **121**, 62—79.

The following formulæ are ascribed to the compounds previously investigated by Kiliani:—Digitonin, $C_{55}H_{90}O_{29}$; digitogenin, $C_{26}H_{42}O_5$; digitogenic acid, β-digitogenic acid, and digitoic acid, $C_{26}H_{38}O_7$; oxydigitogenic acid, $C_{26}H_{38}O_8$; digitic acid, $C_{26}H_{38}O_{10}$. (*Cf.* J.C.S., Sept.).—W. O. K.

Santonin; Occurrence of ——. H. G. Greenish and C. E. Pearson. Brit. Pharm. Conf., July. Pharm. J., 1922, **109**, 85.

The leaves of *Artemisia brevifolia* gave on extraction with chloroform 1·09% of santonin calculated on the material dried at 100° C From *A. mexicana* and *A. redolens*, species occurring widely distributed in North and South Mexico, no santonin could be obtained by extraction of either the leaves or the stems, although Viehoever and Capen have reported its presence in these species (Amer. J. Pharm., 1922, **94**, 446). The leaves of *A. Abrotanum and A. vulgaris* were also examined for santonin but without positive results.—G. F. M.

Arsenic content of some of the marine algæ. A. J. Jones. Brit. Pharm. Conf., July. Pharm. J., 1922, **109**, 86—87.

Seaweeds generally contain small proportions of arsenic, varying from about 0·01% in the coarser varieties, such as *Laminaria* and *Fucus sp.*, to as little as 0·0005% in the so-called edible seaweeds, such as *Chondrus crispus*, or Irish moss, and *Gigartina mammillosa*, the above percentages being calculated on the air-dried weed. These algæ readily yield a large proportion of their arsenic content to cold water, and in one case nearly one-sixth of the total amount was removed by contact with distilled water for 15 mins.—G. F. M.

Adrenaline; The comparative activity of racemic —— and l-adrenaline in increasing the blood-pressure. A. Richaud. J. Pharm. Chim., 1922, **26**, 81—86.

r-Adrenaline employed in very small doses of the order of 0·01 mg. increases the blood-pressure to a somewhat lesser degree than *l*-adrenaline, but the difference in activity is not by any means so great as has been supposed. It is not constant, but rarely exceeds 10—15%, with 25—30% as a maximum difference. As the dose is increased to 0·04—0·05 mg. the difference in activity disappears entirely, and as the usual therapeutic dose is from 0·04 to 0·1 mg. there is no disadvantage attendant on the use of the racemic compound, and the resolution of the synthetic substance into its optical isomerides is therefore quite unnecessary.
—G. F. M.

Thymine; Detection of —— in the presence of sugar. H. J. Deuel and O. Baudisch. J. Amer. Chem. Soc., 1922, **44**, 1581—1584.

Thymine is precipitated in the form of its mercury salt, from a solution which also contains sugar, by the addition of saturated mercuric chloride solution (10 c.c.) and sufficient sodium hydroxide solution to make the mixture decidedly alkaline. The precipitate is separated by centrifuging, and, after pouring off the supernatant liquid, is thoroughly mixed with distilled water (100 c.c.) and again centrifuged. It is then suspended in water (100 c.c.) and decomposed with hydrogen sulphide; the precipitated mercuric sulphide is filtered off and excess of hydrogen sulphide is removed by boiling the filtrate. The remaining liquid is cooled and made up to 100 c.c. Oxidation of the thymine is effected as described by Baudisch (Ber., 1921, **54**, 406), and the test is completed by the method of Johnson and Baudisch (J., 1922, 194 A). Thymine in quantities of 10—15 mg. may readily be detected in the daylight, whilst quantities as small as 1 mg. may be detected by the use of the iron arc light.—H. W.

Scammony resin; Ether-solubility of ——. H. Deane and W. E. Edmonton. Brit. Pharm. Conf., July. Pharm. J., 1922, **109**, 82.

For the determination of the solubility of scammony resin in ether, extraction in a Soxhlet apparatus has been suggested, but to obtain concordant results by this method it is necessary to have the conditions of working very closely defined. Variations in the size of the extractor and the frequency of siphoning may lead to discordant results. Values varying from 76·7 to 97% were obtained

with the same sample of resin extracted with ether under different conditions in Soxhlet extractors.
—G. F. M.

Butylethylmalonylurea, a new hypnotic of the barbituric acid series. P. Carnot and M. Tiffeneau. Comptes rend., 1922, 175, 241—244.

A pharmacodynamical and clinical study was made of a new series of unsymmetrically disubstituted malonylureas. The hypnotic powers referred to that of diethylmalonylurea (veronal) as 10, were as follows:—Ethylmethylmalonylurea 5, ethylpropylmalonylurea 20, ethylbutylmalonylurea 30, ethylisobutylmalonylurea 30, ethylisoamylmalonylurea 30, ethylheptylmalonylurea 25. As in the symmetrically disubstituted series the members containing 10 and 11 C atoms are the most active, and the ethylbutyl-derivative appears to be particularly suitable for therapeutic use on account of its greater solubility in water, which renders it rapid in action and quickly eliminated. The toxicity of this derivative is proportional to its hypnotic activity, 18 cg. per kg. weight of animal being a lethal dose for a mouse, compared with 54 cg. of veronal. The normal dose of the ethylbutyl-derivative for a human being is 5—10 cg. subcutaneously, and 10—20 cg. *per os.*—G. F. M.

Platinum black; Catalysis by ——. G. Vavon and A. Husson. Comptes rend., 1922, 175, 277—279.

A platinum black catalyst which has become poisoned and inactive in the hydrogenation of a particular substance is not necessarily inactive towards another substance, and experiments were undertaken to determine the point at which absorption of hydrogen ceased with various unsaturated substances when the catalyst was progressively poisoned by the gradual addition of small quantities of carbon bisulphide. This limiting point was found to vary with the nature of the substance, with the nature of the solvent, with the quality of the platinum, and with the amount of the catalyst used, but to be independent of the concentration of the solution. In one instance using 5·5 g. of substance, 50 c.c. of alcohol, and 0·2 g. of platinum, the amount of carbon bisulphide required to inhibit hydrogenation was 1·1 mg. for cyclohexene, 0·8 mg. for nitrobenzene, 0·5 mg. for cinnamic acid, and 0·4 mg. for acetophenone, so that a catalyst which was inactive towards acetophenone would still hydrogenate nitrobenzene or cyclohexene.
—G. F. M.

Furfural; Estimation of small quantities of —— *colorimetrically.* P. Fleury and G. Poirot. J. Pharm. Chim., 1922, 26, 87—96.

Small quantities of furfural may be determined colorimetrically with an accuracy of about ±1%, by means of the blue coloration which is formed in an acidic medium with orcinol in a suitable solvent, preferably acetic acid. The reagents required are hydrochloric acid (sp. gr. 1·19) containing 0·02 c.c. of solution of ferric chloride per litre; glacial acetic acid containing 1 g. of orcinol in 1600 c.c., and a standard solution of furfural containing 1 g. in 10 l. of 1% acetic acid. 1 c.c. of the standard solution or of the solution under examination is mixed with 4 c.c. of the acetic acid-orcinol solution and 5 c.c. of the ferro-hydrochloric acid solution and warmed in a water bath for 1 minute. After keeping for 30 mins. the maximum coloration is developed, and comparison is made with the standard in a Duboscq colorimeter. The reaction has a sensitiveness of about 4 mg. of furfural per litre.—G. F. M.

Urea; Direct synthesis of —— *starting from carbon dioxide and ammonia.* K. C. Bailey. Comptes rend., 1922, 175, 279—281.

A yield of 14% of urea calculated on carbon dioxide was obtained by passing this gas with an excess of ammonia through a quartz tube, heated to redness, and traversed by a concentric glass tube through which cold water was circulated. The urea was deposited on the cool walls of the latter, and by using thoria or alumina as catalysts the yield was increased to 19%. By re-circulation of the unused carbon dioxide the yield was raised to 50% or more. Above 500° C. no urea was formed, and at 450° C. in presence of thoria, only a small quantity. As the experiments were conducted at atmospheric pressure and the product was always accompanied by a small amount of ammonium cyanate, ammonium carbamate cannot be considered to be an intermediate product, and it seems probable that the reactions occurring are represented by the equations:—$CO_2+NH_3=H_2O+HO.C{:}N$; $HO.CN \rightleftarrows H.N{:}CO$; $H.N{:}CO+NH_3=CO(NH_2)_2$; $HO.CN+NH_3=NH_4O.CN$.—G. F. M.

Sodium chaulmoograte or gynocardate; Preparation of ——. H. C. T. Gardner. Pharm. J., 1922, 109, 154—155.

Genuine *Taraktogenos Kurzii* (chaulmoogra) oil (80 pts.) is saponified with sodium hydroxide (14 pts.) by boiling for 6 hrs. with lye of 26° B. (sp. gr. 1·22). After cooling salt is added and the precipitated soap is removed, dissolved in cold water, and decomposed by the addition of 31 pts. of sulphuric acid (sp. gr. 1·530). The liberated fatty acids are dissolved in 80—90 pts. of alcohol, and the solution cooled to 8°—12° C. for some hours. The acids which separate are removed and the alcohol is distilled from the residue under reduced pressure. The dry fatty acids remaining should melt at 32°—34° C., otherwise the operation must be repeated until this m.p. is attained. The sodium salts prepared by exactly neutralising (to phenolphthalein) the alcoholic solution of these acids of m.p. 32°—34° C. with sodium hydroxide are satisfactory for therapeutic use, and are soluble in water. The dry salt is isolated by distilling off the alcohol *in vacuo* at a temperature not exceeding 80° C., and preferably lower, to prevent darkening. The dry salt should be stored in air-tight containers.
—G. F. M.

Potassium acetate; Oxidation of —— *to potassium oxalate.* W. L. Evans and P. R. Hines. J. Amer. Chem. Soc., 1922, 44, 1543—1546.

Potassium acetate may be oxidised to potassium oxalate with alkaline permanganate under certain definite conditions. The yield of oxalic acid is a function of the concentration of the reacting materials, the temperature, and the duration of the experiment.—H. W.

Peppermint oils; Differentiation of Japanese and American ——. E. O. Eaton. J. Assoc. Off. Agr. Chem., 1922, 5, 597—599.

Japanese peppermint oil derived from *Mentha arvensis* may be quickly differentiated from the oil of *Mentha piperita* by the following colour reaction: 5 drops of the oil and 1 c.c. of glacial acetic acid are heated with 1 drop of nitric acid in a water bath to about 60° C. for about 2 mins. A violet or bluish colour develops in *M. piperita* oil in a few minutes when observed by transmitted light, and a copper-coloured fluorescence by reflected light. Japanese oils usually show a straw colour or sometimes a very faint blue colour, but no copper-coloured fluorescence. The method of storage of *M. piperita* oils has some effect on the reaction, oils stored in open vessels in sunlight giving a negative result after a few months, but in every case oils which had lost their ability to give the reaction recovered the property on being treated with nascent hydrogen and subsequently steam distilled. Japanese oils treated in the same way *still gave a negative test. The refractive index* and the sp. gr. of Japanese oils are lower than those of *M. piperita* oils, and the odour and taste are also inferior.—G. F. M.

Acetol. Baudisch and Deuel. *See* XVII.

Yeast cells and saponin substances. Boas. *See* XVIII.

Magnesium compound of 8-hydroxyquinoline. Mörner. *See* XXIII.

Patents.

Colloidally soluble substances and of suspensions or emulsions; Process for the manufacture of ——. L. Lilienfeld. E.P. 156,725, 7.1.21. Conv., 1.8.19.

Water-soluble alkyl or aryl ethers of polysaccharides of the empirical formula $(C_6H_{10}O_5)_n$ such as cellulose or its conversion products or derivatives, starch, dextrin, inulin, lichenin, or the like, or mixtures of these ethers, with or without the addition of other protective colloids, are used as protective colloids in the preparation of colloidal solutions, suspensions, or emulsions, especially for therapeutic purposes. For example, 200 pts. by weight of a 5—10% solution of an ethyl- or methylcellulose, or ethyl- or methyl-starch, is mixed with a solution of 5—7 pts. of silver nitrate in 5—7 pts. of water, and 250 pts. of 10% ammonia and 200—250 pts. of 6—8% ammonium formate solution are added. The mixture is heated for some time, cooled, dialysed, and either evaporated *in vacuo* or precipitated by the addition of alcohol or the like, and the precipitate is separated and dried. —L. A. C.

Colloids and colloidal solutions; Process for preparing ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 182,696, 15.7.21.

Colloidal solutions of elements such as silver, gold, mercury, platinum, palladium, lead, sulphur, selenium, arsenic, and the like, are prepared by a process of combined precipitation and dispersion in a colloid mill as described in E.P. 155,836 (J., 1922, 357 A). For example, a mixture of 169 pts. of a 1% silver nitrate solution and 3·4 pts. of 10% ammonia is treated in a colloid mill in the presence of 3 pts. of agar-agar and 30 pts. of 1% formaldehyde, the constituents being added drop by drop. Dissolved salts, such as ammonium nitrate, are removed, and a more permanent and concentrated solution is obtained by subjecting the solution to ultra-filtration at high pressure as described in E.P. 155,834 (J., 1922, 619 A).—L. A. C.

Saccharin; Manufacture of ——. H. Lowe. E.P. 174,913, 5.1.22. Conv., 31.1.21.

Saccharin is obtained in a yield largely exceeding 75%, when *o*-toluenesulphamide suspended in a 2*N* solution of sodium carbonate or bicarbonate is subjected to anodic oxidation with a current of 12 volts and a density of 0·04 amp. per sq. cm. If desired lead, cerium, or manganese compounds or ammonia may be added to the electrolytic bath.—G. F. M.

CC-Isopropylallylbarbituric acid; Manufacture of ——. H. R. Napp. From F. Hoffmann-La Roche & Co. E.P. 181,247, 30.6.21.

Isopropylallylbarbituric acid is obtained in 80% yield by the action of allyl bromide (130 pts.) on a solution of isopropylbarbituric acid (170 pts.) in 500 pts. of water and 135 pts. of 30% sodium hydroxide at 25° C. for 12 hrs. The product is filtered off and crystallised from dilute alcohol. It is sparingly soluble in water, readily soluble in alcohol and ether, and melts at 137°—138° C. —G. F. M.

Cinchona alkaloids and their derivatives; Preparation of amino-derivatives of hydrogenated ——. Howards and Sons, Ltd., J. W. Blagden, and M. Nierenstein. E.P. 182,986, 6.5.21.

Good yields of the amino-derivatives of hydrogenated cinchona alkaloids are obtained by reducing the nitro-derivatives in neutral or nearly neutral solution with suitable reducing agents, such as zinc or iron, in conjunction with a neutral salt. Thus nitrohydroquinine, dissolved in alcohol, or in water in the form of a salt, is heated to 50° or more, and zinc dust and aqueous ammonium sulphate solution are added. After stirring for some hours at this temperature the filtered solution is concentrated *in vacuo* to crystallise the product. —G. F. M.

Hydrocarbon mixtures; Treating gaseous ——. *Process of treating gaseous mixtures. Process of separating ethylene and other components from gaseous mixtures containing the same.* G. O. Curme, jun., Assr. to Union Carbide Co. U.S.P. (A) 1,422,182, (B) 1,422,183, and (C) 1,422,184, 11.7.22. Appl., (A) 5.6.19, (B) 4.5.20, (C) 20.4.17. (C) Renewed 1.12.20.

(A, B) A relatively soluble component is separated from a mixture of hydrocarbons or other gases by compressing the mixture and bringing it in contact with a suitable solvent liquid at a temperature below that of the atmosphere. Residual gases are withdrawn, and the solvent power of the liquid is progressively reduced to liberate the less soluble gases from solution, the gases liberated being brought in contact with portions of the liquid having progressively higher solvent power, and finally returned to the absorption apparatus. The relatively soluble component is separated from the solvent by reducing the pressure on the solution. (C) Ethylene is separated from gaseous mixtures containing it by the process described under (A, B). —L. A. C.

Diphenylguanidine; Process of making ——. M. L. Weiss, Assr. to Dovan Chemical Corp. U.S.P. 1,422,506, 11.7.22. Appl., 2.7.21.

Diphenylguanidine containing carbodiphenylimide as an impurity is dissolved in hot toluene, the solution is cooled, and the crystals are separated, washed with pure toluene, and dried.—L. A. C.

Secondary alcohols; Process of purifying higher ——. R. B. Lebo, Assr. to Standard Oil Co. U.S.P. 1,422,583, 11.7.22. Appl., 16.2.21.

Isopropyl alcohol is separated from mixtures containing it, and higher secondary alcohols by adding at least sufficient benzene to the mixture to form a low-boiling mixture with the isopropyl alcohol, and subsequently separating the low-boiling mixture by fractional distillation.—L. A. C.

Hydrocarbons; Process of chlorinating gaseous —— *and recovering products therefrom.* G. O. Curme, jun., Assr. to Carbide and Carbon Chemicals Corp. U.S.P. 1,422,838, 18.7.22. Appl., 7.7.20.

A mixture of a halogen gas and an excess of a hydrocarbon gas is caused to react with the liberation of a gaseous halogen acid, and reaction products of higher boiling point than the hydrocarbon are separated by anhydrous liquefaction from the mixture of gases obtained. The residual unchanged hydrocarbon is returned for further treatment.—L. A. C.

Dicyanodiamide; Method of making ——. H. C. Hetherington and J. M. Braham. U.S.P. 1,423,799, 25.7.22. Appl., 28.6.21.

Calcium cyanamide is extracted with water, and the solution is filtered. Sufficient sulphuric acid

is added to the solution to combine with one-half of the calcium present, the calcium sulphate formed is separated, more sulphuric acid is added, in finely-divided streams, calcium sulphate is again removed, and dicyanodiamide is recovered.
—L. A. C.

Dicarboxylic acids; Production of ——. A. G. Williams, Assr. to The Barrett Co. U.S.P. 1,423,980, 25.7.22. Appl., 22.3.21.

An aromatic compound containing a diketone group forming part of a carbocyclic ring structure is dissolved in an alkaline reducing solution, and the solution is oxidised.—L. A. C.

[*Maleic acid;*] *Purification of substances* [*e.g.* ——] *by distillation with a solvent.* G. C. Bailey, C. W. Fischer, and J. F. W. Schulze, Assrs. to The Barrett Co. U.S.P. 1,424,138, 25.7.22. Appl., 9.2.21.

Maleic acid containing benzoquinone as impurity is purified by distillation in the presence of xylene.
—L. A. C.

Chlorinated nitronaphthalenes; Preparation of ——. O. Matter. G.P. 348,069, 14.1.19.

The products obtained by treating chlorine addition products of naphthalene with nitric acid are treated with ammonia or mixtures which liberate ammonia. Dry ammonia gas is led into a solution of nitronaphthalenetetrachloride in methyl alcohol, or a mixture of ammonium chloride and calcium hydroxide is added to the solution. The product is separated by filtration, washed with water, and purified by distillation under reduced pressure and crystallisation from methyl alcohol, yielding 5.8-dichloro-1-nitronaphthalene, m.p. 94° C.
—L. A. C.

Betaine and other organic bases; Production of pure ——. Akt.-Ges. f. Anilin-Fabr. G.P. 348,380, 18.4.17, and 348,381, 14.6.17.

Solutions of betaine or other organic bases which contain an excess of base or acid are treated in the cathode chamber of an electrolytic cell until the anions of the acid are completely removed. The solution of betaine obtained thereby is either used direct, or the betaine is separated or converted into salts. The process is not applicable for purifying strong bases, such as tetra-alkylammonium bases.
—L. A. C.

Basic aluminium salts containing silicic acid; Preparation of solutions of ——. *Preparation of solid mixtures containing basic aluminium acetate or aluminium salts containing silicic acid.* Lecinwerk E. Laves. G.P. (A) 348,411, 19.9.20, 349,984, 16.11.20, and 351,732, 24.12.20, (B) 351,731, 7.12.20.

(A) Colloidal aluminium silicate, prepared by the addition of aluminium sulphate to solutions of soluble silicates, is dissolved in a mixture of dilute hydrochloric or sulphuric acid and acetic acid or other organic acids, such as lactic acid, formic acid, tartaric acid, aldehydesulphurous acid, or mixtures of these acids with acetic acid, more aluminium sulphate and calcium carbonate are added to the solution, and calcium sulphate is separated by filtration. For example, water-glass diluted with water is added to a mixture of dilute hydrochloric acid and 96% acetic acid; aluminium sulphate and calcium carbonate are added to the solution, which is then stirred for several hours and filtered. The clear solution contains about 1·5% of colloidal silicic acid and 8% of aluminium acetate, *i.e.*, 1 mol. of SiO_2 to 2 mols. of $Al(OH)(CH_3CO_2)_2$, does not gelatinise on standing for 1 year, and possesses the properties of colloidal silicic acid in stimulating leucocytosis and the formation of connective tissue. The sodium chloride present in the solution has usually no harmful effect, but can be separated by dialysis after the addition of a little acetic acid, or solutions containing no alkali salts can be prepared without dialysis by adding aluminium sulphate to solutions of water-glass diluted with distilled water, the precipitate formed after filtration and washing with water, being dissolved in a mixture of dilute sulphuric acid and 96% acetic acid, and subsequently treated as described above. (B) Starch, amylodextrin, vegetable mucilage, the extracts of quince seeds, linseed, and the like, or other protective colloids, with or without the addition of inactive substances, such as talc or lycopodium, are added to solutions prepared as described in (A), and the mixtures are dried at low temperatures *in vacuo*. The products can be used in the form of powder or may be added to ointments, and on account of the ready solubility of the active constituents, possess the same therapeutic properties as the solutions.—L. A. C.

Aromatic selenium compounds; Preparation of ——. Farbw. vorm. Meister, Lucius, und Brüning. G.P. 348,906, 26.1.19, and 350,376, 18.2.19. Addns. to 299,510.

Aromatic compounds are treated with selenic acid, instead of with selenium or selenium dioxide as described in the chief patent, in the presence of concentrated sulphuric acid or other suitable solvents. A product containing 16% Se is prepared by treating *o*-nitrophenol with selenic acid in the presence of sulphuric acid; antipyrine on similar treatment yields a product, m.p. about 238° C., containing 17% Se. The compound diantipyrilselenide described in the chief patent can be prepared by treating an aqueous solution of antipyrine or the base itself with selenious acid or with 67% aqueous selenic acid. Solutions of *p*-nitroantipyrine in formic acid and *p*-tolylantipyrine in ethyl alcohol on heating with solutions of selenium dioxide in the same solvents yield respectively di-*p*-nitroantipyrilselenide, m.p. about 260° C. (decomp.), and di-*p*-tolylantipyrilselenide, $(C_{12}H_{13}ON_2)_2$ Se, m.p. about 255° C. (decomp.).
—L. A. C.

Carbonic acid esters of monohydric alcohols; Preparation of ——. C. F. Boehringer und Soehne G.m.b.H. G.P. 349,010, 29.1.21.

One mol. of carbonyl chloride is added to 2 mols. of a monohydric alcohol, or a mixture of monohydric alcohols, in the presence of dialkylaniline, and the mixture is allowed to stand for several hours. The desired neutral ester is obtained in almost quantitative yield. The process can be employed for the production of neutral esters of aliphatic, aromatic, or hydroaromatic alcohols, *e.g.*, benzyl alcohol and menthol. An example is given describing the preparation of diethyl carbonate by the action of carbonyl chloride on ethyl alcohol below 30°—40° C. in the presence of dimethylaniline and benzene.—L. A. C.

Di- and polyhalogen substitution products of monohydric phenols; Preparation of ——. Akt.-Ges. f. Anilin-Fabr. G.P. 349,794, 29.7.14. Addn. to 281,175 (J., 1915, 543).

Tri- or polyhalogen substitution products of aromatic hydrocarbons are heated under pressure with alkali hydroxides and methyl alcohol, or its homologues, with or without the addition of other solvents. 1.2.4.5-Tetrachlorobenzene on heating under pressure to 160° C. for 7 hrs. with sodium hydroxide and methyl alcohol, with or without the addition of pyridine, or to 200° C. for 10 hrs. with potassium hydroxide and ethyl alcohol, or to 200° C. for 16 hrs. with potassium hydroxide and amyl alcohol, yields 2.4.5-trichlorophenol, m.p. 64°—65° C. The corresponding tribromo compound has m.p. 80° C. 1.2.4-Trichlorobenzene on heating under pressure for 4 hrs. at 180°—190° C. with sodium hydroxide and methyl alcohol yields 2.5-dichlorophenol, b.p. 211° C., m.p. 58° C. The product obtained by treating 60 pts. of naphthalene with 320 pts. of bromine at 100° C., on heating at 150° C. under pressure for 6 hrs. with sodium hydroxide and methyl alcohol, yields a resinous mixture of polybromohydroxynaphthalenes. The products are of value as germicides.—L. A. C.

Serums, vaccines, and the like; Process for sterilising ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 349,806, 11.9.18.

Complex organic mercury compounds which are soluble in water and which have no chemical action on proteins, *e.g.*, complex aliphatic or aromatic mercurycarboxylic acids, or oxymercurycarboxylic acids, or their anhydrides or salts, or derivatives of these compounds, such as sodium oxymercurysalicylic acid, sodium oxymercuryacetic acid, salts of mercury fatty acids, and mercuriated aryloxy fatty acids, are suitable for sterilising serums, vaccines, and the like. Such compounds are superior to mercuric chloride for sterilising purposes, and have no injurious effect on the serums and vaccines.—L. A. C.

2-Phenylquinoline-4-carboxylic acid; Process for manufacture of derivatives of a hydrogenated ——. Chem. Werke Grenzach A.-G. G.P. 351,464, 18.12.17.

The derivatives are produced by electrolytic reduction of 2-phenylquinolinecarboxylic acid in alkaline solution, or by the use of an alkaline reducing agent, the resulting hydrogenated acid being converted by the usual methods into esters, or into N-alkyl or N-acidyl derivatives and the latter into esters. The crystals of the hydrogenated acid produced by cathodic reduction of 2-phenylquinoline-4-carboxylic acid have m.p. 167° C., and give, on esterification with alcohol and concentrated sulphuric acid, the ethyl ester as white needles, m.p. 83° C., soluble in the usual organic solvents, but insoluble in dilute alkaline solutions. The methyl ester of hydro-2-phenylquinoline-4-carboxylic acid crystallises from methyl alcohol in colourless needles, m.p. 99° C. If the hydrogenated acid is heated with acetic anhydride and several drops of concentrated sulphuric acid under a reflux condenser, it is converted into the N-acetyl-hydro-2-phenylquinoline-4-carboxylic acid, m.p. 209° C. The acetyl derivative is soluble in the usual organic solvents and in dilute alkaline solutions. These compounds stimulate reflex action and are therefore of use for treating diseases of the nervous system.
—A. G.

Cells, parasites, tissues, and organs; Process for decomposition and extraction of ——. Tetralin Ges.m.b.H. G.P. 349,807, 20.2.21.

The organs are treated with hydronaphthalenes, either alone or in admixture with other substances. The substances are treated with a quantity of hydronaphthalene (or its derivatives) insufficient for complete solution, and the insoluble matter is separated. The bacilli of tuberculosis and typhoid bacteria are rendered soluble by the action of hydronaphthalene, whilst large organs, *e.g.*, the brain, can also be made to dissolve, yielding clear solutions. If more than 4 mg. of tubercle bacilli are treated with 1 c.c. of tetrahydronaphthalene, the insoluble residue, after separation from the solution, yields a new, easily resorbable product, which is highly serviceable for diagnosis, inoculation and therapeutic purposes.—A. G.

Crotonaldehyde; Preparation of ——. Consortium für elektrochem. Ind. G.m.b.H. G.P. 349,915, 30.11.19.

Acetaldehyde vapour, at a temperature below 300° C., is led through a contact chamber containing heated metal oxides, such as wood charcoal coated with titanium oxide, or blocks of aluminium oxide or hydroxide, beryllium oxide, calcium hydroxide, bog iron ore, cement, or mixtures of these, at such a velocity that the acetaldehyde is only partially converted into crotonaldehyde. The unchanged acetaldehyde is separated from the product, *e.g.*, by fractional distillation or blowing, and is then mixed with the vapour admitted to the chamber.—L. A. C.

Drugs; Production of extracts of ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 350,122, 4.4.20.

Acetamide or formamide is used as the extracting medium, either in the molten state or in solution. The extracted products have a better taste than those extracted with aqueous or alcoholic solutions, and in many cases contain a larger proportion of active substance. They are quite stable and are not liable to take fire. Extracts produced with the aid of acetamide can be concentrated, and converted into pulverulent or tabloid form, whilst formamide is used for the production of liquid extracts. Solutions of the drugs can be made with greater facility in aqueous solutions of formamide or acetamide than in diluted alcohol of the same concentration.—A. G.

Dialkylamides of pyridine-3-carboxylic acid (nicotinic acid); Preparation of ——. Ges. f. Chem. Ind. in Basel. G.P. 351,085, 14.9.20.

Pyridine-3-carboxylic acid dialkylamides, which are of therapeutic value owing to their property of raising the blood pressure and regulating the central nervous system, are prepared by treating compounds containing the pyridine-3-carboxylic acid nucleus, *e.g.*, the acid halides, with secondary aliphatic amines, such as diethylamine, dipropylamine, diamylamine, or piperidine. Pyridine-3-carboxylic acid dipropylamide, diamylamide, and piperidide have b.p. 184° C. under 17 mm., 210° C. under 20 mm., and 310° C. respectively.—L. A. C.

Bile acid; Preparation of an unsaturated ——. J. D. Riedel A.-G. G.P. 352,129, 24.3.17.

The acid prepared as described in G.P. 334,553 (J., 1921, 529 A), is treated with bromine, and the product is treated with alkalis. For example, bromine is added, drop by drop, to a cooled solution of the acetic acid compound of apocholic acid in acetic acid or methyl alcohol, the oily dibromide produced is heated with a dilute alkaline solution until dissolved, and an unsaturated bile acid, m.p. 245°—247° C. after recrystallisation from acetic acid, is precipitated by the addition of dilute hydrochloric acid to the solution. The product has a strong antiseptic action and is of therapeutic value.—L. A. C.

Medicinal solutions; Production of oily ——. Byk-Guldenwerke Chem. Fabr. A.-G. G.P. 352,364, 27.9.17.

For compounding non-oily substances such as iodoform, salicylic acid, phenol, iodine, camphor, naphthalene, menthol, soaps, etc., esters of the higher fatty acids, which are fluid at normal temperatures, are used as solvent. The ethyl, methyl, and propyl esters of linolic acid and the alkyl esters of oleic acid and palmitic acid are better solvents for solid medicinal substances than the natural glycerides. The solutions made with the alkyl esters are easily absorbed and can therefore be used for injection purposes. Substances such as mercuric chloride and alkaline earth and heavy metal soaps, which are quite insoluble in linseed oil, are soluble in the alkyl esters.—A. G.

Hydrated magnetic oxide of iron; Production of finest ——. H. Spude. G.P. 352,365, 27.11.19.

Precipitated and elutriated ferrosoferric oxide is stirred with gum arabic and water without previous drying, and disintegrated (atomised) under pressure. After settling of the coarser material the suspension of the finest particles is concentrated by draining off the liquid with the aid of suction. The product mixed with water is used for injections for the treatment of cancerous affections.—A. G.

Carbon compounds; Process [catalysts] for hydrogenation and dehydrogenation of ——. Badische Anilin- u. Soda-Fabrik. G.P. 352,439, 16.11.13. Addn. to 307,580.

Combined silica or an alkali silicate is used as activating substance. The catalyst is highly insensitive to catalyst poisons, has a long life, and possesses a high reaction efficiency. Pumice is made into a paste with nickel carbonate and a solution of water-glass. After drying, the mass is reduced with hydrogen at 300°—350° C. With the aid of this catalyst, phenol can be converted continuously at 100°—120° C. into cyclohexanol, without the formation of by-products. In place of nickel, copper or mixtures of nickel and aluminium may be used. The catalyst can also be used for the production of methylcyclohexanone from methylcyclohexanol, aniline from nitrobenzene, and for the hydrogenation of oils.—A. G.

Carboxylic acids of the purine series; Preparation of ——. E. Merck, O. Wolfes, and E. Kornick. G.P. 352,980, 25.4.20.

Salts of mono- or dialkylated xanthine are treated with salts of monohalogenated aliphatic carboxylic acids, yielding N-alkylcarboxylic acids of mono- and dialkylated xanthine which are of therapeutic value. For example, sodium-theobromine and theophylline on heating with monochloroacetic acid in aqueous alkaline solution yield respectively theobromine-1-acetic acid, m.p. 260°., and theophylline-7-acetic acid, m.p. 266° C., and sodium 3-methylxanthine on heating with β-iodopropionic acid, first to 100° C. and then to 105° C., yields 3-methylxanthinepropionic acid, m.p. 308°—309° C. (decomp.).—L. A. C.

Monohydroxyethyl catechol ether; Process for manufacture of ——. Chem. Werke Grenzach A.-G. G.P. 352,983, 27.7.19.

Either ethylene-halogenhydrin is allowed to react with the acid alkali salts of catechol, or ethylene oxide is treated with free catechol. For example, a solution of catechol in 40% caustic soda is heated with ethylene-chlorhydrin to 100° C., or catechol is heated with ethylene-oxide under pressure to 140°—150° C. The ether, $C_6H_4(OH)(O.CH_2.CH_2OH)$ crystallises from water or benzene, has m.p. 99°—100° C., and gives with a drop of ferric chloride a temporary violet colour which changes almost instantaneously to yellowish-red.—A. G.

Esters of dioxydiethylsulphide and process of making same. G. Kränzlein and M. Corell, Assrs. to Farbw. vorm. Meister, Lucius, und Brüning. U.S.P. 1,422,869, 18.7.22. Appl., 2.7.21.

See E.P. 154,907 of 1920; J., 1922, 309 A.

sym-Octohydro-anthracene and -phenanthrene. G.P. 352,721 and 352,719. *See* III.

Catalyst for hydrogenation. G.P. 352,431. *See* XII.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

[Photographic] sensitisers for the deep red; New ——. C. E. K. Mees and G. Gutekunst. Brit. J. Phot., 1922, **69**, 474—475.

The methods of preparation and properties of three sensitising dyes, Naphthacyanole, Acetaminocyanole, and Kryptocyanine are described. Naphthacyanole shows a maximum at 690μμ, and a sensitising power for green less than Pinacyanol; it can be added to the emulsion or used as a bath for plates. Acetaminocyanole, when added to the emulsion gives a maximum at 730μμ, but when used in solution for bathing plates, entirely different results are obtained. Kryptocyanine is the most powerful sensitiser known and gives a maximum at 760μμ. It is useless for infra-red work at wavelengths above 900μμ, and confers no green sensitiveness.—W. C.

Latent [photographic] image; Conductivity of the ——. A. G. Rabinovich. J. Phys. Chem., 1922, **26**, 577—590.

The electrical conductivity of a dry "Premo" photographic film, 5×10 mm. is 10^{-11} ohm^{-1}/cm. at 18°—20° C. and has a temperature coefficient of 10% per degree, whilst the specific conductivity of a silver bromide gelatin emulsion is $8·0\times10^{-4}$ ohm^{-1} at 22° and the temperature coefficient is 3% per degree. These values are unchanged by exposing the films or emulsions.—J. F. S.

[Photographic] development; Grain structure v. light quanta in the theory of ——. W. Clark. Brit. J. Phot., 1922, **69**, 462.

"Reduction centres" from which development of the silver halide grains of an emulsion proceeds may be rendered visible by treatment with 10% sodium arsenite solution and partial development with ordinary developers, in absence of light. The centres thus shown follow the same laws of distribution among the grains as those made visible by the action of light and X-rays. This indicates that the centres are an essential part of the grain structure and that light action is not necessary for their formation.—W. C.

Actinometer with electrodes of mercury halides or sulphides. G. Athanasiu. Comptes rend., 1922, **175**, 214—217.

Mercury covered with very thin layers of mercurous halide or mercuric sulphide can be used in the same way as silver salts as electrodes in an electro-actinometer, and measurements were made of the E.M.F. generated by the illumination of one electrode of such an actinometer by the light of a mercury vapour lamp. The results for the various salts in different electrolytes are given, from which it appears that the light increases the potential of the halogenated electrodes, and diminishes that of the mercuric sulphide electrode. The most sensitive films were those of mercuric iodide prepared by treating mercury with a dilute alcoholic solution of iodine. Perfectly pure mercury is insensitive to light.—G. F. M.

Patents.

X-ray photography [; Intensifying screen for use in ——]. N. E. Luboshez. E.P. 182,496, 5.1.21.

An intensifying screen consisting of a sheet of opaque material coated with calcium tungstate or similar material is caused to adhere to the back of the emulsion-bearing base of an X-ray photographic film or plate by means of rubber, or various resins or waxes, so that the screen may be readily separated when desired without being wetted. If desired, an intensifying screen may be likewise applied to the emulsion surface.—J. S. G. T.

X-ray plates; Preparation of ——. Kranseder und Co. G.m.b.H., and Lüppo Cramer. G.P. 348,661, 30.12.20.

In X-ray plates having a film of silver bromide, this film is treated with desensitising agents which reduce its sensitiveness to light rays but have no influence on its sensitiveness to X-rays. Suitable desensitisers are aminophenols, diamines, and dyestuffs containing amino groups, or substituted amino groups, such as phenylenediamine, N-dimethyl-*p*-phenylenediamine, carbazoleleucoindophenolsulphonic acid, *p*-amino-*p*-hydroxydiphenylamine, Safranines, Brilliant Rhoduline Red, Methylene Blue, Auramine, Brilliant Green, Chrysoidine, and Vesuvine. The desensitising effect of dyestuffs is purely chemical, and is independent of the shade. Methylene Blue possesses the strongest desensitising action, but red and yellow dyestuffs which dye yellow and red shades appearing bright in the light of the dark room give the best results. The desensitising agent may either be added to the silver bromide-gelatin emulsion before coating the plates, or the coated plates may be steeped in a solution of the desensitiser.—L. A. C.

Photographs; Production of coloured ——. P. von Ditmar. G.P. 350,005, 13.1.21.

An alcoholic solution containing an aniline dyestuff with a metallic lustre and a substance which causes the dyestuff to remain amorphous on drying the solution, is poured on to a hot sheet of glass or the like. When dry, the plate is placed under a negative or diapositive, exposed to light, and subsequently treated successively with a bath containing chlorides or sulphates, potassium carbonate solution, and a solution of calcium hypochlorite or is exposed to the action of chlorine gas. For example, thymol, pyrogallol, or pyridine, is added to an alcoholic solution of Fuchsine, and the solution is poured over heated glass or paper into which the colour cannot penetrate. On exposure to light, the colour begins to crystallise, and after exposure, the plate is rapidly developed by treatment in the solutions described above. If treatment with potassium carbonate is omitted, silver images on a dark ground are obtained.—L. A. C.

Developing paper; Process for the manufacture of photographic ——. O. Mente. G.P. 351,322, 11.1.21.

Between the paper and the sensitive film a layer of colour is interposed, which absorbs chemically active rays, but is inert to the silver halide layer, and which can be subsequently destroyed or washed out. Certain red colouring matters, potassium permanganate, and manganese dioxide can be used for this purpose.—A. G.

Composition for coating metals for the purpose of permitting electric currents to operate by the action of light. H. L. Falk, Assr. to L. D. Wood. U.S.P. 1,424,088, 25.7.22. Appl., 10.12.21.

A mixture of crystals of platinum-barium-cyanide of potassium, crude sulphur, sodium tungstate, calcium chloride, and selenium crystals forms a composition for coating surfaces for the purpose of permitting electric currents to operate by light action.—W. C.

Photographic images; Process for treating and dyeing —— *and products obtained thereby.* W. Van D. Kelley. E.P. 160,137, 11.3.21.

See U.S.P. 1,411,968 of 1922; J., 1922, 393 A.

Photographic materials; High-temperature development of ——. A. J. Agnew and F. F. Renwick, Assrs. to Ilford, Ltd. U.S.P. 1,424,062, 25.7.22. Appl., 28.2.19.

See E.P. 128,337 of 1918; J., 1919, 602 A.

XXII.—EXPLOSIVES; MATCHES.

Nitration of aromatic substances; Rôle of mercuric nitrate in the "catalysed" ——. *Nitration of naphthalene.* T. L. Davis. J. Amer. Chem. Soc., 1922, **44**, 1588—1591.

Concentrated nitric acid, even in the presence of mercuric nitrate, converts naphthalene into nitronaphthalenes, the amount of nitronaphthols formed being exceedingly small. The best conditions for the direct production of the latter from naphthalene consist in the use of moderately dilute acid and moderately low temperature; in addition to nitronaphthalenes, 2.4-dinitro-α-naphthol and probably 2-nitro-α-naphthol are obtained. The unexpected formation of substituted α-naphthols renders the interpretation of the course of the action a matter of considerable difficulty.—H. W.

Patents.

Explosive. C. J. S. Lundsgaard and K. T. Herbst. U.S.P. 1,423,233, 18.7.22. Appl., 14.9.21.

A perchlorate of a methyl-substituted ammonium compound is used as an explosive.—H. C. R.

Pyrotechnic composition. W. T. Scheele, Assr. to Government of the United States. U.S.P. 1,423,264, 18.7.22. Appl., 9.12.19.

The composition comprises hexamethylenetetramine and strontium nitrate in the form of a double salt, to which a finely powdered metal is added.
—H. C. R.

XXIII.—ANALYSIS.

Refractive indices of liquids; Simple instrument for taking ——. R. Fouracre. Brit. Pharm. Conf., July. Pharm. J., 1922, **109**, 88—89.

A parallel beam of light from a small electric lamp placed at the focus of a convex lens, is projected through another convex lens laid on a glass plate with the liquid to be examined between the two, and brought to a focus on a plane surface. The focal length of the lens used in the combination divided by the distance between the surface of the liquid and the image, and the result subtracted from 2, will give the refractive index of the liquid.
—G. F. M.

Diphenylguanidine; Symmetrical —— *as a standard in acidimetry and alkalimetry.* C. A. Carlton. J. Amer. Chem. Soc., 1922, **44**, 1469—1474.

Diphenylguanidine is the only basic substance, proposed as a standard, which fulfils all the requirements of an ideal standard. It can easily be purified by three recrystallisations of the crude material from toluene, it is stable in air, and soluble in alcohol. It may be titrated directly in cold solution with either an alcoholic or an aqueous solution of hydrochloric acid, using either bromophenol blue or methyl red as indicator. The results are comparable with those obtained with sodium carbonate or silver chloride, and diphenylguanidine is more convenient to use.—J. F. S.

Fluorine; Detection of ——. B. Fetkenheuer. Wiss. Veröffentl. Siemens-Konzern, 1922, **1**, [3], 177.

The substance to be tested for fluorine is heated with sand and a few c.c. of strong sulphuric acid to

90° C. in a test-tube. On shaking, the acid runs off the glass like water off an oily surface if fluorine is present. With 2 g. of substance 0·01% F is easily detected after heating for 1 minute. Fluorides which are only attacked with difficulty by sulphuric acid, *e.g.*, ignited aluminium fluoride, must first be fused with a little sodium carbonate and sand and the melt treated as above with sulphuric acid.—A. R. P.

Magnesium compound of 8-*hydroxyquinoline.* [*Detection of magnesium.*] C. T. Mörner. Pharm. Zentralh., 1922, **63**, 399—402.

Magnesium hydroxide in suspension, magnesia mixture, or magnesium salts in alkaline solution give a yellow microcrystalline precipitate with aqueous solutions of 8-hydroxyquinoline sulphate. The reaction is very sensitive for magnesium. The precipitate approximates to the composition $(C_9H_6NO)_2Mg,4H_2O$. (*Cf.* J.C.S., Sept.) —G. W. R.

Potash; Determination of small amounts of —— by the Lindo-Gladding method. W. Hazen. J. Assoc. Off. Agr. Chem., 1922, **5**, 456—460.

In the determination of potassium by the Lindo-Gladding method the use of 90% alcohol for washing gives better results than that of 80% alcohol, and when working with small amounts of potash and high accuracy is desired, it is advisable to use the stronger alcohol for washing after the ammonium chloride treatment as well as for the first washing. The lower results obtained by using the weaker alcohol do not appear to be due to the sodium salts which may be present, as has been suggested, as equally low results are obtained in the absence of sodium salts. As, however, it takes a longer time to wash out the ammonium salts with 90% alcohol, it is preferable to use 80% alcohol for the second washing in ordinary work with fertilisers, where the percentage error arising from this will not be very serious, as the samples generally contain relatively high amounts of potash.—G. F. M.

Sulphur; Rapid estimation of ——. L. Losana. Giorn. Chim. Ind. Appl., 1922, **4**, 297—299.

Application of the method previously described (J., 1922, 614 a) to the estimation of sulphur in pyrites, copper pyrites and other mineral sulphides, ultramarine, adulterated white lead, cement, various rocks, sulphates of copper, sodium, etc. shows that the method serves generally with inorganic sulphur compounds. With fuels such as petroleum, anthracite and coke, results are obtained agreeing perfectly with those furnished by Eschka's method, which takes a considerably longer time. With ichthyol, saccharin, ebonite, and rubber, the method also gives excellent results.—T. H. P.

Uranium; Electrometric titration of —— with potassium permanganate and potassium bichromate. D. T. Ewing and E. F. Eldridge. J. Amer. Chem. Soc., 1922, **44**, 1484—1489.

When solutions of uranyl sulphate, reduced with zinc, are titrated electrometrically with permanganate, or when solutions of uranium chlorides similarly reduced are titrated with bichromate, a change in the oxidation potential occurs when the trivalent uranium is all oxidised to quadrivalent uranium, and a second change occurs when the latter is all oxidised to the hexavalent condition. Thus the total amount of uranium may be calculated. A third change of potential is observed when iron is present, and this is the stage at which all the ferrous iron is oxidised to ferric iron. The determination is carried out with apparatus of the usual type except in the form of the titration vessel. Since it is necessary to prevent the free access of air, the titration cell is a glass vessel closed by a tightly fitting cover which has six holes bored through it. Through the holes pass a tube for leading in carbon dioxide, a platinum electrode, the connecting tube of a calomel electrode, a stirrer fitted with a mercury seal, the tip of a burette, and the mouth of a Jones "reductor." All the tubes are tightly fitted. The method of procedure is as follows: *Estimation of uranium with permanganate.* Ten c.c. of a solution of uranyl sulphate, containing about 0·013 g. U_3O_8 per c.c. is added to 40 c.c. of sulphuric acid *A* (2 c.c. of concentrated acid to 88 of water) and warmed to 80°—90° C. Carbon dioxide is passed through the titration cell to remove the air, and the uranium solution slowly passed through the Jones "reductor" into the cell, the "reductor" being finally rinsed with 50 c.c. of sulphuric acid *A*. At this stage the solution is brown in colour, has a volume of 100 c.c., and contains 2 c.c. of concentrated sulphuric acid. The stirrer is set in motion and the permanganate slowly added. The EMF rises slowly at first and then jumps to a steady value, which is the point where all the trivalent uranium has passed into the quadrivalent condition and the solution has become green. Continued addition of permanganate does not affect the EMF markedly until the second change point is reached, and here the EMF jumps rapidly. At this point the whole of the quadrivalent uranium has passed into the hexavalent condition. The volume of permanganate used between the first and second end points represents the theoretical amount of oxidising agent required to oxidise uranium from the quadrivalent to the hexavalent state. Hence from this quantity the total amount of uranium present, no matter what its state of oxidation provided that none is hexavalent, can be calculated. *Estimation of uranium and iron with permanganate.* The process is carried out as above, the first and second change points giving the amount of uranium. After the uranium has all been oxidised to the hexavalent condition the oxidation of the ferrous iron commences, and is complete when the third change point is observed. Hence the amount of permanganate required to carry the EMF from the second to the third change point is equivalent to the amount of iron present. *Estimation of uranium by bichromate.* The two change points observed have the same significance as in the other cases. All the methods yield excellent results. —J. F. S.

Carbon and hydrogen; Volumetric estimation of —— in organic compounds. J. Lindner. Ber., 1922, **55**, 2025—2031.

The substance is burnt in the usual manner and the products of its combustion are passed over a substance which by its hydrolysis gives hydrogen chloride, and thence into a known volume of standard barium hydroxide solution. This is titrated with $N/10$ hydrochloric acid in the presence of phenolphthalein; the carbon dioxide is removed subsequently after addition of an excess of hydrochloric acid and the resulting solution is again titrated with barium hydroxide. The most suitable substance for hydrolysis is chloronaphthyloxychlorophosphine, prepared by passing chlorine into molten naphthyldichlorophosphine.—H. W.

Micro incineration. A. Schoeller. Ber., 1922, **55**, 2191—2192.

The substance under investigation is spread evenly over a thin strip of glass (5—6 mm. wide), which is placed in a horizontal hard glass tube about 10 mm. in diam. and 12 cm. long. The tube is heated very gently until all volatile matter is expelled. The residue is allowed to cool and is subsequently heated rather more strongly in a current of moist oxygen; in most cases the carbon disappears rapidly without at any time glowing. With difficultly combustible substances it is advisable to interrupt the heating again. Too powerful ignition is to be avoided. The minutest trace of ash is readily visible under the microscope. The method is particularly suitable for the incineration of sections of plant tissue, since the original structure is better preserved than when they are heated over a free flame.—H. W.

Filtration of vegetable juices. G. André. Comptes rend., 1922, 175, 286—289.

The passage of the expressed juice of potatoes, clarified by centrifuging, through a collodion membrane impoverishes the liquid in nitrogen and phosphorus, the results in a typical instance showing a reduction from 0·385% to 0·167% of the former, and from 0·044% to 0·019% of the latter. The phosphorus traversing the membrane is practically all mineral phosphate. Coagulation of the juice at 100° C. produces a similar effect as far as the nitrogen is concerned, but the reduction of the phosphorus in solution is, in general, not nearly so great, 0·033% being non-coagulable in the juice above cited, against only 0·019% traversing the membrane. Instances were not lacking, however, where the fraction of the phosphorus traversing the collodion approached that remaining in the non-coagulable liquid.—G. F. M.

See also pages (A) 659, *Fuel oil viscosimeters* (Herschel). 667, *Calcium in natural phosphates* (Meurice). 671, *Chromium in nickel-chromium steels* (Hild); *Ferrotungsten* (Losana and Carozzi); *Molybdenum in tungsten* (Hall). 672, *Chromium* (Loffelbein). 675, *Acid value of fats* (Kremann and Schöpfer). 678, *Superphosphate* (Tibaldi); *Acetol. Carbohydrates* (Baudisch and Deuel). 679, *Unfermented sugar in spent washes from saccharified wood* (Pringsheim). 680, *Wheat starch* (Wallis); *Phosphates in milk* (Müller); *Moisture in dried milk* (Holm); *Milk foods* (Crichton). 681, *Chlorides in foodstuffs* (Bornand); *Phytin in foodstuffs* (Arbenz); *Proteins and colour reactions* (Rakusin). 682, *Sulphates in water* (Kuhlmann and Grossfeld); *Bacteria fermenting lactose in water analysis* (Levine); *Cresol in cresol-soap solutions* (Schmatolla); *Phenol in trade liquors.* 683, *Strychnine and quinine* (Evers); *Quinine salts in tablets* (Liversedge and Andrews); *Alkaloids* (Bliss). 684, *Alkaloidal bismuthic iodides* (François and Blanc); *Microsublimation* (Viehoever); *Thymine* (Deuel and Baudisch); *Scammony resin* (Deane and Edmonton). 685, *Furfural* (Fleury and Poirot); *Peppermint oil* (Eaton).

Patents.

Calorific value of fluids [gas]; Method of and apparatus for carrying on the combustion of proportioned quantities of fluid for the purpose of measuring the ——. Igranic Electric Co., Ltd. From Cutler-Hammer Mfg. Co. E.P. 182,573, 7.4.21.

In a gas calorimeter, "firing back" at the burner is prevented by mixing the combustible gas, prior to combustion, with less than the total requisite proportion of the other constituent of the combustible mixture and supplying the remainder at or near the point of combustion.—J. S. G. T.

Gases; Method of and apparatus for measuring the density of ——. G. König. E.P. 159,845, 5.3.21. Conv., 5.3.20.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given; they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Alexander. Separating liquids of different specific gravity. 22,172. Aug. 18.

Altenkirch, and Siemens-Schuckertwerke Ges. Refrigerating-apparatus of the absorption type. 22,571. Aug. 18.

Bloomfield, and Boake, Roberts and Co. Distilling and fractionating apparatus. 22,781. Aug. 22.

Broadbridge, Minerals Separation, Ltd., and Williams. Filtration and conveying of granular etc. material. 22,576. Aug. 18.

Burt, Boulton, and Haywood, Ltd., and China. Grinding-mills. 23,132. Aug. 25.

Collins. Mixing-machines. 23,181. Aug. 26.

Crosfield and Sons, Ltd., Hilditch, and Wheaton. Manufacture of porous or absorbent material. 22,093. Aug. 14.

Dried Milk Dairy Products, Ltd., and Sierra. Separation of solids from gases. 22,748. Aug. 21.

Dried Milk Dairy Products, Ltd., and Gluckstein. Collection and separation of solids from gases. 22,749. Aug. 21.

Fowler. Grinding-mills. 22,332. Aug. 16.

Hurrell. Pressure filters. 22,261. Aug. 16.

Hurrell. Continuous pressure filter. 22,282. Aug. 16.

Kirchhoff & Co., and Oppen. 22,591. *See* XI.

Lambert. Mixing-machines. 23,056. Aug. 24.

Lawrence Patent Water Softener and Sterilizer Co., Ltd., and Warden-Stevens. Proportioning, mixing, and dividing liquids and dissolving solids etc. 23,213. Aug. 26.

Loke. Furnace linings, crucibles, etc. 22,519. Aug. 18.

Paterson. Apparatus for treating liquids by chemical reagents. 23,063. Aug. 24.

Pehrson. Rotary furnaces. 22,543. Aug. 18. (Sweden, 20.8.21.)

Richards and Sopwith. Refrigeration. 22,070. Aug. 14.

Shores, and United Alkali Co., Ltd. Manufacture of ice. 22,096. Aug. 14.

Stuart. Heat exchangers. 22,826. Aug. 22. (U.S., 22.8.21.)

Stuart. Filter screens. 22,827. Aug. 22. (U.S., 22.8.21.)

Thomas. Apparatus for mixing gases automatically. 23,110. Aug. 25.

Thomson. Disintegrating solids. 23,155. Aug. 25.

Tunnadine. Means for filtering liquids. 22,605. Aug. 19.

Yardley. Apparatus for purifying etc. air etc. 23,146. Aug. 25.

Complete Specifications Accepted.

4898 (1921). Barbet et Fils et Cie. Process and apparatus for continuous rectification of liquid air. (159,131.) Aug. 30.

10,024 (1921). Mather. Condensers, preheaters, heat-exchangers, and the like. (184,222.) Aug. 23.

10,889 (1921). Twigg. *See* VIII.

12,395 (1921). Schloemann and Dobbelstein. Process and apparatus for the conveyance of loose materials. (184,237.) Aug. 23.

12,524 (1921). Glossop, Bradley, and Willsdon. *See* III.

12,981 (1921). Pessi. Method of preventing incrustation in steam-boilers. (163,013.) Aug. 23.

13,379 (1921). Sturtevant Engineering Co., Ltd., and Powell. Treatment of material and substances ith jets of fluid. (184,557.) Aug. 30.

14,848 (1921). Burden. Machines or apparatus or reducing or disintegrating minerals and similar materials. (184,609.) Aug. 30.

18,336 (1921). Schull. Process and apparatus or purifying and condensing exhaust steam and or purifying the condensate. (184,342.) Aug. 23.

34,962 (1921). Von Wurstemberger. Prevention f selective corrosion in machines or apparatus of metallic parts made of copper and copper-containng alloys and subject to the corrosive action of water containing ions. (174,059.) Aug. 30.

17,391 (1922). Gardner. Mixing and/or disntegrating machines. (184,433.) Aug. 23.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION, HEATING; LIGHTING.

Applications.

Allan, Burmah Oil Co., Ltd., and Moore. 22,168. *See* XII.

Broadhead. Manufacture of combustible gases. 22,884. Aug. 22.

Burmah Oil Co., Ltd., and Moore. 22,167. *See* XII.

Burn. Gas-producers. 23,160. Aug. 25.

Davidson. Destructive distillation of coal etc. 22,198. Aug. 15.

Ges. für Kohlentechnik. 22,127. *See* VII.

Hudson and Hudson. Complete coal gasification plant. 22,475–6. Aug. 18.

Lelarge. Apparatus for separating coke etc. from ashes etc. 22,562. Aug. 18.

Leopold, and Meguin A.-G. Magnetic separating process for treatment of residues of fuel. 22,751. Aug. 21. (Ger., 21.8.21.)

Pautriero. Electric lamps. 22,839. Aug. 22.

Pedersen and Prass. Manufacture of electric-incandescent lamps. 22,456. Aug. 17.

Pickard. Production of combustible gases. 22,280. Aug. 16.

Poulson. 22,606. *See* XII.

Complete Specifications Accepted.

4996 (1921). Roberts. Process and apparatus for recovering by-products from distillate gases. (184,507.) Aug. 30.

7317 (1921). Withers (Deutsche Evaporator A.-G.). Method and means for utilising the heat contained in the fuel residues of furnaces. (184,211.) Aug. 23.

8636 (1921). Hird. Apparatus for the carbonisation of coal, shale, peat, lignite, and the like. (184,525.) Aug. 30.

12,406 (1921). Thompson (Ver. Glühlampen- und Elektrizitäts A.-G.). Sealing of leading-in wires for electric incandescent lamps and for similar purposes. (184,238.) Aug. 23.

12,700 (1921). Blyth. Process for the combustion of pulverised fuel. (184,250.) Aug. 23.

12,911 (1921). Jacobs. Drying of lignite, peat, turf, and the like. (163,719.) Aug. 23.

13,010 (1921). Patent Treuhand Ges. für Elektrische Glühlampen. *See* X.

13,277 (1921). Haddan (Torfverwertungsges. Pohl und von Dewitz). Process of drying and compressing raw peat and the like. (165,445.) Aug. 30.

13,278 (1921). Haddan (Torfverwertungsges. Pohl und von Dewitz). Process of dry distillation and coking of raw peat and the like. (169,952.) Aug. 30.

13,447 (1921). Dale. *See* XXIII.

13,514 (1921). Quarzlampen-Ges. Quartz mercury-vapour lamps. (165,081.) Aug. 23.

13,515 (1921). Dunstan. Refining of liquid hydrocarbons. (184,281.) Aug. 23.

14,144 (1921). Oberlander and Le Maréchal. Incandescent electric lamps and the like. (184,291.) Aug. 23.

14,188 (1921). Plauson's (Parent Co.), Ltd. (Plauson). *See* XX.

14,781 (1921). Hawes. Alcohol fuel. (184,607.) Aug. 30.

14,918 (1921). Woosnam. Electric glow lamps. (184,302.) Aug. 23.

15,248 (1921). Courbeyeur and Clabaut. Apparatus for generating combustion-products under pressure. (164,693.) Aug. 30.

16,469 (1921). Climie. Gas-producers. (184,323.) Aug. 23.

29,429 (1921). Ges. für Drähtlose Telegraphie. *See* XXIII.

34,948 (1921). Schulz. Regenerators for heating air or gas for combustion. (184,744.) Aug. 30.

2401 (1922). British Thomson-Houston Co., Ltd. (General Electric Co.). Electric incandescent lamps. (184,748.) Aug. 30.

15,444 (1921). Dingler'sche Maschinenfabrik A.-G. Process for pre-heating blast-furnace and like gases in dry-gas purifying-plants. (182,102.) Aug. 30.

III.—TAR AND TAR PRODUCTS.

Complete Specifications Accepted.

12,524 (1921). Glossop, Bradley, and Willsdon. Process and apparatus for distilling tar and other liquids. (184,242.) Aug. 23.

13,515 (1921). Dunstan. *See* II.

15,726 and 34,279 (1921). Thermal Industrial and Chemical (T.I.C.) Research Co., Ltd., Morgan, and Rider. Distillation of tar. (184,624.) Aug. 30.

IV.—COLOURING MATTERS AND DYES.

Applications.

Bailey. 22,979. *See* VI.

Sokal (Kalle und Co., A.-G.). Process for producing vat colouring-matters. 23,033. Aug. 24.

Complete Specification Accepted.

8254 (1921). Farbw. vorm. Meister, Lucius, und Brüning. *See* VI.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Cope (Pfarrius). Method of treating fibrous material. 22,067. Aug. 14.

Dawber. Utilisation of waste refuse from paper-making. 22,151. Aug. 15.

Perry. 22,211. *See* XVIII.

Plauson's (Parent Co.), Ltd. (Plauson). Treatment of cellulose etc. 22,687. Aug. 21.

Complete Specifications Accepted.

3742 (1921). Duclaux. Process for utilising cellulose esters. (184,197.) Aug. 23.

7570 (1921). Little, Inc. Process of preparing cellulose butyrate. (167,143.) Aug. 23.

10,615 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Manufacture and treatment of viscose. (184,533.) Aug. 30.

13,592 (1921). Schülke. Method of and apparatus for producing artificial threads, more particularly multiple-filament threads, from cellulose solution. (163,312.) Aug. 23.

14,852 (1921). Budde. Manufacture of hydra-oxy-cellulose and a xanthogenated compound obtained therefrom and a solid compact material obtained by coagulation of the latter. (184,610.) Aug. 30.

19,531 (1921). Dreyfus. Manufacture of solutions, compositions, preparations or articles made with cellulose derivatives. (184,671.) Aug. 30.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Bailey. Apparatus for ascertaining fastness of dyes to milling etc. and/or effect of such operations on fabrics. 22,979. Aug. 24.

Lord. Sizing, dyeing, bleaching, etc. machines for hanks. 22,923. Aug. 23.

Wolfenden. Dyeing-apparatus. 22,978. Aug. 24.

Complete Specifications Accepted.

20,033 (1921). Burton and Glover. *See* XV.

8254 (1922.) Farbw. vorm. Meister, Lucius, und Brüning. Manufacture of stable dry and soluble vat-preparations for dyeing. (177,526.) Aug. 30.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Casale. Apparatus for catalytic synthesis of ammonia. 23,072. Aug. 24.

Clayton, and Salt Union, Ltd. Manufacture of hydrogen peroxide. 22,045. Aug. 14.

Crosfield and Sons, Ltd., Hilditch, and Wheaton. Manufacture of base-exchanging compounds. 22,091–2. Aug. 14.

Crosfield and Sons, Ltd., Hilditch, and Wheaton. 22,095. *See* XIX.

Douglas. Manufacture of sulphate of ammonia. 22,347. Aug. 17.

Fairlie. Acid plant equipment. 23,083. Aug. 25.

Gardner and Taverner. Extraction of iron and titanium compounds from titanium ores. 22,728. Aug. 21.

Ges. für Kohlentechnik. Process of removing sulphuretted hydrogen from gases. 22,127. Aug. 14. (Ger., 20.9.21.)

Reynard, Tapping, and Thornley. Process for utilisation of seaweed. 22,644. Aug. 19.

Sim and Smith. Manufacture of lead carbonate. 22,455. Aug. 17.

Soc. Gamichon Frères. Process of manufacture of lead oxides. 22,103. Aug. 14. (Fr., 19.8.21.)

Complete Specifications Accepted.

4672 (1921). Williams. Process of manufacturing soluble phosphates. (184,206.) Aug. 23.

4898 (1921). Barbet et Fils et Cie. *See* I.

9617 (1921). Dossett. Process of and apparatus for crystallising copper sulphate. (184,527.) Aug. 30.

12,573 (1921). Chem. Fabr. Griesheim-Elektron, and Suchy. Process for the electrolytic production of potassium bicarbonate from potassium chloride solutions. (184,244.) Aug. 23.

13,290 (1921). Minami Manshu Tetsudo Kabushiki Kaisha. Process of manufacturing anhydrous chlorides of alkaline earth metals. (163,304.) Aug. 23.

22,404 (1921). Von Faber. Process for recovering iodine. (168,324.) Aug. 23.

VIII.—GLASS; CERAMICS.

Applications.

Grace. Means for separating fine micaceous and siliceous particles from china clay. 22,444. Aug. 17.

King. Production of colour effects in glass, crystal, etc. 22,514. Aug. 18.

Loke. 22,519. *See* I.

Mellersh-Jackson (Libbey-Owens Sheet Glass Co.). Apparatus for drawing sheet glass. 23,074. Aug. 24.

Mellor. 22,149. *See* X.

Spangenberg. Abrassive and cleansing etc. material, and method of producing same. 22,436. Aug. 17.

Unwin. Enamel kilns etc. 22,904. Aug. 23.

Complete Specifications Accepted.

10,889 (1921). Twigg. Method and means of utilising waste heat for effecting the drying of bricks or such like. (184,540.) Aug. 30.

13,172 (1921). Feldenheimer and Plowman. Treatment of clay. (184,271.) Aug. 23.

24,874 (1921). Bailey. Kilns for firing pottery and other ware. (184,716.) Aug. 30.

26,797 (1921). Scheid, and Schomburg und Söhne A.-G. Manufacture of pottery particularly adapted to electric insulators. (184,725.) Aug. 30.

IX.—BUILDING MATERIALS.

Applications.

Andrews. Manufacture of Portland cement. 22,982. Aug. 24.

Newton. Cement or adhesive composition. 22,341. Aug. 17.

Complete Specification Accepted.

13,504 (1921). Hildyard. Production of imitation wood. (184,565.) Aug. 30.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Anderson and Thornhill. Process for production of sponge iron etc. 22,059—60. Aug. 14.

Barter Trading Corp., Ltd., and Watson. Ferro-silicon blocks. 22,409. Aug. 17.

Bengough and Stuart. Method of preserving aluminium and its alloys from corrosion. 22,625. Aug. 19.

British Thomson-Houston Co., Ltd. (General Electric Co.). Composite metal articles, and methods of manufacturing same. 22,638. Aug. 19.

Davies and Thompson. Magnetic separators. 22,620. Aug. 19.

Drysdale and Evans. Protection of metals from corrosion. 22,353. Aug. 17.

Grogan and Rosenhain. Process of improving commercial aluminium. 22,454. Aug. 17.

Leggo. Roasting-furnaces. 22,460. Aug. 17.

Lloyd. Furnace for manufacture of liquid steel. 23,199. Aug. 26.

Mathesius and Mathesius. Process for producing lead alloys containing strontium. 23,048. Aug. 24. (Ger., 24.8.21.)

Mellor. Manufacture of clay crucibles, stoppers, etc. for steel melting etc. 22,149. Aug. 15.

Mond (International Process and Engineering Corp.). Chloridising roasting of ores etc. 22,243. Aug. 15.

Nobel. Manufacture of ferro-chromium. 22,951. Aug. 23.

Nobel. Production of ferro alloys. 22,952. Aug. 23.

Poulson. Blast furnaces. 22,352. Aug. 17.

Complete Specifications Accepted.

4782 (1921). Mellersh-Jackson (Soc. Metalurgica Chilena "Cuprum"). Process for treating ores. (184,501.) Aug. 30.

4892 (1921). Marks (Valley Mould and Iron Corp.). Method of casting steel-ingots and mould for use therewith. (184,505.) Aug. 30.

7797 (1921). Malmberg and Holström. Apparatus for the determination of the percentage of carbon in iron and steel. (184,215.) Aug. 23.

12,793 (1921). Façoneisen-Walzwerk L. Mannstaedt und Co. A.-G., and Bansen. Hearth-smelting or heating furnaces. (184,252.) Aug. 23.

13,010 (1921). Patent Treuhand Ges. für Elektrische Glühlampen. Manufacture of drawn tungsten wires. (163,014.) Aug. 23.

13,622 (1921). Soc. d'Electro-Chimie et d'Electro-Metallurgie. Process for obtaining metallic electrolytic deposits easily detachable from the cathode. (165,082.) Aug. 30.

15,815 (1921). Elmore, and Chemical and Metallurgical Corp., Ltd. Treatment of argentiferous lead-zinc sulphide ores. (184,628.) Aug. 30.

16,871 (1921). Harris. Apparatus for refining metals. (184,639.) Aug. 30.

26,787 (1921). Bardt. Process for dissolving-out or recovering the metal constituents of metalliferous materials. (184,402.) Aug. 23.

34,962 (1921). Von Wurstemberger. *See* I.

15,444 (1922). Dingler'sche Maschinenfabr. A.-G. *See* II.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Crosfield and Sons, Ltd., Hilditch, and Wheaton. Electric battery. 22,094. Aug. 14.

Hartman. Ozone-generator. 22,104. Aug. 14.

Kirchhoff und Co., and Oppen. Electric gas-purifiers. 22,591. Aug. 19. (Belg., 16.9.21.)

Nickum. Electrolytic apparatus, and method of depolarising same. 22,859. Aug. 22.

COMPLETE SPECIFICATIONS ACCEPTED.

7973 (1921). Elektrizitäts A.-G. vorm. Schuckert und Co. Electrolytic cell. (165,071.) Aug. 30.

12,573 (1921). Chem. Fabr. Griesheim-Elektron, and Suchy. *See* VII.

13,622 (1921). Soc. d'Electro-Chimie et d'Electro-Metallurgie. *See* X.

17,765 (1921). Smith. Secondary cells, or batteries for electricity storage. (184,649.) Aug. 30.

17,784 (1921). De Vos. Electric accumulators. (184,336.) Aug. 23.

18,589 (1921). Dinin. Electric accumulators. (184,658.) Aug. 30.

26,797 (1921). Scheid, and Schomberg und Söhne A.-G. *See* VIII.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Allan, Burmah Oil Co., Ltd., and Moore. Stoves for manufacture of waxes. 22,168. Aug. 15.

Burmah Oil Co., Ltd., and Moore. Apparatus for cooling oil etc. 22,167. Aug. 15.

North. 22,242. *See* XIX.

Poulson. Process of clarifying oils. 22,606. Aug. 19.

Spangenberg. 22,436. *See* VIII.

Villain. Manufacture of transparent soaps etc. 22,833. Aug. 22.

COMPLETE SPECIFICATIONS ACCEPTED.

10,616 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of compositions of oils or other organic substances. (184,534.) Aug. 30.

10,940 (1921). Eppenberger. Process for rendering fat-containing granular products impalpable. (176,305.) Aug. 30.

12,628 (1921). Chamberlin. Detergent with disinfecting properties. (184,248.) Aug. 23.

15,448 (1921). Mellersh-Jackson (Murray Co.). Art of forming and wrapping oil-bearing material prior to the expression of oil therefrom. (184,621.) Aug. 30.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Consortium für Elektrochemische Industrie Ges. Manufacture of resins resembling shellac. 22,222. Aug. 15. (Ger., 27.8.21.)

Freegard. Composition of matter for removal of paint etc. 22,554. Aug. 18.

Gardner. Paints etc. 22,727. Aug. 21.

Ponter. Preparation for removing paint etc. 23,153. Aug. 25.

Sim and Smith. 22,455. *See* VII.

Soc. Gamichon Frères. 22,103. *See* VII.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATIONS.

Gould. Rubber composition for roads etc. 22,550. Aug. 18.

Mead. India-rubber manufacture. 22,513. Aug. 18.

Warmund. Process for production of compound for sealing pneumatic etc. tyres and for preserving rubber. 22,822. Aug. 22. (Ger., 22.8.21.)

COMPLETE SPECIFICATIONS ACCEPTED.

13,871 (1921). Britton, and Griffiths Bros. and Co., London, Ltd. Preparation of rubberised fabric and rubber goods. (184,578.) Aug. 30.

XV.—LEATHER; BONE; HORN; GLUE.

COMPLETE SPECIFICATIONS ACCEPTED.

13,500 (1921). Devonshire and Foord. Composition for use in the manufacture of buttons and other articles. (184,563.) Aug. 30.

20,033 (1921). Burton and Glover. Preparation of a tanning-agent for the chrome tannage or dyeing of leather. (184,360.) Aug. 23.

XVI.—SOILS; FERTILISERS.

APPLICATIONS.

Beer. 22,438. *See* XIX.

Gradl. Manufacture of artificial manures. 22.217, Aug. 15. 22,888, Aug. 22. 23,067, Aug. 24. (Ger., 15.8, 3.9, and 22.11.21.)

COMPLETE SPECIFICATION ACCEPTED.

4672. Williams. *See* VII.

XVII.—SUGARS; STARCHES; GUMS.

APPLICATIONS.

Perry. 22,211. *See* XVIII.

Rigby. Utilisation of exhausted sugar-beet slices, waste brewery grains, etc. 22,179–80. Aug. 15.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATIONS.

Johansson. Process for denaturing alcohol etc. 23,143. Aug. 25. (Sweden, 26.8.21.)

Perry. Process for treating cellulose etc. for obtaining fermentable sugars etc. 22,211. Aug. 15.

Rigby. 22,179–80. *See* XVII.

Complete Specifications Accepted.

14,781 (1921). Hawes. *See* II.

22,079 (1921). Vydra. Process of producing a malt preparation for brewing purposes. (184,381.) Aug. 23.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Abbott, Cork, McNeill, Macredie, and Remus. Process for preparation of meat powders. 22,459. Aug. 17. (New Zealand, 27.8.21.)

Adeane, Harding, and Whetham. Treatment of whey etc. 23,121. 23,123. Aug. 25.

Adeans, Hopkins, Stewart, and Whetham. Treatment of whey etc. 23,127. Aug. 25.

Beer. Fungicides for plants or seeds. 22,438. Aug. 17.

Crosfield and Sons, Ltd., Hilditch, and Wheaton. 22,091–2. *See* VII.

Crosfield and Sons, Ltd., Hilditch, and Wheaton. Process of regenerating base-exchanging compounds after use. 22,095. Aug. 14.

Enefer. Meal for bread-making. 22,807. Aug. 22.

Lawrence Patent Water Softener and Sterilizer Co., Ltd., and Warden-Stevens. 23,213. *See* I.

Leo. Food products, and method of making same. 22,852. Aug. 22.

Luft. Food products, and process of preparing same. 22,246. Aug. 15.

Luft. Food products. 22,435. Aug. 17.

Marks (Wayne Tank and Pump Co.). Continuous softening of water. 22,320. Aug. 16.

Melhuish. Manufacture of milk. 22,693. Aug. 21.

North. Process of producing milk artificially. 22,240. Aug. 15.

North. Process of making butter from artificial cream. 22,241. Aug. 15.

North. Process of obtaining oil from milk. 22,242. Aug. 15.

O'Connor and O'Connor. Manufacture of bread etc. 22,349. Aug. 17.

O'Connor and O'Connor. Manufacture of butter etc. 22,350. Aug. 17.

Paterson. 23,063. *See* I.

Roggers. Treatment of sewage etc. 22,115. Aug. 14.

Yardley. 23,146. *See* I.

Complete Specifications Accepted.

4208 (1921). International Dry Milk Co., and Dick. Dehydrated milk. (184,203.) Aug. 23.

10,940 (1921). Eppenberger. *See* XII.

12,628 (1921). Chamberlin. *See* XII.

29,429 (1921). Ges. für Drähtlose Telegraphie. *See* XXIII.

34,124 (1921). Imhoff. Treatment of sewage in undrained settling basins. (184,742.) Aug. 30.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Application.

Etabl. Poulenc Frères. Process for preparation of aminophenylarsinic acids. 22,440. Aug. 17. (Fr., 7.9.21.)

Complete Specifications Accepted.

10,616 (1921). Plauson's (Parent Co.), Ltd. (Plauson). *See* XII.

13,664 (1921). Galbraith, Shannan, Adam, and Siderfin. Manufacture of amines from phenolic compounds. (184,284.) Aug. 23.

14,049 (1921). Soc. Anon de Prod. Chim. Etabl. Maletra. Process for the production of acetaldehyde from acetylene. (165,085.) Aug. 30.

14,188 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of ichthyol oil and ichthyol preparations and the like. (184,292.) Aug. 23.

15,730 (1921). Imray (Soc. of Chem. Ind. in Basle). Manufacture of dialkylamides of nicotinic acid. (184,625.) Aug. 30.

15,732 (1921). Johnson (Badische Anilin und Soda Fabrik). Manufacture and production of oxalic acid. (184,627.) Aug. 30.

34,532 (1921). Lilienfeld. Manufacture of a remedy for malignant tumor. (173,507.) Aug. 23.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Applications.

Dunning and Kelley. Motion-picture films. 22,711. Aug. 21.

Lucoque, Pilgrim, and Rudkin. Photographic films. 22,388. Aug. 17.

Lucoque, Pilgrim, and Rudkin. Photographic developing-solutions. 22,389. Aug. 17.

Lucoque, Pilgrim, and Rudkin. Production of direct photographic positives. 22,390. Aug. 17.

Complete Specifications Accepted.

3233 (1921). Ott. Process for coating the surface of cinematograph films. (184,495.) Aug. 30.

4437 (1921). Stewart and Killick. Method for producing kinematograph pictures in natural colours. (184,205.) Aug. 23.

6902 (1921). Luboshey. Sensitive film-supports for X-ray photography. (184,519.) Aug. 30.

10,954 (1921). Lepine. Picture films. (184,541.) Aug. 30.

XXII.—EXPLOSIVES; MATCHES.

Application.

Nobel Industries, Ltd., and Weir. Manufacture of detonators. 22,214. Aug. 15.

XXIII.—ANALYSIS.

Complete Specifications Accepted.

7797 (1921). Malmberg and Holström. *See* X.

13,447 (1921). Dale. Apparatus for the analysis and recording of gases. (184,279.) Aug. 23.

29,429 (1921). Ges. für Drähtlose Telegraphie. Means for indicating the presence of noxious gases such as fire-damp. (171,988.) Aug. 30.

I.—GENERAL; PLANT; MACHINERY.

Steam-pipe coverings; [Determination of] efficiency of —— at high temperatures. C. Jakeman. Engineering, 1922, 114, 155.

The covering to be tested is put on a steel pipe 4 in. internal diameter, the pipe ends being closed with blind flanges. Correction for loss by radiation from the blank ends is obtained by dividing the experimental pipe into two unequal lengths, 2 ft. and $13\frac{3}{4}$ ft., so that the loss is eliminated by difference; the difference between the amounts of heat lost by the two lengths corresponds to the heat lost in a pipe of differential length, $11\frac{3}{4}$ ft. An electric heater in which the wires are arranged in six concentric rings, each ring being controlled by a separate switch, runs through the interior of the pipe. When all wires are used it is possible to raise the bare pipe to 1000° F. (about 540° C.). A pipe fitted with a good covering requires from $\frac{1}{8}$ to $\frac{1}{15}$ of the heat energy required for the bare pipe. The apparatus and method of calibration are described in detail.—J. B. F.

Adsorption: its bearing on catalysis. M. Guichard. Bull. Soc. Chim., 1922, 33, 647—653.

The adsorption of a vapour by a catalyst is conditioned by the equilibrium pressure and temperature at which the action takes place and is reversible. On the other hand, increase in temperature of preparation or in duration of preliminary heating of the catalyst decreases the quantity adsorbed and the action is, in this case, irreversible. These conclusions are drawn from a study of the adsorption of water vapour by precipitated silica, quartz sand, and reduced nickel, and of iodine vapour by some natural silicates, alumina, and glucina. The author maintains that the preliminary heating of the catalyst results in diminution of active surface and cites facts which tend to support this view.—H. J. E.

Patents.

Separating suspended particles from electrically insulating fluids, especially gases; Method and device for ——. The Lodge Fume Co., Ltd. From E. Möller. E.P. 183,768, 16.11.21.

Insulating fluids, more especially gases, containing fine suspended particles are submitted to the action of a single- or multi-stage bilateral electric field prior to treatment by a unilateral electric discharge in accordance with E.P. 17,840 of 1912 (F.P. 449,337; J., 1913, 495), and E.P. 19,733 of 1913. The finer particles are thereby more readily flocculated, and, if desired, the effect is increased by the use of a number of flocculation chambers arranged in series and not provided with electrodes.
—J. S. G. T.

Distilling column. F. E. Lichtenthaeler, Assr. to W. E. Lummus Co. U.S.P. 1,424,173, 1.8.22. Appl., 8.5.18.

The column is divided into compartments by transverse partitions. Means are provided for supporting one of the partitions and for supporting the other partitions from this one.—H. H.

Precipitation of solid or liquid suspended matter from gases by high-tension electricity; Process of ——. Metallbank u. Metallurgische Ges. A.-G. G.P. 350,259, 10.9.20. Addn. to 348,377.

In an installation such as that described in the previous patent (J., 1922, 491 a) the discharge electrodes are composed of non-conducting material or are coated with non-conducting material. Thus filaments or rods of quartz, glass, porcelain, or similar acid-resisting material may be employed. The device is particularly suitable for use where acids, *e.g.*, hydrochloric acid, are precipitated from the gas.—J. S. G. T.

Stable foam for preventing the evaporation of stored liquids. J. M. Jennings, Assr. to Standard Oil Co. U.S.P. 1,423,719–21, 25.7.22. Appl., (a) 22.11.20, (b) 24.5.21, (c) 26.10.21.

The foams are formed from (a) an aqueous solution containing 25% of glue, 10% of glycerin, 2% of ferrous sulphate, and a minute proportion of preservative; (b) a liquid consisting of less than 15% of water, glycerin, and a body-forming material; (c) a liquid containing 40—81% of glucose, 6—12% of water, 5—10% of glue, and a small proportion of a setting agent. (*Cf.* U.S.P. 1,415,351–2; J., 1922, 491 a.)—T. A. S.

Evaporator. R. Mellor, Assr. to Kestner Evaporator Co. U.S.P. 1,424,254, 1.8.22. Appl., 9.8.20.

A counter-current evaporator is formed of a vertical series of horizontal liquor tubes each provided with a heating jacket. Heating vapour flows through the series of jackets from an inlet on the uppermost jacket to an outlet for vapour and condensed liquid on the lowermost jacket. Trapped bypass connexions intercept condensed liquid at intervals and direct it to the outlet.—H. H.

Recovery of solid matter from liquids by evaporation; Process of and apparatus for ——. G. A. Krause u. Co. A.-G. G.P. (a) 347,073, 1.4.17, (b) 349,183, 5.1.18. (b) Addn. to 347,138.

(a) A vertical axial tube is supported upon the floor of a vertical hollow cylinder serving as evaporation vessel. The tube, which extends some distance within the cylinder, is provided with a number of horizontal openings in its circumference at one or more transverse sections of the tube and at the same height as corresponding horizontal openings in the cylinder. Above the openings, within the chamber, is a high-speed centrifuge which discharges atomised liquid into the chamber, this liquid then falling through a gaseous evaporating medium which passes practically horizontally between the respective openings in the tube and chamber. (b) In a process carried out in accordance with G.P. 347,138 (J., 1922, 316 a), in place of openings in the wall or floor of the evaporating chamber, a disc is mounted in the chamber so that there is an annular space between the edge of the disc and the casing. The stream of evaporating medium flows between the annular opening and the central opening provided for the supply of air.—J. S. G. T.

[Filter press sack] fabrics; Process of producing a repair in ——. A. O. Austin, Assr. to The Ohio Brass Co. U.S.P. 1,424,332, 1.8.22. Appl., 12.5.20.

Vulcanisable material is inserted in the portion of the fabric to be repaired, and is cured to cause it to adhere to the fabric and form a continuation thereof.—H. H.

Extracting apparatus; Rotary ——. J. W. Bodman, Assr. to W. Garrigue and Co. U.S.P. 1,424,335, 1.8.22. Appl., 13.1.21.

A horizontal jacketed rotary drum is provided at one end with a head enclosing a pocket connected by a pipe with the jacket. A valve at the inner side of the head is formed by a rotary member and a stationary member, and is provided with an interior space. Within the drum are secured spaced steam-delivery pipes connected with the valve so that they open into the valve space only when they occupy the lower portion of the drum during the rotation. A pipe leads axially through the outer portion of the head into the pocket, and a pipe of smaller diameter extends through this pipe into the valve space.—H. H.

Fractionation of volatile, and more especially easily volatile liquid mixtures; Process of ——. "Metan" Spolka z ograniczona odp. G.P. 351,082, 13.6.18. Conv., 27.3.17.

The mixture is supplied continuously under pressure to the top of a vertical dephlegmator, and the several fractions are withdrawn from the column at various heights according to the respective boiling points of the fractions. Owing to the higher boiling points due to the pressure in the column, a better separation of the several fractions is obtained than hitherto.—J. S. G. T.

Drying coal or other material; Apparatus for ——. T. A. Goskar. U.S.P. 1,424,565, 1.8.22. Appl., 29.10.21.

See E.P. 175,674 of 1920; J., 1922, 282 A.

Liquors; Method of evaporating ——. E. Josse and W. Gensecke. U.S.P. 1,425,020, 8.8.22. Appl., 27.4.20.

See E.P. 138,871 of 1920; J., 1921, 455 A.

Air pumps; Mercury vapour ejector ——. A.-G. Brown, Boveri, & Co. E.P. 173,500, 19.12.21. Conv., 31.12.20. Addn. to 165,400.

Air filters; Filter bag cleaning device for ——. W. F. L. Beth. E.P. 175,281, 9.2.22. Conv., 12.2.21. Addn. to 132,513.

Grinding mills [; Means for exerting elastic pressure on rollers in ——]. C. F. Leubli. E.P. 183,215, 14.4.21.

Gas and air valves [of gas-heated furnaces] and the like; Means for actuating ——. South Metropolitan Gas Co., D. Chandler, and J. J. Cooke. E.P. 183,862, 15.4.21.

Solids of different specific gravities; Means for separating ——. J. A. Fletcher. E.P. 184,049, 26.7.21.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal seams; Method of representing the structure of ——, *and the proportion and properties of the four constituents (vitrain, clarain, durain, and fusain) contained in certain seams.* F. S. Sinnatt. Trans. Inst. Min. Eng., 1922, 63, 307—317.

A method of estimating the percentages of the various constituents in a seam is described. These percentages were, for Arley coal, vitrain 14·6%, clarain 65·9%, durain 18·1%, and fusain 1·4%; for the Queen Mine, vitrain 1·3%, clarain 98·7%, durain nil, and fusain nil; for the Wigan Yard, vitrain 25·1%, clarain 51·9%, durain 20·2%, and fusain 1·0%, with 1·8% of foreign matter. The lowest proportion of durain (5·6%) occurs in the Trencherbone Bottoms, and the highest (35·5%) in the Trencherbone Tops. The fusain content ranges from nil in the Queen Mine to 2·0% in the Trencherbone Bottoms, whilst the clarain varies between 51·9% in the Wigan Yard to 98·7% in the Queen Mine. The analysis of any particular constituent is by no means constant when determined on samples from different seams. Vitrain apparently contains the highest percentage of moisture and the lowest percentage of ash; clarain evolves the highest percentage of volatile matter less moisture, and contains only a slightly higher percentage of ash than vitrain. Durain contains the lowest percentage of moisture and the greatest percentage of ash; the volatile matter evolved is less than that from either vitrain or clarain, and the percentage of ash is not so high as that found by Wheeler and Tideswell for the Hamstead Thick Seam. Fusain contains a high percentage of ash and a considerably lower percentage of volatile matter. The agglutinating values of the constituents, determined with electrode carbon of 60—90 mesh (I.M.M. standard sieves) were as follows:—Arley coal: coal 15, vitrain 9, clarain 17, durain 6, fusain nil; Wigan Five Feet: coal 4, vitrain 3, clarain 7, durain 5, fusain nil. Contrary to the observation made by Lessing on the Hamstead Thick Seam, the durain possesses marked caking properties, and in the case of the Wigan Five Feet Seam the agglutinating power of the durain is higher than that of the vitrain.—A. G.

Volatile matter in coal; Determination of the ——. E. St.-Claire Deville. Soc. Tech. Ind. du Gaz en France, June, 1922. Gas World, 1922, 77, 112.

The sample of coal, 2·5 g., is placed in a thick platinum crucible with an ovoid bottom and covered with a lid provided with a chimney of 5 mm. bore. The crucible is placed over a Méker burner in a small furnace the effect of which is to eliminate errors due to the different amounts of heat radiated from different crucibles. The crucible is heated gently for about 2 mins. until the flame at the tip of the chimney become non-luminous, then a perforated lid is placed on the furnace, and the temperature is raised for about 1 min. until the hydrogen flame dies down into the chimney. The crucible is removed to an iron frame and, when cold, the coke is taken out and weighed, the deposit upon the crucible lid being discarded.
—H. Hg.

Coal ash; Recovery of combustible material from ——. H. Nitzsche. Z. angew. Chem., 1922, 35, 458—460.

A description of the Krupp magnetic process for the recovery of combustible material from coal ash is given. Ash is fed on to the surface of a brass drum rotating about a horizontal axis and is there submitted to the action of a stationary magnetic field, the strength of which increases from the top of the cylinder to where the surface of the cylinder becomes vertical, thereafter decreasing to its least value in the lower quadrant of the cylinder. Particles of clinker, owing to their content of iron oxides, formed during the combustion of the original coal, are retained for a longer period on the drum than the non-magnetic combustible constituents of the ash. The power necessary varies from 0·6 to 2·4 kw.h. per ton of ash treated. Particulars are given of tests carried out with various samples of ash.
—J. S. G. T.

Gas-producers; Contribution to the theory of —— *and its application to blast-furnace practice.* A. Korevaar. Chim. et Ind., 1922, 8, 12—25.

The state of equilibrium in a gas-producer in full working order, *i.e.*, its temperature, and the composition and temperature of the issuing gases, is governed by its dimensions, the heat-insulating properties of its walls, the porosity, size, and activity of the fuel with which it is charged, and the velocity and temperature of, and proportion of oxygen and water vapour in, the current of air through it. A series of equations connecting these variables and the volume of the zone of combustion in an ideal gas-producer is developed, and it is shown that for a minimum zone of complete combustion, *i.e.*, to carbon dioxide, there is a definite critical value for the velocity of the air in order to maintain the maximum temperature in the zone. If the air is preheated its critical velocity is increased with a corresponding increase in the maximum temperature and decrease in the size of the zone of complete combustion. The more finely divided, more porous, and more "active" the carbon, the higher is the maximum temperature and the smaller the zone of complete combustion. The theory may be applied to the study of the economical working of blast furnaces by assuming that they are gas-producers working at a very high temperature and having a comparatively short zone of combustion in the neighbourhood of the tuyères. In this way it is shown that less fuel is needed the more "active" it is, and an explanation is possible of the fact that less fuel is required with a preheated than with a cold blast and with a slow air current than with a more rapid one, which simply serves to extend the zone of combustion.—A. R. P.

Gum- and resin-forming constituents in manufactured [carburetted] gas. R. L. Brown. Amer. Gas Assoc. "Monthly." Gas J., 1922, **159**, 327.

Resinous substances deposited in gas meters and service pipes are formed from unsaturated hydrocarbons in the gas; the presence of indene has been established in several samples of condensate examined. The gum-forming constituents are derived from the gas oil used and their occurrence depends upon the nature of the oil used and the methods of carburetting and purifying the gas.—H. Hg.

[Gas retorts;] Thin metal ascension pipes [for ——]. N. G. Caputi. Gas World, 1922, **77**, 105.

Ascension pipes were made of 12-gauge steel with welded joints; the cross-section of the pipes was 12 in. square between the bridge cap and the top of the retort, tapering to 8 in. square at the points between the mouthpieces and the buckstays, and to a 9 in. diam. spigot fitting the off-take of the mouthpiece. The bridge pipes were of the same material and general design. Due to the decreased thickness and increased area of the pipes there was more condensation within the pipes, and as the interior surfaces of the pipes were comparatively smooth there was less tendency for adherence of pitch deposits. Comparative tests showed that the average reduction of gas temperature within the steel pipes was 866° F. (480° C.) and within cast iron pipes 559° F. (310° C.).—H. Hg.

Blue water-gas in conjunction with coal gas; Plant for the manufacture of ——. J. Lowe. Gas J., 1922, **159**, 324—326.

The plant described in E.P. 149,928 (J., 1921, 207 A) has given the following working results:—16,290 cub. ft. of mixed gas containing 21·6% of water-gas and with a calorific value of 526 B.Th.U. per cub. ft. was made per ton of coal carbonised; the calorific value of the water-gas was 326 B.Th.U. per cub. ft., the blow gas contained 15·25% CO_2, 9·5% O_2, and 10·5% CO, and was used for heating the retorts; after allowing for the coke thus saved in the retort furnaces the efficiency of water-gas manufacture was 91·6%. In computing this efficiency figure allowance was made for the total heat of the steam used but not for the power required for blowing. Further thermal economy can be secured by passing the hot water-gas into vertical retorts used for coal gas manufacture. The period of blowing the producer is equal to the period of gas making, there being no loss due to over-blowing when the blow gas is used in the retort settings.—H. Hg.

Gas; New controller for quality of ——. A. Grebel. Soc. Tech. Ind. du Gaz en France, June, 1922. Gas World, 1922, **77**, 110—111.

Gas is supplied through a delicate pressure regulator to two Bunsen burners with adjustable primary air supplies. One burner is adjusted to give a sharp blue inner cone and the other to give a distinct luminous tip on the inner cone. The respective heights of the cones are noted when burning a standard coal gas. The heights of the cones increase or decrease as richer or poorer gas is supplied to the burners.—H. Hg.

Flame; Limits for the propagation of —— in vapour-air mixtures. Mixtures of air and one vapour at the ordinary temperature and pressure. A. G. White. Chem. Soc. Trans., 1922, **121**, 1244—1270.

Limits for upward, horizontal, and downward propagation of flame for vapours of twelve organic solvents (ether, alcohol, acetone, methyl ethyl ketone, benzene, toluene, methyl alcohol, ethyl acetate, acetaldehyde, ethyl nitrite, pyridine, carbon bisulphide) mixed with air were determined at room temperature (17° to 18°±3°) in tubes of internal diameter varying from 2·5 cm. to 7·5 cm. By varying the means of ignition the type of flame started was controlled, and the type of flame determined whether the flame was extinguished in or traversed certain vapour-air mixtures. The lower limits did not differ greatly with the direction of propagation; the upper limits for upward propagation were approximately one and a half times those for downward propagation, except for cases in which a "cool flame" appeared, in which case the ratio was much greater. Where a cool flame appears two ranges exist, one for the cool flame and one for the ordinary flame; the cool flame was not generally propagated downwards. With one exception (carbon bisulphide) the lower limit for propagation downwards was approximately proportional to the net calorific value of the vapour used; the upper limit was about three and a half times the lower. The velocity of the uniform movement of flame downwards was with one exception almost the same in the lower-limit mixtures. The ratio of the amount of available oxygen in the limit mixture for the combustion of the vapour to the amount required for the perfect combustion of one molecule of the vapour was nearly constant.—J. B. F.

Petroleum; Evaporation loss of —— in the Mid-Continent field. J. H. Wiggins. U.S. Bureau Mines Bull. 200, 1922, 115 pages.

Large losses are caused by evaporation during storage and handling of crude petroleum between the well and the refinery, but from two-thirds to four-fifths of this loss may be prevented by protecting the oil from free contact with air. Laboratory tests showed that gasoline present in light crude oil will evaporate about one-half as rapidly as when stored in the pure state after distillation. Blending the separated gasoline with a very heavy, viscous, high-flash oil will greatly reduce its rate of evaporation (by nearly two-thirds in the tests described), but blending with heavier gasoline or mineral seal oil does not materially reduce the rate of evaporation. Californian gasolines evaporate approximately twice as fast as those of the same gravity from the other U.S. oilfields.—H. M.

Oils; Determination of volatility of ——. A. R. Matthis. Bull. Fed. Ind. Chim. Belg., 1922, **1**, 397—405.

Some precautions that should be taken in measuring the evaporation of oils on being heated are frequently omitted and thus contradictory results are obtained. In addition to the quantity of oil used for the test and the temperature and duration of heating, the area of exposed surface and the projection of the vessel above the surface of the oil should be taken into account as these have a definite bearing on the rate of evaporation. The author, using vessels of different shape and different quantities of oil, shows that in extreme cases loss of weight may vary by 228% under otherwise identical conditions of heating. Details of a number of experiments are given and suggestions for the standardisation of the tests are put forward.—H. J. E.

See also pages (A) 709, *Reversible expansion of silica* (Houldsworth and Cobb). 719, *Oxidation of paraffin hydrocarbons* (Salway and Williams). 722, *Ammonium bicarbonate* (Gluud). 731, *Phosphorus in coal ash* (Misson); *Hydrogen in presence of gaseous paraffins* (Muller and Foix).

PATENTS.

Concentration of coal. F. B. Jones, and Minerals Separation, Ltd. E.P. 183,504, 22.2.21.

COAL particles of linear dimensions between 0·1 and 0·5 in. are separated from impurities by film flotation or by sub-aeration, after the crude coal has been coated with oil or tar either by immersion or by agitation of an aqueous pulp of the coal with the oil. The quantity of oil required is 2 lb. per ton of crude coal. Suitable apparatus for the film flotation process is described in E.P. 25,204, 25,204 A, 25,858 and 29,374 of 1904 (J., 1906, 112; 1905, 1238, 893). Apparatus of the type described in E.P. 10,929 of 1910, 21,650 of 1913 or 10,312 of 1914 (J., 1911, 369; 1914, 1160; 1915, 620) may be used for the sub-aeration process, a trap being provided below the surface of the pulp to retain the large particles of coal discharged by the bubbles near the surface. The crude coal may also be treated by froth flotation in the apparatus described in E.P. 23,949 of 1910 (J., 1912, 31), in which case previous removal of the particles below 0·1 in. in size is unnecessary, so that fine coal is recovered in the froth and larger particles in the trap. Sea water may be used for the flotation of the larger particles.—H. Hg.

Peat and the like [e.g., sewage sludge]; Treatment of ——. Thermal Industrial and Chemical (T.I.C.) Research Co., Ltd., and J. S. Morgan. E.P. 183,180, 12.3.21.

PEAT pulp or sewage sludge is pumped through two preheaters into an autoclave where, by means of a stirrer, it is exposed to the action of live steam. The pulp then flows over a weir in the autoclave and comes in contact with a rotary drum filter. Water and steam are withdrawn from the drum into a separator, whence the water is pumped through the first preheater and the steam is drawn through the second preheater. The partially dried material is removed from the drum by a scraper and passed into a bath of molten metal where it may be treated as described in E.P. 174,974 (J., 1922, 239 A). After the water content has been thus reduced to 15%, the material is forced through a pipe, having a choke to prevent loss of steam, into a bunker from which, in the case of peat, it is delivered to a briquetting machine. The vessel containing the molten metal is fitted with a steam valve loaded to ensure a temperature of 160° C. for the steam evolved from the material. This steam passes into the autoclave and dries the material on the filter; any excess which passes the loaded valve may be used for external purposes. The hot waste gas from the furnace surrounding the metal bath may be used to expel further moisture from the material leaving the metal bath.—H. Hg.

Peat for fuel or distillation purposes; Method of and apparatus for disintegrating, dehydrating, and otherwise treating ——. C. W. G. Clewlow. E.P. 183,566, 25.4.21.

PEAT pulp of the consistency of cream is heated to a temperature of about 300° F. (149° C.) under a pressure of 120—130 lb. per sq. in., and is then passed through a loaded relief valve so that the pressure is suddenly released. The outlet of the valve is connected with two pulp receivers and also, in an upward direction, with a chamber having a flue and a perforated conical base surrounded by a drainage space for the retention of any peat carried away by the steam.—H. Hg.

Peat; Process for drying ——. K. von Haken. G.P. 353,033, 2.10.19. Addn. to 341,179.

IN the treatment of peat either continuously or intermittently in several stages as described in the chief patent (J., 1922, 130 A), each drying space is connected with two heat accumulators to form one stage or unit, and the unsaturated mixture of air or gas and vapour is circulated between the more highly heated heat accumulator of that particular stage and the material in the drying space of the stage concerned. The circulation of the air or gas-vapour mixture is necessary to transfer the necessary quantity of heat to the material to be dried, without using excess of air.—A. G.

Gas retorts. H. Wood. E.P. 161,918, 15.4.21. Conv., 15.4.20.

A TAPERED vertical retort of rectangular cross-section is superimposed on a gas producer and surrounded by a series of superimposed heating chambers through which gas may pass in a zig-zag path. The bottom chamber communicates with the producer through a passage formed by a midfeather wall within the latter. Each chamber is provided with an external opening fitted with a gas-tight door for cleaning purposes. The blow gases from the producer may be passed through the chambers or, after the preliminary heating of the retort, heating gas may be supplied to burners projecting into the chambers, in which case the passage between the producer and the bottom chamber is closed by a damper.—H. Hg.

Gas producer and process. E. M. Braxton, Assr. to M. R. Spellman. U.S.P. 1,424,077, 25.7.22. Appl., 18.11.21.

A BED of lignite, conical on its underside, is rotated during gasification, and the gas is superheated at a point near the apex of the cone prior to being cleaned, cooled, and dried.—H. Hg.

Tar; Process for increasing the yield and quality of —— by carbonisation and gasification of solid fuels. Allgem. Elektrizitäts-Ges., and F. Münzinger. G.P. 349,685, 2.7.18.

HORIZONTAL cooling sections are built in the fuel chamber at one or several different heights so that the material to be treated can be cooled over the whole cross-sectional area of the chamber to a uniform degree in layers as desired. The cooling sections are so arranged that the gases from the lower strata can be cooled, either wholly or in part, before they reach the higher strata. The cooling sections regulate the temperature of the column of fuel continuously by transference of heat from the hot fuel to the cooling sections, and intermittently in that as a result of the cooling and/or partial withdrawal of gas entering a highly heated zone, little heat is carried upwards.—A. G.

Gas producer with means for separately producing and removing the distillation and producer gases. A. H. Nass. G.P. 350,220, 27.10.20.

FUEL is distilled in an annular chamber rotating around the outer wall of a gas producer provided with a rotating hearth. During the rotation of the chamber, the fuel is discharged into the producer through openings in the walls of the latter. Outlets are provided at the top of the chamber and the producer for drawing off the distillation and producer gases respectively.—L. A. C.

Coals and other tar-yielding materials; Coking of —— by means of the continuous action of hot combustible gases. H. Pape. G.P. 350,678, 28.11.19.

The gas to be used for coking is preheated first in a preheater, preferably of iron, heated externally, and then by mixing with the gases of combustion of a heating flame, burning in the stream of gas. —A. G.

Coke and gas; Process for preheating air and, if necessary, gas in chamber ovens with vertical heating conduits for the manufacture of ——. O. Wolff. G.P. 353,058, 13.7.21.

A portion of the waste heat is utilised to heat the waste heat conduit, lying between the waste gas collecting flues of the heating walls and the generator or recuperator-chamber, and the mains through which the gas and air pass to the burners in the same direction. In consequence of the avoidance of cooling losses the air and gas, or the air alone, are preheated to a higher degree than usual. —A. G.

Cooling, cleansing or scrubbing gases in connection with all types of gas producers; Apparatus for use in ——. O. B. Davies. E.P. 183,160, 19.1.21.

Gas passes downwards through an annular space formed by two concentric cylinders and then upwards through the inner cylinder. A helical plate is fixed within the annulus in order to increase the gas velocity and separate the impurities by centrifugal force. The impurities collect in a space below the open end of the inner cylinder and may be withdrawn by removing the base of the outer cylinder. A baffle having the form of propeller blades may be placed within this space. Removable filters may be placed within the inner cylinder. The outer cylinder is provided with cooling gills or flanges or is surrounded by a cooling jacket or by air cooling pipes.—H. Hg.

Hydrocarbons; Process of manufacturing liquid —— from fish oils. K. Kobayashi. E.P. 170,264, 22.4.21. Conv., 13.10.20.

Fish oils, *e.g.*, herring, salmon, or sardine oils, are decomposed by heating with Japanese acid clay to a temperature not lower than 500° C. Glycerin and fatty acids are formed and are subsequently broken down forming liquid hydrocarbons from which light oil, illuminating oil, and other fractions may be separated by distillation. (*Cf.* J., 1921, 250 A; 1922, 242 A.)—T. A. S.

Distillation of [hydrocarbon] oils. Trent Process Corp. Assees. of W. E. Trent. E.P. 171,075, 13.4.21. Conv., 4.11.20.

Oil is mixed with finely divided fuel of relatively high volatile content, *e.g.*, coal, anthracite, bituminous coal, or lignite, and distilled in a retort at a temperature approximating to 350° C. It is claimed that considerable cracking takes place, increasing the yield of gasoline and light oil from the oil. Any carbon residue is obtained as a dry dust. During distillation the mixture is agitated by rabbles. The mixture consists of 1 part of oil and 2 parts of coal by weight.—T. A. S.

Distillation of crude oil; Fractional ——. Apparatus for distilling crude oil and other liquids. P. Mather. E.P. 182,827—8, 11.1.21.

Crude oil, before delivery to a continuous still, is preheated both by the hot residue and the still vapours. The oil is sprayed or dropped on to coils containing the residues or vapours and provision is made for the partial evaporation of the crude oil in the heat-exchangers and the admission of steam. A series of heat exchangers is provided to ensure the economical use of the heat, and the quantity of hot residue passing through the heat exchangers is controlled by a valve on the hot residue main and a valve admitting hot residue to the heat exchanger, both operated by a worm. The apparatus operates in conjunction with a vertical still so arranged that vapours may be drawn off at different levels and consequently at different temperatures.—T. A. S.

Desulphurising oils [e.g., shale oil]; Means for ——. A. C. Nesfield. E.P. 183,527, 24.3. and 14.6.21.

The oil is treated in a thin film with chlorine gas. The treatment takes place in a tower down which the oil descends and is caused to form films by flowing over cones. The chlorine is circulated, but has to be replaced in time owing to loss of efficiency. The sulphur is precipitated in flocculent form and is separated from the oil by filtration, centrifugal treatment, or by means of water. The reaction is expedited by the addition of quicklime and by preheating the oil to a suitable temperature—for certain oils 100°—120° C. The precipitate consists of sulphur compounds in addition to sulphur and may contain bituminous matter.—T. A. S.

Desulphurising [mineral] oil; Process of ——. Process for obtaining sulphur compounds from mineral oils and the like. Method of desulphurising oil. J. C. Clancy, Assr. to The Nitrogen Corp. U.S.P. (A) 1,423,710, (B) 1,423,711, and (C) 1,423,712, 25.7.22. Appl., 8.7., 14.7. and 17.7.20.

(A) The oil is treated with liquid anhydrous ammonia to cause the formation of an ammonia-sulphur compound which is then separated. A catalyst may be used to facilitate the formation of the ammonia-sulphur compound. (B) The sulphur compounds, separated from the oil as ammonia-sulphur compounds through the agency of liquid ammonia, are recovered. (C) Mineral oil is desulphurised by heating it with ammonia vapour and steam.—T. A. S.

Fuel for use in internal combustion engines. H. R. Ricardo. E.P. 183,577, 26.4.21.

The introduction of water into the cylinder of an internal combustion engine, with the object of reducing the temperature at which the engine works, cooling the piston, inlet and exhaust valves, is attained by using mixtures of benzol, acetone, and water with or without the addition of ethyl or methyl alcohol. At least 8% of water is required. A suitable fuel consists of 60% of ethyl alcohol, 20% of acetone, 10% of benzol, and 10% of water. —T. A. S.

Fuel. Fuel of liquid type. Liquid fuel. B. R. Tunison, Assr. to U.S. Industrial Alcohol Co. U.S.P. (A) 1,423,048, (B) 1,423,049, and (C) 1,423,050, 18.7.22. Appl., 12.4.20.

(A) A liquid fuel denser than kerosene consists of a relatively heavy aliphatic hydrocarbon and alcohol. (B) A liquid fuel consists of a petroleum distillate heavier than kerosene, an ester of an organic acid, and a monohydric alcohol, the heavy oil forming three-quarters of the mixture. (C) A liquid fuel consists of a petroleum distillate heavier than kerosene and an aromatic hydrocarbon.—T. A. S.

Fuel for use in internal combustion engines. M. C. Whitaker, Assr. to U.S. Industrial Alcohol Co. U.S.P. 1,423,058, 18.7.22. Appl., 12.11.19.

The fuel consists of benzol 17—35 pts., gasoline 20—50 pts., ethyl acetate 5 to 20 pts., and alcohol more than 20 pts. by volume.—T. A. S.

Fuel; Production of liquid —— from oils containing creosote. Maschinenfabr. Augsburg-Nürnberg A.-G. G.P. 351,817, 5.12.20.

COAL-TAR oil containing phenols is added to oils containing creosote to prevent formation of pitch and asphaltic deposits.—L. A. C.

Crude oil; Apparatus connected with an internal combustion or oil engine for converting —— into fuel. T. D. Key. E.P. 183,600, 2.5.21.

THE removal of impurities from crude oil is facilitated by heating it by means of the exhaust gases from the engine. The apparatus is so arranged that a thermo-siphon is set up. The oil passes through filters to remove suspended matter, and sumps are provided for the removal of water and asphalt. —T. A. S.

Transmission and motor oil. W. K. Boileau, Assr. to Pittsburgh Oil Refining Corp. U.S.P. 1,423,512, 25.7.22. Appl., 5.6.22.

AN oil for the lubrication of cylinders, bearings and transmission of internal combustion engines and the fabric lining of transmission and brake parts consists of petroleum oil of the ordinary consistency used in the cylinders of internal combustion engines combined with 2—12% of neutral wool-fat. —T. A. S.

Gasoline and the like; Process for producing ——. J. C. Clancy, Assr. to The Nitrogen Corp. U.S.P. 1,423,709, 25.7.22. Appl., 31.7.19.

THE vapour of hydrocarbon oil is cracked by submitting it to the catalytic action of mercury vapour.—T. A. S.

Shale; Process of distilling ——. E. E. Hedges. U.S.P. 1,423,716, 25.7.22. Appl., 13.6.21. Renewed 8.4.22.

OIL-BEARING shale is distilled in an elongated retort with constant agitation. The shale is moved along the retort, which is heated at one end to a temperature necessary to drive off the most volatile constituents and at the other end to a temperature sufficiently high to decompose water in the presence of carbon. The discharged gases pass backwards through the progressively cooler portions of the retort. Steam is admitted at the hotter end of the retort, from which the spent shale is removed. —T. A. S.

Sludge acids [from refining of mineral oils]; Method of treating ——. I. Hechenbleikner and T. C. Oliver, Assrs. to Chemical Construction Co. U.S.P. 1,423,766–7, 25.7.22. Appl., 25.1.22.

THE method consists in heating a weak sludge acid with agitation to concentrate it to an intermediate strength and then further concentrating the acid without agitation.—T. A. S.

Fuel; Combustion of ——. E. C. R. Marks. From Stephens Engineering Co. E.P. 183,512, 12.3.21.

SEE U.S.P. 1,369,200 of 1921; J., 1921, 251 A.

Hydrogen in coal gas; Method and apparatus for increasing the yield of ——. J. H. West and A. Jaques. U.S.P. 1,424,749, 1.8.22. Appl., 13.5.22.

SEE E.P. 181,062 of 1921; J., 1922, 579 A.

[Petroleum] oils; Process of converting ——. A. M. McAfee, Assr. to Gulf Refining Co. U.S.P. 1,421,674, 1.8.22. Appl., 30.9.13.

SEE E.P. 22,243 of 1914; J., 1916, 298.

Briquette forming materials; Method of mixing —— with a fluid binding agent. W. Glawe. E.P. 183,212, 14.4.21.

Stoking apparatus for furnaces [for pulverised fuel]. H. Simon, Ltd., and H. Walder. E.P. 183,496, 27.1.21.

Liquid fuel; Preheating of —— for liquid fuel fired furnaces [of the Burdon type]. W. M. and M. M. Burdon, and Burdons, Ltd. E.P. 183,673, 17.6.21.

Gas retort mouthpieces. A. E. Burton. E.P. 183,225, 16.4.21.

See also pages (A) 697, *Foams for preventing evaporation* (U.S.P. 1,423,719–21). 703, *Distillation of mineral oils* (E.P. 183,682). 708, *Removing hydrogen sulphide from gases* (G.P. 355,408); *Removing carbon dioxide from gases* (G.P. 352,800). 711, *Refractory lining for gas producers* (E.P. 183,219). 719, *Synthetic waxes* (E.P. 183,186). 726, *Phenol-contaminated liquors* (E.P. 161,976). 728, *Fatty acids from hydrocarbons* (G.P. 350,621). 731, *Gas calorimeters* (E.P. 183,408–9).

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

PATENTS.

Decolouring charcoal of high activity [from sulphite-cellulose waste liquor]; Process for the manufacture of ——. R. Adler. E.P. 165,788, 29.6.21. Conv., 5.7.20.

SULPHITE-CELLULOSE waste liquor, or the residue left after the manufacture of alcohol therefrom, is heated under a pressure of several atmospheres with an alkaline-earth hydroxide or with a neutral salt in order to precipitate the organic matter. The precipitate is pressed and dissolved in an alkaline solution. The solution is filtered if necessary and the filtrate is dried and carbonised. The product is suspended in water and carbon dioxide is passed into the suspension to convert the sulphides present into carbonates. The resulting alkali carbonate solution is separated from the charcoal for further use. Alternatively the charcoal may be washed with water before the conversion of sulphides into carbonates.—H. Hg.

Low temperature carbonisation of materials; Process of and apparatus for ——. G. Polysius. E.P. (A) 157,318, 10.1.21. Conv., 1.2.18. (B) 178,126, 10.1.21.

(A) COAL gravitates from a hopper on to a spiral conveyor which delivers it through gas-tight connexions into a horizontal rotary retort heated externally. The outlet end of the retort is fitted with an adjustable coke delivery which determines the amount of coal retained in the retort and which discharges through a gas-tight connexion into the upper part of a vertical coke shaft. The gas evolved from the retort passes through a condenser and then part of it enters the base of the coke shaft so as to carry the sensible heat of the coke into the retort. (B) The upper part of the coke shaft is fitted with a funnel which prevents direct passage of gas from the shaft to the retort. The gas leaving the shaft, before it enters the retort, passes through a regenerator where it is further heated by the combustion of part of the gas leaving the condenser. The products of combustion leaving the regenerator are used for heating the retort externally.—H. Hg.

Conductors for making electrical connexion with mercury. E.P. 183,683. *See* XI.

III.—TAR AND TAR PRODUCTS.

Thiophen series; Studies in the ——. XIII. Action of acetylene on pyrites. W. Steinkopf and J. Herold. Annalen, 1922, **428**, 123—153.

The product of the action of acetylene on finely divided pyrites at 300° C. contains the following substances: carbon, hydrogen, hydrogen sulphide, methane, butadiene, acetaldehyde, carbon bisulphide, acetone, benzene, thiophene (about 40%), 2-thiotolene, 3-thiotolene, 2.3-thioxine, 2-ethylthiophene, and 3-ethylthiophene, and probably, in addition, butane, ethylacetylene, toluene, xylene, and higher homologues of acetylene. (*Cf.* J.C.S., Sept.)—C. K. I.

Patents.

Distillation of coal tar, mineral oils, and the like; Stills for continuous ——. J. A. Yeadon. E.P. 183,682, 30.6.21.

A series of shallow oblong stills is used, through which the coal-tar or oil flows in succession by gravity. The bottoms of the stills are corrugated transversely thereby adding to the strength and heating surface of the stills. The stills are set at a slight inclination, and oil flows from one still to the next by means of a U-tube, so that the passage of vapour is prevented. Each still is fitted with its own condenser.—T. A. S.

Tar; Plant for the continuous distillation of ——. C. Schaer. G.P. 349,437, 16.3.16.

A fan, and an ejector supplied with air under pressure by the fan, are so arranged that the mouth of the suction tube of the ejector is located in the pitch delivery section of the plant. The conveyor tube of the ejector serves to condense the vapours passing through the tube, the condensed liquid being returned to the oil-collecting receptacle. One or more further ejectors may be used to provide the necessary draught for heating the still.—A. G.

Phenol: Production of pure —— free from homologues, from coal-tar oils. R. E. Ghislain. G.P. 355,388, 14.4.20.

A coal-tar fraction boiling between 175° and 200° C., and from which naphthalene has been separated by crystallisation, is treated with highly concentrated caustic soda solution, then with sulphuric acid of 66° B. (sp. gr. 1·84), avoiding rise of temperature above 80°—85° C. The black oil is separated, the remaining liquor decanted from the sodium sulphate solution, and the aqueous liquid is distilled. The process yields colourless, pure and crystalline phenol in quantitative yield.—A. G.

α-Ketohydronaphthalenes; Process for the preparation of ——. G. Schroeter, and Tetralin G.m.b.H. G.P. 352,720, 5.9.20.

α-Naphthol or iso- or heteronuclear substituted derivatives of α-naphthol are treated, either in solution or after fusion, with hydrogen under pressure until the amount absorbed corresponds to less than two molecules of the gas for each molecule of the substance. As a catalyst a finely divided precious metal or a metal, such as nickel, on some suitable carrier such as kieselguhr is used. For example, carefully purified α-naphthol is dissolved in tetrahydronaphthalene and the solution is heated in an autoclave with stirring under 10—20 atm. pressure of hydrogen to 120°—180° C., in the presence of kieselguhr coated with finely divided reduced nickel. When 1·5 mols. of hydrogen has been absorbed the process is interrupted and the solution, after cooling, filtered and subjected to fractional distillation under reduced pressure. At 14 mm. tetrahydronaphthalene distils at 100° C., the temperature then rises to 130°—137° C., and α-ketotetrahydronaphthalene (b.p. 134°—135° C. at 14 mm.) distils over. The higher boiling fractions consist of unused α-naphthol and *ar*-tetrahydronaphthalene and are used again in the process. β-Naphthol yields no keto-compound under similar conditions, the chief product of the reaction being *ac*-tetrahydro-β-naphthol. 1.5-Dihydroxynaphthalene yields 1-ketotetrahydro-*ar*-5-hydroxynaphthalene in colourless crystals, m.p. 156°—157° C., while 1.8-dihydroxynaphthalene gives 1-ketotetrahydro-*ar*-8-hydroxynaphthalene, and 1-hydroxy-5-acetaminonaphthalene gives 1-ketotetrahydro-*ar*-5-acetaminonaphthalene.—A. R. P.

Liquid fuel. G.P. 351,817. *See* IIa.

Sludge acids. U.S.P. 1,423,766–7. *See* IIa.

Hardening pitch. G.P. 352,521. *See* XIII.

Phenol-contaminated liquors. E.P. 161,976. *See* XIXb.

IV.—COLOURING MATTERS AND DYES.

Fluorescein; Formation and properties of ——. O. Fischer and M. Bollmann. J. prakt. Chem., 1922, **104**, 123—131.

In Fluorescein as ordinarily prepared there is at most only traces of monoresorcinolphthalein, a fact no doubt due to the instability of this compound at the temperature of the reaction. In presence of boric acid, however, the more stable boric ester is formed, and fair yields of monoresorcinolphthalein, m.p. 208°—209° C., are obtained. Oxonium salts of the methyl ethers of Fluorescein are described. (*Cf.* J.C.S., Sept.)—W. O. K.

o-Aminoazo compounds; Constitution of the products arising from the condensation of —— with aldehydes. O. Fischer. J. prakt. Chem., 1922, **104**, 102—122.

The colourless bases obtained by Goldschmidt by the action of aldehydes on *o*-aminoazo compounds and considered by him to be triazines, are shown to be derivatives of N-aminobenziminazole, as they are decomposed by hydrogen iodide into a derivative of benziminazole and an amine, and they can be synthesised from such a benziminazole derivative by heating the chloroimine, obtained from it on treatment with hypochlorite, with a base. (*Cf.* J.C.S., Sept.)—W. O. K.

Camphoric anhydride; Dyes derived from ——. A. C. Sircar and S. Dutt. Chem. Soc. Trans., 1922, **121**, 1283—1286.

Dyestuffs of the phthalein type were prepared by the condensation of camphoric anhydride with phenols and amines by means of zinc chloride. The depth of colour and intensity of fluorescence of these dyestuffs were similar to, if not more marked than, those of the corresponding compounds from phthalic anhydride, but their isolation was very tedious and difficult on account of the large proportion of tarry by-products which was produced. Resorcinolcamphorein is a reddish-brown powder, and its sodium salt dyes wool brick-red shades. Its tetrabromo derivative dyes wool and tannin-mordanted cotton brilliant pink shades. *m*-Dimethylaminophenolcamphorein hydrochloride forms glistening green prisms, m.p. 125°—126° C.; its solutions exhibit an orange fluorescence, and dye pink shades on wool, and reddish-violet on tannin-mordanted cotton. Phloroglucinolcamphorein forms orange-red needles, and dyes orange shades. *m*-Aminophenolcamphorein is a brown powder exhibiting in solution a dark green fluorescence. *m*-Phenylenediamine-camphorein crystallises in brownish-yellow prisms, m.p. 234° C. (with decomp.). Its solutions show a green fluorescence. —G. F. M.

Camphoreins. Studies in optically active dyes. I. B. K. Singh, R. Rai, and R. Lal. Chem. Soc. Trans., 1921, **121**, 1421—1430.

A SERIES of camphoreins was prepared by condensing camphoric anhydride with phenol, *o*-cresol, quinol, catechol, phloroglucinol, and pyrogallol. The condensation was best effected by means of stannic chloride in the first three cases; zinc chloride was used for catechol, and a few drops of sulphuric acid in the case of phloroglucinol and pyrogallol. Optical rotation was observed and measured in the case of *o*-cresolcamphorein, $[\alpha]_D = +93°$, but in other cases the deep colour of the solutions prevented observation. Some of the dyestuffs diffuse easily through animal membranes, and have staining properties for animal and vegetable tissues, and it is suggested that, being optically active, they might have special value as selective histological stains. Phenolcamphorein dyes wool and silk yellow from a bath containing sodium sulphate and excess of sulphuric acid with chrome and iron mordants. The cresol- and quinol-camphoreins have poor dyeing properties. Catecholcamphorein exhibits a green fluorescence in sulphuric acid solution. Pyrogallolcamphorein dyes wool deep brown shades on chrome, aluminium, tin, and iron mordants. Tetrabromoresorcinolcamphorein was obtained as a reddish-yellow powder, m.p. 133°—135° C. The position of the absorption bands of the above compounds was determined.
—G. F. M.

Anthracene series; Studies in the ——. II. E. de B. Barnett and J. W. Cook. Chem. Soc. Trans., 1922, **121**, 1376—1391.

MONOHYDROXYANTHRAQUINONES and dihydroxyanthraquinones which do not contain two hydroxyl groups in the *ortho*- or *para*-positions with reference to one another, when treated with bromine in presence of a large excess of pyridine do not give pyridinium salts, but are merely brominated. Quinizarin, on the other hand, is not brominated, but is converted into quinizarin-2.3-dipyridinium dibromide, probably through the intermediate formation of a diquinone, which forms a dibromide. This then unites with two mols. of pyridine with simultaneous enolisation. A similar reaction occurs with hystazarin. In the case of alizarin, 3-bromo-alizarin is produced if only 1 mol. of bromine is used with 2 mols. of bromine, or on further treatment of 3-bromoalizarin, 3-bromoalizarinpyridinium bromide is formed, whilst 3 mols. of bromine converts alizarin into alizarindipyridinium dibromide. Similar compounds are obtained from 3-nitro- and 4-nitroalizarin. All these pyridinium salts pass with varying ease into betaine-like compounds by loss of hydrogen bromide, either spontaneously, or when recrystallised from alcohol and ether. The betaine formation probably occurs between a β-hydroxyl group and the pyridinium group in the *ortho*-position to it. During the course of the research it was found incidentally that the nitration of 3-bromoalizarin yields 3-nitroalizarin, and conversely bromination converts 3-nitroalizarin into 3-bromoalizarin, contrary to what would have been expected from the behaviour of the corresponding chloro-derivative.
—G. F. M.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Cellulose; Preparation of —— by means of chlorine gas. U. Pomilio. Chim. et Ind., 1922, **8**, 41—45.

THE De Vains process for the preparation of cellulose by means of a solution of chlorine under pressure as described by De Perdiguier (*cf.* J., 1922, 288 A) is compared with that of Cataldi, who **employs gaseous chlorine, and is adversely** criticised **in that it requires more caustic soda and fuel** and **less chlorine, which is the cheapest reagent,** than **the latter process, the yield by which is higher** than that of any process yet known. In the Cataldi process the greater part of the chlorine (sometimes as much as 80%) is eliminated during the chlorination as hydrochloric acid, which is readily removed from the apparatus without neutralising or raising the temperature. The cellulose produced from poplar averages 74% of α-cellulose and 21% of the β and γ varieties, and contains 1·7% of ash. The average length of the fibres is 1·1 mm. and their mean diameter 0·026 mm. The process is operating successfully at Naples.—A. R. P.

PATENTS.

Artificial silk; Composition for the treatment of ——. C. A. Snyder. U.S.P. 1,423,041, 18.7.22. Appl., 3.9.21.

ARTIFICIAL silk thread is finished with a composition consisting of olive oil soap dissolved in water to which olive oil is added.—T. A. S.

Artificial fabrics containing nitrocellulose; Process for increasing the softness and elasticity of ——. Chem. Fabr. vorm. Weiler-ter Meer. G.P. (A) 353,233, 4.4.20, and (B) 353,234, 13.4.20.

(A) THE nitrocellulose is worked up with the addition of acetals of fatty-aromatic alcohols. Benzylacetal, from acetaldehyde and benzyl alcohol, an oil boiling at 198° C. at 20 mm., and xylylacetals boiling about 12° higher, are superior to the softening media previously used on account of their great stability. (B) The nitrocellulose is treated with aliphatic-aromatic ethers of polyhydric alcohols, *e.g.*, the dibenzyl, dixylyl, or dichlorobenzyl ethers of glycol, or the tribenzyl or dibenzyl ether of glycerol. Films are obtained of great flexibility, strength, and elasticity.—A. G.

Wood pulp; Process for making ——. L. Enge. G.P. 353,105, 16.7.21.

THE wood is treated with a bleaching agent immediately after boiling or steaming and before grinding. The bleaching is carried out either in the boiler or in another closed vessel. The wood is completely saturated with the bleaching liquid by keeping it for some time in an evacuated vessel and then treating it either with an aqueous solution of the bleach under pressure or with "warm air almost completely saturated with this solution." Gaseous bleaching agents may also be used. If solutions of bisulphites, such as sodium bisulphite, are used as bleaching agents, the wood must be allowed to lie for several days after treatment before it is separated into fibres. The incrustation is thereby also softened, so that a very tough fibrous pulp can be obtained from the bleached raw wood.—H. C. R.

Sizing paper; Process for ——. L. Ubbelohde. G.P. 303,324, 18.7.16, 305,006—305,010 dated 14.11.16, 31.12.16, 31.12.16, 9.2.17, 31.12.16, respectively, and 307,098, 9.2.17.

MATERIALS composed mainly of humic acid and its salts are employed for sizing paper and finished pieces and products made of paper. Humic acid is soluble in water and in dilute alkalis, but when dried into the paper it behaves as an irreversible colloid and is no longer soluble in water. Humic acid can be obtained from substances containing it or from peat. The solution obtained by treating peat or lignite with alkalis can be used directly for sizing paper or for impregnating paper or paper goods. This solution, equally with humic acid solution, can be precipitated with acids or metallic salts. Humous, bituminous or similar material, such as peat and lignite, can also be fractionally dissolved by treatment with various alkalis or alkaline solutions and the fractions, either alone or mixed together, can be used for sizing. The liquids obtained are more or less cloudy colloidal solutions or suspensions. The solutions obtained by bleaching humic acid solutions, crude humic acid, or the fractions obtained from these acids with chlorine can also be used for sizing paper and for impregnating paper and paper goods. In order to improve the sizing action of these materials, small quantities of other materials, such as water glass, beech wood tar size, coumarone resin emulsions, vegetable mucilage or sizes, such as are used as substitutes for rosin-size in the sizing of paper, may be added. The addition of these substances is also of advantage in the impregnation of paper goods. A better incorporation of the bituminous matter is also obtained by the use of other known sizing materials such as rosin size or animal size at the same time. Ferric sulphate forms a valuable substitute for the commonly used precipitating agents in the sizing of material with solutions of humic acid.—H. C. R.

Paper; Method for sizing —— with animal glue or proteins. Badische Anilin- und Soda-Fabr. G.P. 349,881, 23.1.17. Addn. to 331,350 (J., 1921, 384 A).

Artificially prepared, organic glue precipitants other than the sulphonic acids described in the chief patent, preferably in the presence of resin size, resin soap, or resin emulsions, are used for sizing paper with animal glue or proteins. For example, solutions containing 0·25% of resin size, 2% of animal glue, 4% of the condensation product from cresolsulphonic acid and formaldehyde ("Neradol D"), and 1—2% of aluminium sulphate, the weights being reckoned on the weight of the dry material, are added to the material in the hollander, and the material is subsequently worked up in the usual manner.—L. A. C.

Adhesive; Preparation of an —— from waste cellulose liquors. H. P. Kaufmann. G.P. 353,570, 30.7.19. Addn. to 352,138 (J., 1922, 641 A).

In place of calcium oxide equivalent quantities of other alkaline earths or of magnesia or magnesium hydroxide are used, and ammonium salts may be used instead of salts of the alkalis. For example, the mixture may consist of 5 pts. of cellulose pitch, 2·5 pts. of casein, 1·9 pts. of magnesia, and 1 pt. of sodium fluoride.—A. R. P.

Textile products derived from animal fibres; Manufacture of ——. A. G. Bloxam. From Technochemia A.-G. E.P. 183,249, 21.4.21, and 183,270, 27.4.21.

See U.S.P. 1,389,274–5 of 1921; J., 1921, 765 A.

Animal fibre; Process for treating —— to improve the spinning and felting properties thereof. A. O. Trostel. E.P. 183,885, 26.2.21.

See U.S.P. 1,371,951 of 1921; J., 1922, 10 A. (Reference is directed, in pursuance of Sect. 7, Subsect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 4144 of 1879.)

Cellulose acetate products; Treatment of ——. J. F. Briggs, Assr. to American Cellulose and Chemical Mfg. Co., Ltd. U.S.P. 1,425,364, 8.8.22. Appl., 16.4.21.

See E.P 169,741 of 1920; J, 1921, 808 A.

Paper-making machines. W. P. Carpmael. From Bagley and Sewall Co. E.P. 183,185, 17.3.21.

Paper-pulp strainers, paper- and rag-dusters and similar machines. The Watford Engineering Works, Ltd., and J. Paramor. E.P. 183,901, 22.4. and 27.7.21.

See also pages (A) 702, *Decolorising charcoal* (E.P. 165,788). 705, *Prints on paper* (G.P. 303,372). 720, *Resins from cellulosic materials* (G.P. 353,380). 724, *Starch* (G.P. 351,370). 725, *Sugar from wood* (E.P. 164,329). 728, *Salts of condensation products of formaldehyde and phenols* (G.P. 350,043). 730, *Dissolving nitrocellulose* (G.P. 352,905).

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Tannin, Tamol and Katanol [; Comparison of —— as mordants for basic dyestuffs]. H. Wagner. Farben-Zeit., 1922, 27, 3015—3016.

The mordanting properties of tannin and its substitutes, Tamol (a formaldehyde compound of a naphthalenesulphonic acid) and Katanol (a thiophenol), have been compared in the case of Auramine, Safranine T, Rhodamine B, Methyl Violet B, Methylene Blue BG, and Brilliant Green. Dyeings obtained by means of Tamol and Katanol, though slightly inferior in fastness to light, have a greater fastness to lime than dyeings obtained by means of tannin. On the whole, Tamol and Katanol are superior to tannin as mordants for basic dyestuffs, since they are cheaper and yield purer shades. —A. J. H.

Patents.

Soluble vat-preparations for dyeing; Manufacture of stable, dry and readily ——. Farbw. vorm. Meister, Lucius, und Brüning. E.P. 171,078, 15.6.21. Conv., 1.11.20.

Stable, dry and readily-soluble vat-preparations, particularly those containing a sulphurised or non-sulphurised quinone vat dyestuff capable of dyeing wool, are prepared by evaporation to dryness, preferably *in vacuo*, of a mixture containing about equal amounts of an alkali leuco-salt of the vat dyestuff and an alkali leuco-salt of Indigo, together with an agglutinating or diluting agent when necessary.—A. J. H.

Paper or fabric surfaces that have been treated with proteins; Process for producing water- and friction-resisting print or colourings on ——. Exportingenieure für Papier- und Zellstofftechnik G.m.b.H. G.P. 303,372, 29.9.15.

The printing ink or colour contains the same or a similar protein to that used in producing the surface on the paper or fabric, and after printing, the whole mass is subjected to treatment with a hardening material which renders all the protein present insoluble in water. For example, if animal glue or casein is used as the protein, the finished print is sprayed with a solution containing tannic acid or chromium compounds and set aside until the surface hardens. To increase the capacity of the prepared paper to absorb water and to obtain sharp prints, an extract of horse-chestnuts is added to the ink, and to increase the resistance of the finished print to water it is coated with a protein solution and again subjected to hardening. The paper may also be treated with a hardening agent before printing. —A. R. P.

Animal fibres; Process for protecting —— in treating them with alkaline liquids. A. G. Bloxam. From Act.-Ges. für Anilinfabrikation. E.P. 183,868, 27.1.21.

See U.S.P. 1,419,497 of 1922; J., 1922, 584 A. Instead of sulphite-cellulose waste liquor, an active constituent of the liquor, *e.g.*, sodium ligninsulphonate or "cell pitch," or a sugar may be used.

Dyeing apparatus. Jackson and Bro., Ltd., G. P. Gass, R. Hammond, and J. R. Fish. E.P. 183,526, 24.3.21.

Starch. G.P. 351,370. *See* XVII.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Hydrochloric acid; A new vessel for the absorption of ——. S. L. Tyler. Chem. and Met. Eng., 1922, **27**, 223—225.

Hydrochloric acid is absorbed by water in a series of broad vessels made of fused silica, connected to form a number of S-bends, and constituting a single conduit through which the gases and water flow. Liquid is retained in each vessel by means of a weir. The roof of each vessel slopes downwards on each side towards the middle, where there is a depression from which condensed liquid drips, forming a curtain through which the gases pass. Packed towers may be arranged between the absorption vessels. Absorption systems suitable for use with the gases from the pan and muffle sides respectively of a hydrochloric acid plant are described. —J. S. G. T.

Potash; Elimination of borates from American ——. W. H. Ross and W. Hazen. Chem. and Met. Eng., 1922, **27**, 167—170.

Potassium chloride produced from the brine of Searles Lake may contain as much as about 25% of borax. Serious injury to crops results from the use of such potassium chloride as a fertiliser. By rapid cooling of the mother liquors containing the potassium salts a high-grade potassium chloride containing less than 0·5% of anhydrous borax is now being prepared from the brine. The product meets the requirement of the U.S. Department of Agriculture limiting the borate content of potassium salts used as fertilisers to a maximum of 0·5—1% of anhydrous borax.—J. S. G. T.

Potassium iodide; Adulteration of —— *with potassium bromide.* J. Grossmann. Pharm. Zeit., 1922, **67**, 689.

Attention is drawn to the occurrence of potassium iodide adulterated with considerable proportions (up to 25—30%) of potassium bromide, and to the inadequacy of the usual test for bromide, owing to the sparing solubility of silver bromide in ammonia. It is recommended that in all cases attention should be paid to the colour of the silver iodide precipitate (darkening on exposure to light occurs more rapidly when bromide is present) and that in doubtful cases the precipitate should be tested for bromide by distillation with ferric chloride.—H. R. D.

Iodates; Detection of —— *in potassium iodide according to the French Codex,* 1908. Lachartre. J. Pharm. Chim., 1922, **26**, 134—138.

The test for iodates in potassium iodide described in the Codex lacks precision, and takes no account of the influence of such factors as the strength of the iodide solution, the amount of acid added, the duration of the reaction, etc. The following method is suggested: A 10% solution of iodide in distilled water is prepared, and to 10 c.c. 3 c.c. of chloroform and 5 drops of glacial acetic acid are added. After shaking for 30 secs. the chloroform, examined immediately after separation, should not be coloured. Performed in this way the limit of sensitiveness of the test is 0·08 pt. per 1000. The presence of small quantities of copper, *e.g.*, 0·0015 pt. per 1000, has no effect on the reaction with a perfectly pure iodide, but appreciably accelerates the development of the iodine coloration when traces of iodate are present. The amount of copper in ordinary distilled water is, however, too small to have any effect on the reaction in either case.—G. F. M.

Sulphites; Oxidation of —— *in concentrated solutions.* J. Milbauer and J. Pazourek. Bull. Soc. Chim., 1922, **33**, 676—678.

A study of the oxidation of sodium sulphite solutions of different concentrations. The rate of oxidation increases with dilution, but is considerably decreased by the presence of carbonic and sulphurous acids. Feebly alkaline solutions are more rapidly oxidised than neutral solutions, but when strongly alkaline the rate of oxidation, even in the presence of catalysts, is diminished. In neutral solutions of all concentrations salts of cobalt are good catalysts, whilst copper salts only function in dilute solutions of high purity. In concentrated solution, sulphites of sodium, potassium, and ammonium behave similarly, both with and without catalysts; in each case, especially with ammonium sulphite, impurities retard oxidation. —H. J. E.

Sulphides; Estimation of —— *by oxidation with ferric sulphate.* P. P. Budnikow and K. E. Krause. Ber. Polyt. Iwanowo Wosniessensk, 1921, [4], 157—159. Chem. Zentr., 1922, **93**, IV., 106—107.

Sodium sulphide solution to which a small quantity of sodium carbonate is added is treated slowly with a 40% solution of ferric sulphate, boiled for 10—15 mins. to oxidise any ferrous sulphide to ferrous sulphate, acidified with sulphuric acid, and then titrated with potassium permanganate. At first it is necessary to keep the solution alkaline to prevent interaction between the ferrous sulphate and sodium sulphide. The method is only applicable to sulphides soluble in water and acids, such as those of sodium, calcium, zinc, etc.—J. B. F.

Phosphates; Estimation of iron and aluminium in natural ——. O. Nydegger and A. Schaus. Bull. Fed. Ind. Chim. Belg., 1922, **1**, 405—407.

Von Gruebeb's method (Prost, Manuel d'anal. Chim., 105) consists in neutralising the solution of the phosphate in hydrochloric acid with 20% caustic soda, adding excess of the latter, boiling the solution to convert aluminium phosphate into aluminate, filtering, acidifying the solution, and precipitating the aluminium as phosphate by means of ammonia. The iron is estimated by titration with permanganate. The authors show that this method is not accurate, the aluminium not being precipitated quantitatively as phosphate, as the preliminary preparation of the solution removes phosphoric acid, so that insufficient remains for the purpose. The error is obviated by the following procedure: 12·5 g. of the phosphate is dissolved in hydrochloric acid and the solution evaporated to dryness to render the silica insoluble. After again dissolving in hydrochloric acid, the solution is diluted, boiled, and made up to 250 c.c. Of this, 100 c.c. is used for estimation of iron and a further 100 c.c. for aluminium. To the latter 10—20 c.c. of a 10% solution of sodium phosphate is added, the whole neutralised with caustic soda, a further 20 c.c. of sodium phosphate added, and the mixture boiled for 5 mins., or until the precipitate is of a brick-red colour. After cooling, the solution is diluted to 250 c.c., filtered, 100 c.c. of the filtrate (equivalent to 2 g. of phosphate) acidified with hydrochloric acid and the aluminium precipitated as phosphate with ammonia, care being taken to avoid an excess of the latter. Control experiments show this modification of the method to be trustworthy.—H. J. E.

Silica and sodium chloride; Interaction of ——. F. H. Clews and H. V. Thompson. Chem. Soc. Trans., 1922, **121**, 1442—1448.

Silica and sodium chloride when strongly heated interact to give, in dry air, sodium silicate and chlorine; in moist air sodium silicate, hydrochloric acid, and a small quantity of chlorine; in moist nitrogen, sodium silicate and hydrochloric acid. The lower temperature limit of the reaction is about 600° C., and the extent of the reaction is still very small at 1000° C. Rise in temperature and presence of moisture increase the velocity of the reaction to a considerable extent. The results obtained by varying the proportions of sodium chloride and silica indicate that the area of contact is more important than the composition of the mixture, unless the proportion of salt falls much below 50%. When quartz is heated with sodium chloride at 1000° C. it is converted into tridymite. The conversion is probably the result of recrystallisation from a solution of quartz in the molten chloride. At 1000° C. quartz is more reactive than precipitated silica or tridymite to sodium chloride.—J. B. F.

Monazite; Attack and analysis of ——. P. Wenger and P. Christin. Ann. Chim. Analyt., 1922, **4**, 231—232.

The hitherto published methods for the attack of monazite are either tedious or else leave large quantities of the rare earths undissolved. By the following method the whole of the mineral can readily be brought into solution. About 1 g. of the finely ground material is heated for 5 hrs. with 5 c.c. of sulphuric acid (sp. gr. 1·84) at 230° C. The resulting pasty mass is gradually poured into iced water, when all but a small residue passes into solution. This is filtered off and again heated with sulphuric acid, a little hydrofluoric acid being added to volatilise the silica. The residue is then melted with 6 pts. of sodium carbonate. On treatment with water the tantalum passes into solution, and any slight residue still remaining will be zirconia and may be brought into solution by fusion with potassium bisulphate. In the subsequent analysis the rare earths should be precipitated by oxalic acid at 55° C. in a solution containing 0·15—0·75% of sulphuric acid and with an excess of 3% of oxalic acid. At this temperature precipitation may be considered quantitative for yttrium, thorium, cerium, and didymium. Lanthanum oxalate, being the most soluble, is not completely precipitated, and 50 c.c. of the solution under the above conditions would retain 0·011 g. in solution.—G. F. M.

Ferrosilicon; Formation of —— in carbide works. O. Hackl. Chem.-Zeit., 1922, **46**, 740.

In the manufacture of calcium carbide at Austrian and Bavarian works a number of brittle metallic reguli were obtained which proved to be ferrosilicon containing a high percentage of silicon.—A. R. P.

Catalysts; Behaviour of certain metals as ——. *I.* C. Sandonnini. Gazz. Chim. Ital., 1922, **52**, I., 394—408.

Experiments have been made on the changes occurring, under the influence of various metallic catalysts, in systems containing detonating mixtures of hydrogen and oxygen together with a compound capable of ready oxidation or hydrogenation, such as ethylene, phenanthrene, nitrobenzene, and allyl alcohol. The velocity of the formation of water from hydrogen and oxygen in presence of finely divided nickel is very greatly diminished by addition of ethylene, although at the ordinary temperature it is the only reaction which proceeds to an appreciable extent. When the temperature is raised the hydrogenation of ethane proceeds with increased velocity and oxidation of ethylene also becomes appreciable. At 225° C. most of the ethylene is hydrogenated to ethane. When copper is used as catalyst it is markedly oxidised, and this favours oxidation phenomena. In mixtures of hydrogen, oxygen, and nitrobenzene, the reduction of the last-named in presence of nickel is more rapid than the formation of water from the hydrogen and oxygen. (*Cf.* J.C.S., 1922, ii., 557.)—T. H. P.

Detonating gas; Combination in —— in presence of colloidal palladium solution. C. Sandonnini and A. Quaglia. Gazz. Chim. Ital., 1922, **52**, I., 409—416. (*Cf.* preceding abstract.)

Experiments with mixtures of hydrogen and oxygen in different proportions in presence of colloidal palladium solution showed that the velocity of combination is proportional to the concentration of detonating gas ($2H_2+O_2$) in the mixture. With mixtures having the same concentration of detonating gas the reaction velocity is greater when excess of hydrogen is present than in presence of excess of oxygen. When the gas mixture contains reducible compounds (ethylene, allyl alcohol, nitrobenzene, sodium phenylpropiolate), in addition to hydrogen and oxygen, hydrogenation reactions may occur as well as formation of water, and it is concluded that the reactions are due to active or atomic hydrogen. (*Cf.* J.C.S., 1922, ii., 556.)—T. H. P.

Sulphur; Solubility of —— in certain organic liquids. R. Delaplace. J. Pharm. Chim., 1922, **26**, 139—140.

The solubility of sulphur in chloroform, carbon tetrachloride, benzene, toluene, and ether was determined at various temperatures ranging from 13° C. to 24° C. The divergence of the results from those obtained by earlier workers is attributed in some cases to the slowness of saturation, continuous agitation for 12 hrs. being required to obtain saturated solutions in benzene and toluene for example. From the results, which are given in tabular form, the following figures for the weights of sulphur dissolved in 100 g. of solvent are abstracted:—In chloroform at 15° C., 0·874 g.; in carbon tetrachloride at 15·5° C., 0·723 g.; in toluene at 20° C., 1·857 g.; in benzene at 15° C., 1·582 g., and in anhydrous ether at 13° C., 0·188 g. —G. F. M.

Sodium in alumina. Geith. *See* X.

Ammonium bicarbonate. Gluud. *See* XVI.

Oxidation of carbon by nitric acid. Philippi and Rie. *See* XX.

Oxidation of carbon by sulphuric acid. Philippi and Thelen. *See* XX.

Patents.

Sulphuric acid; Manufacture of ——. G. Mirat and P. Pipereaut. E.P. 163,030, 13.4.21. Conv., 6.5.20.

The apparatus consists of ten small lead chambers of 280 cub. m. capacity, arranged in series with inlets at the top and outlets near the bottom. The long connecting pipes are rectangular in section and are fitted with superimposed troughs down which a current of water flows. The usual Glover tower is provided, but between the last chamber and the Gay Lussac tower is interposed a series of ten stoneware collectors of 1000 l. capacity, of which the first four contain water and the others strong sulphuric acid. "From this apparatus the gases enter the coke tower deprived of NO_2, which is not soluble in the sulphuric acid and would not be decomposed within the coke tower."—C. I.

Ammonia; Synthesis of —— from its elements and catalyst therefor. The Nitrogen Corp. Assees. of J. C. Clancy. E.P. 156,698, 7.1.21. Conv., 7.1.20.

A catalyst for ammonia synthesis, consisting of a sation of salt from the fuel and its subsequent deposition on the burned ware where it is changed partly to the sulphate by the action of the oxides of sulphur evolved by the fuel.—H. S. H.

Terra-cotta; Shivering of ——. J. L. Carruthers. J. Amer. Ceram. Soc., 1922, **5**, 518—526.

A WHITE matt glaze which had shivered badly in use was applied to bodies prepared from six terra-cotta clays, one non-shivering clay, and one badly shivering clay, and fired to cone 3. Shivering was caused by the presence of finely-divided silica in the body due to the use of highly silicious clays or finely-ground grog of a silicious nature, the presence of soluble salts in the clay, grog, or tempering water, or from too long a firing period. It was eliminated by using a flux such as felspar, felsite, or similar rock to overcome the action of the finely-divided silica, by using a coarse grog or sand so as to give an open structure, and by using barium carbonate to overcome the effects of the soluble salts.—H. S. H.

Zinc oxide [*ceramic*] *bodies; Some properties of* ——. E. E. Libman. J. Amer. Ceram. Soc., 1922, **5**, 488—491.

PURE zinc oxide was moistened with 20% of water and pressed into small cylinders which were heated for several hours in a closed platinum box in a platinum resistance furnace at 1400° C. After cooling the cylinders had a sparkling coarsely crystalline structure, and were probably identical with the mineral zincite. The melting point was above 1800° C. The shrinkage and porosity of the cylinders were determined after heating at temperatures differing by 100° C. from 1000° C. to 1600° C. The shrinkage increased uniformly with rise of temperature, but the porosity decreased gradually to a minimum at 1350° C. and then increased as the temperature was raised, a result due to the gradual growth of large crystals at the high temperatures. In the discussion E. W. Washburn pointed out the possible advantages of incorporating zinc oxide in a zinc retort body.—H. S. H.

Porosity of highly vitrified [*ceramic*] *bodies; Determination of the* ——. E. W. Washburn and E. N. Bunting. J. Amer. Ceram. Soc., 1922, **5**, 527—537.

THE limits of accuracy of the general laboratory research type of porosimeter (J., 1922, 176 A, 217 A, 253 A) are discussed and the principles of design indicated. A new type of porosimeter is described with which the pore volume of any test piece may be determined directly within 0·01—0·02 c.c. Tests of eight pieces of electrical porcelain gave porosities of ±0·01%, results which were confirmed by dye-penetration tests. A simple apparatus for rapidly measuring the porosity of a full size brick is described.—H. S. H.

Tunnel kiln; The Harrop ——. W. E. Cramer. J. Amer. Ceram. Soc., 1922, **5**, 492—499.

THE Harrop car tunnel kiln has been used successfully for the firing of electrical porcelains placed in saggars. The kiln was operated at cones 10, 11, and 12, depending upon the ware being fired. Natural gas was used as fuel, but the kiln can also be fired with oil or coal. Ware has been fired through the kiln in 48 hours. The kiln produces a very uniformly fired product, while the fuel and labour charges and the capital cost are considerably less than for periodic kilns of the same capacity. —H. S. H.

Furnace; New type of gas-fired vitreous enamelling ——. H. H. Clark. J. Amer. Ceram. Soc., 1922, **5**, 478—487.

THE furnace has a working chamber 4 ft. wide, 3 ft. high, and 10 ft. long, and is heated by 5 gas burners on each side supplied with town gas. It can be brought to the working temperature in less than an hour, and in addition to being very economical in fuel, labour, initial cost, and repairs, it produces ware with a very high gloss.—H. S. H.

Silicates; Adsorption and dissolution of gases by ——. (*"Spit-out."*) B. Moore and J. W. Mellor. Trans. Ceram. Soc., 1921-22, **21**, 289—316.

"SPIT-OUT" results from the production and bursting of bubbles in glazes on firing in the enamel kiln at 700°—900° C. It may be caused by the sulphur dioxide and oxygen set free as a result of the diminution in the solubility of sulphates by an increase in the acidity of the glaze brought about by dissolution of silica from the body by the glaze, by the volatilisation of "lead" from the glaze, or by the absorption of "lead" by the body from the glaze. A similar result is produced by the reduction of stable sulphates to unstable sulphites. Microscopical examination of numerous glazes showed that few cases of "spit-out" were caused by the bursting of bubbles which were imprisoned in the glaze during glost firing. The absorption of hydrocarbon gases by glazes when cooling in an atmosphere of coal gas was shown experimentally. Large amounts of hydrocarbon vapours are generated in the earlier stages of firing muffles containing ground laid ware, ware decorated with oils, and lithographed ware. The glaze may then become charged with combustible gases which on heating in an oxidising atmosphere may burn below the surface of the glaze forming steam and carbon dioxide and giving rise to local heating, which will soften the glaze locally and facilitate "spitting." A certain amount of solid carbon may enter the glaze and if its subsequent combustion is rapid, "spitting" will result. The glaze may take up abnormal amounts of gas when hard fired and reject it in the form of "spits" in cooling, a result which is frequently accompanied by devitrification. Silicious glazes or glazes on highly silicious bodies, calcareous glazes, and all glazes having a tendency to devitrification in the enamel kiln are liable to this defect, which is corrected by the addition of alumina. It is important that enamel kilns should be well ventilated, so that oils distilled from the hot ware are not condensed on cooler ware, but are carried out of the kiln. The inside of hollow-ware is frequently "spitted" when the outside is good, owing to the difficulty of renewing the atmosphere inside the ware. If organic matter in the body has been imperfectly oxidised in the biscuit oven, the entry of air into the body in any subsequent firing causes the combustion of the organic matter, and the resulting products of combustion, heated by the reaction, are forced through the glaze, causing "spitting." Bad ventilation of the oven permits hydrocarbons and moisture to collect round the ware and so prevent the ingress of oxygen until a high temperature is reached, when the carbonaceous material burns with violence and damages the glaze. Carbonaceous matter may also be absorbed by the body in the ovens or kiln and burned out at a higher temperature. The rapid evolution of moisture absorbed by the body is a frequent cause of "spitting" and the authors consider that the presence of moisture or organic matter in the body causes 80% of the "spitting" which occurs in the manufacture of pottery. Any cause which favours absorption of moisture by the biscuit or glaze, and abrupt rises of temperature favouring an explosive evolution of steam etc. should be avoided.—H. S. H.

Glaze-fit; Control of —— *by means of tensile test specimens.* F. H. Riddle and J. S. Laird. J. Amer. Ceram. Soc., 1922, **5**, 500—503.

THE selection of a suitable glaze for a particular

body by the usual inspection of a field of glaze trials is not sufficiently precise and gives no indication of slow crazing tendencies. The effect of glazes on the tensile strengths of electrical porcelain test pieces was determined, and it was found that the best fitting glazes increase the strength, while the poorer ones decrease it. Glazes which craze weaken the specimens very markedly owing to the production of strains in the surface layer of the porcelain.
—H. S. H.

Patents.

Glass furnace; Electro-fining ——. W. G. Clark. E.P. 161,192, 6.4.21. Conv., 6.4.20.

The glass is maintained in the molten state in a vessel heated directly by gas or other suitable fuel, and at the same time an electric current is passed through the molten mass for fining the glass. The distance between the electrodes immersed in the molten glass is gradually increased as the temperature rises, so as to maintain a constant electrical resistance between them. Direct current or alternating current of low frequency is unsuitable owing to the tendency to decompose the oxides of the glass. No such decomposition occurs if the frequency of the alternating current is greater than 60 cycles.
—H. S. H.

Glass furnaces. J. S. Atkinson, and Stein and Atkinson, Ltd. E.P. 183,373, 26.8.21.

In tank furnaces fired by means of horseshoe or side firing and which may be arranged so that the flames have reverberatory effect, the recuperator, fixed under the tank, is made of special heat-exchanging blocks (E.P. 182,075) which are provided with ribbed internal passages increasing the area exposed. These blocks are built up so that the internal passages are vertical throughout the length, and the secondary air is drawn up through these passages. The producer is built right up to the furnace. The heat-exchanging blocks in the recuperator are set so as to provide ample room between them for the passage of waste gases. In the case of the transversely fired type, the recuperator is in two parts, one under each side of the tank.—A. C.

Furnaces; Glass and other ——. C. S. Stafford. E.P. 183,572, 25.4.21.

A waterproofing material is applied to the outer face of the furnace blocks to enable water cooling to be applied without injury to the blocks or causing devitrification of the glass by penetration to the inner surface of the block. Molten metal, *e.g.*, brass, or a vitreous enamel may be sprayed on by any known apparatus. If necessary the block may be coated prior to assembly and the joints faced over. An oxyhydrogen burner rather than an oxyacetylene one should be used with metal, as the surface is then less porous. Means for applying the water and removing the drainage are indicated. A cement to be applied before spraying and which is non-shrinking and less porous than the blocks is composed of 60% of grog, 38% of fireclay, and 2% of sodium silicate, ground very fine and thoroughly mixed.—A. C.

Moulds; Metallic —— *for forming glass articles.* R. L. Frink. E.P. 183,582, 26.4.21.

Moulds with vasculer or finely pitted surfaces are used which, when dipped in water or other fluid, retain sufficient to provide a vapour cushion when the hot glass is blown in, thus preventing actual contact of the glass with the mould, resulting in a finer polish on the glass and less wear on the mould. Mineral oil or tallow may be used as lubricant under special conditions. Suitable alloys for the whole mould or the inner lining to provide the necessary vascular condition of the surface are those of copper or aluminium with alkaline-earth metals or magnesium, *e.g.*, aluminium alloyed with 4% of calcium and 1% of barium. The pitted surface of the necessary character for the particular type of ware is produced by treating with alkali hydroxides for a suitable period, and sometimes by additional heat treatment. A "master alloy" which can be mixed with aluminium to give the required properties is given as 75% of aluminium and 25% of barium or calcium. The temperature to which it is heated before casting has a great effect on the characteristics of the product.—A. C.

Ceramic materials, glass and glazing; Production of ——. Ges. für Tuff- und Ton-Technik m.b.H. E.P. 166,558, 18.7.21. Conv., 20.7.20.

Pumice tuff which has previously been freed mechanically or chemically from extraneous substances is employed in the production of ceramic materials, glass, and glazes.—H. S. H.

Gas producers, electric furnaces, crucible furnaces, and the like [; *Refractory linings for* ——]. Ferolite, Ltd., and H. B. Clapp. E.P. 183,219, 15.4.21.

A material suitable for resisting the action of heat and fuel ash in furnaces is prepared by mixing 1 pt. of chromite crushed to pass through a $\frac{1}{8}$ in. mesh with 1 pt. crushed to pass through a $\frac{1}{16}$ in. mesh. About 5% of finely ground ferrosilicon containing about 70% Si is suspended in about 10% of a sodium silicate solution and incorporated with this mixture to give a plastic mass which may be made into bricks or tamped around a core.—H. Hg.

Synthetic jewel bearing. T. G. McDougal and S. J. McDowell, Assrs. to Champion Ignition Co. U.S.P. 1,422,216, 11.7.22. Appl., 14.1.20.

A process of manufacturing a synthetic jewel bearing consists in mixing two batches of ingredients which when fused form glasses of high viscosity, one of the batches having a higher fusing point than the other. A body for the bearing is compressed from the batch of higher fusion point, additional material from the other batch being compressed with it to form a facing. The bearing is then fused while supported on powdered material to which it will not adhere when fused, and is subsequently annealed.
—H. S. H.

Zinc retorts and other refractory shapes; Making of ——. W. F. Rossman, Assr. to American Zinc, Lead, and Smelting Co. U.S.P. 1,424,120, 25.7.22. Appl., 16.5.21.

A refractory material for zinc retorts and the like consists of plastic clay mixed with finely ground silica and ground grog in about equal proportions.
—A. R. P.

Kiln; Continuous chamber —— *for burning ceramic wares, lime, dolomite, etc.* H. Koppers. G.P. 349,951, 22.8.19.

A continuous chamber kiln is provided with flues leading from the top of one chamber to the sole of the next, to supply cold air, with trace holes through which the hot gases pass from the sole of one chamber to that of another, and with sand ducts for sealing the trace holes with sand. Any surplus hot air gives up its heat to a regenerator, which is then used for warming the gases which have been previously cooled to facilitate purification. In burning lime, dolomite, etc., the waste gases are used to preheat the freshly-set chambers and the incoming heating gases, the air supply being preheated by the hot calcined material.
—A. B. S.

Kiln; Continuous down-draught chamber ——. A. W. F. Weyers. G.P. 349,952, 22.4.20.

A continuous down-draught chamber kiln has a series of gas producers in each of the partition walls between the chambers, and the air or mixture of air and hot gases is supplied in part to the grate of the producer, and in part upwards around the walls of the producers. The gas-producers and air-flues are arranged alternately across the kiln. In the lower part of each producer are poke holes, so that air may be freely admitted through these holes, or the production of gas may be regulated by closing the holes with ashes; this arrangement permits adequate regulation of the temperature without the use of dampers.—A. B. S.

Sheet glass; Method of and apparatus for drawing ——. W. J. Mellersh-Jackson. From The Libbey Owens Sheet Glass Co. E.P. 184,053, 28.7.21.

Kiln; Tunnel ——. A. McD. Duckham and A. T. Kent. U.S.P. 1,424,560, 1.8.22. Appl., 27.2.22.

See E.P. 177,561 of 1920; J., 1922, 417 A.

IX.—BUILDING MATERIALS.

Patents.

Wood; Process for the artificial maturing or seasoning of ——. G. F. Lyon. E.P. 182,504, 2.2.21.

The wood is first subjected to a pressure a little lower than atmospheric in an autoclave and is subsequently treated with dry ozonised air for a suitable period, the process being repeated until the required effect is obtained.—H. S. H.

Fire-proofing and/or waterproofing treatment of materials [wood etc.]. A. Arent. E.P. 164,730, 23.5.21. Conv., 9.6.20. Addn. to 132,813.

See U.S.P. 1,418,610 of 1922; J., 1922, 548 A. Waterproofing agents, such as rubber, varnish gums, drying oils, and the like, may be added to the solution of antimony trichloride in benzol.

Kiln. G.P. 349,951. *See* VIII.

Calcining marble etc. G.P. 351,352. *See* X.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Blast-furnace practice; The bases of modern ——. A. K. Reese. Iron and Steel Inst., Sept., 1922, [Advance proof.] 35 pages.

A description of the bases of modern blast-furnace practice under the headings: preparation of materials; furnace design; auxiliary equipment; method of operation. An essential feature of the modern method of operation is the supply of a uniform volume of blast irrespective of furnace pressure or resistance.

Cast iron; Growth of grey —— during repeated heatings and coolings. T. Kikuta. Sci. Rep. Tôhoku Imp. Univ., 1922, 11, 1—17.

The rate of leakage of air into a hollow cylinder of grey cast iron heated repeatedly to a temperature of 910°—960° C., increased up to 60 heatings and afterwards decreased. For less than 20 heatings the leakage rate was nearly constant with rising temperature up to 900° C.; with more than 34 heatings the rate first decreased and afterwards increased with rising temperature. It is improbable that growth during repeated heating and cooling through the A1 range is caused by the pressure of occluded gases, though at higher temperatures this may be the cause. From measurements of the density of specimens after different heat treatments and of thermal dilatation during continuous heatings and coolings, the following explanation of the growth of grey cast iron is given. During the first heating through 700°—800° C., growth is partly due to the decomposition of cementite. During repeated heating and cooling through the A1 range *in vacuo*, growth ensues from the formation of numerous fissures in the neighbourhood of graphite flakes, due to differential expansion of different micro-portions of the metal. Under oxidising conditions oxides are formed and fill the fissures during the Ar1 transformation, thus accelerating the growth. The effect of the oxidation is therefore only indirect. The growth of white cast iron is almost completed during the first heating to 800° C., being due to the extent of about one-third to the decomposition of cementite and to the extent of about two-thirds to the minute fissures caused by irreversible expansion of different micro-portions.
—T. H. Bu.

Cast iron; Influence of cross-sectional area of the test-piece on [the results obtained for] the tensile and bending strength of ——. P. Oberhoffer and W. Poensgen. Stahl u. Eisen, 1922, 42, 1189—1192.

Determinations of the bending and tensile strengths of test-pieces of cast-iron of different diameters cut from the same casting gave figures that increased rapidly to a constant value when the diameter of the test-piece exceeded 20—25 mm. The results are discussed from the point of view of the distribution of the graphite inclusions and the phosphide network in the structure of the metal.
—A. R. P.

Boiler plate after cold work or work at blue heat. H. J. French. Chem. and Met. Eng., 1921, 24, 211—216.

Mechanical tests on fire-box plate which had been reduced 6·25% and 12·5% respectively by light rolling at 295° C. showed that the increase in strength of the metal was about twice that produced by similar cold reduction. Above this temperature the increase due to blue deformation was somewhat less than from cold rolling. The maximum strength of the steel subjected to 6·25% reduction was obtained at 295° C., the strength-temperature curve being similar to that of cold-worked steel. The proportional limit resulting from blue strain (6·25% reduction) was greater than that obtained from a cold reduction twice as great. Elongation and reduction in area decreased to a minimum at about 200° C., and increased to high values at 460° C., with a marked increase between 295° and 410° C. Annealing for 30 mins. at 700° C. completely removed the effect of blue deformation. The general form of curves showing tensile strength in a transverse direction was similar to those for longitudinal tests, but the limit of proportionality did not increase with the first rise in temperature in the transverse test specimens. Repeated overstrain at blue heat whether at constant or increasing loads raised the apparent limit of proportionality, which in one case increased from 15,000 to 56,000 lb. per sq. in. Such deformation did not, however, appear to modify other mechanical properties when the specimen was broken finally. Heating steel overstrained at blue heat, to above the Ac1 point, or allowing a period of rest, restored the apparent elasticity of the metal at ordinary temperature. The increased strength of steel due to blue deformation was not a skin or surface effect.—C. A. K.

Carbon tool steels; Black fractures in ——. A. W. F. Green. Chem. and Met. Eng., 1922, 27, 256—267.

Certain ingots of a hyper-eutectoid tool steel made by the crucible process to the following composition, 1·16% C, 0·30% Mn, 0·024% P, and 0·25% Si, showed on fracturing a considerable black area usually concentric with the contour of the ingot and containing a small white area of the same shape in the middle. These formations were noticed only after the steel had been annealed to cause the cementite to assume a spheroidal form, *i.e.*, at a temperature just below the Ac 1, 2, 3, range. Chemical analysis of black and white parts gave identical figures, but the Brinell hardness of the black part was only 95 as compared with 170 for the white part. Further annealing of the material at a low temperature caused the formation of further black areas, while quenching from 770° C. had the same hardening effect in both black and white areas. Photomicrographs and a heating and cooling curve are given. —A. R. P.

Chromium steels; Resistance to corrosion of various types of ——. H. S. Rawdon and A. I. Krynitsky. Chem. and Met. Eng., 1922, 27, 171—173.

Details are given of the corrosion effects produced in samples of chromium- and nickel-steels when exposed to the action of dilute hydrochloric acid, and when submitted to a weathering test consisting in immersing the steel in distilled water just below the surface and exposing to the atmosphere. Pure iron and steels of low chromium content were much more resistant to hydrochloric acid than those of high chromium content. In the weathering test the general order of resistance to corrosion was reversed. Hardened samples were considerably more resistant to acid attack and to weathering than annealed samples. Steels containing considerable nickel were most resistant to acid attack. Steels of high chromium content showed the least corrosion effects in the weathering test, while steels of low chromium content were more resistant than carbon steel or pure iron. Adhering patches of oxide had a marked effect in accelerating the corrosion due to weathering. A steel containing a high nickel and chromium content (20·12% Ni, 7·68% Cr) was least attacked by acid and was very resistant to atmospheric corrosion.—J. S. G. T.

Gold precipitation by zinc dust in conjunction with de-aeration of solution at Modderfontein B [*Transvaal*]. S. Newton and L. L. Fewster. J. Chem. Met. Soc. S. Afr., 1922, 22, 249—257.

The cyanide solution from the leaching tanks is passed through three clarifiers in parallel and the clear liquid is then pumped into precipitating tanks where a uniform feed of 90-mesh zinc dust is mechanically sprinkled into the solution. The whole is then pumped through precipitation presses where the whole of the solution at some period comes into contact with layers of fine-grained precipitant, thus ensuring complete removal of the gold. The effluent from the presses, containing 0·02 dwt. of gold per ton, is used for washing the sands after leaching. The press-cake is cleaned with acid, smelted in Tavener furnaces and the product is cupelled. To obtain the best results in the precipitation process with the minimum zinc consumption it was found necessary to de-aerate the solution by passing it through a vessel where it is subjected to a vacuum of 22 in. In this case the zinc consumption is so reduced that the gold is precipitated in a slimy state, so that it was found necessary to add a filtering medium such as coke, sawdust, or kieselguhr, whereby a sufficiently "dry" cake for handling was obtained. Lead nitrate solution is added to the liquor from the clarifiers to assist in collecting the gold; added in this way less zinc is required than by the older method of allowing lead nitrate solution to drip continuously into the precipitating tank.—A. R. P.

Silver; Density of molten ——. R. Hoffmann and W. Stahl. Metall u. Erz, 1922, 19, 357—358.

The average coefficient of expansion of silver between t_1° C. and t_2° C., the latter temperature being above the melting point, is given by the equation $K=(V_2-V_1)/(V_1t_2-V_2t_1)$ where V_1 and V_2 are the volumes of the same mass of silver at t_1° and t_2° C. respectively. Using this relation and representing the specific gravity of silver at t_1° and t_2° C. respectively by S_1 and S_2, the specific gravity of molten silver at any temperature may be calculated by means of the equation $S_2=S_1(1+Kt_1)/(1+Kt_2)$. The values as obtained for 1000°, 1025°, and 1050° C. are 9·653, 9·633, and 9·613 respectively. —A. R. P.

Ferro-titanium; Rapid [*method for the*] *complete analysis of* ——. C. Grandjean. Chim. et Ind., 1922, 8, 46.

One gram of the powdered alloy is roasted for 15 min. and the product is fused with 25—30 g. of sodium carbonate in a nickel crucible. The melt is extracted with water, the insoluble residue collected on a filter and well washed with dilute sodium carbonate solution. The filtrate is used for the determination of silicon and aluminium, and the residue is dissolved in hydrochloric acid. The solution is treated with ammonia until a small white precipitate just fails to redissolve, then boiled with 50 c.c. of sulphur dioxide solution for 15 min. to precipitate the titania, which is filtered off, ignited, and weighed at TiO_2. It must be tested for iron by ammonium sulphide in ammoniacal tartrate solution and a correction applied corresponding to the amount of iron found. The filtrate from the titania is used for the determination of iron, manganese, calcium, and magnesium by the usual methods.—A. R. P.

Copper; Study of the "hydrogen sickness" of ——. O. Bauer and Vollenbruck. Z. Metallk., 1922, 14, 296—299.

In rolling cast copper bars into sheets it is usual to heat them to the rolling temperature by causing a gas flame to play on the upper surface of the bar. In the case of bars containing cuprous oxide cracks and fissures often develop during the subsequent rolling and it is shown that the cause of these cracks is most probably the reduction of the cuprous oxide to metallic copper by the hydrogen in the gas with the simultaneous formation of steam in the metal under considerable pressure, this steam forcing its way out and producing a crack. During the rolling this crack becomes filled with fresh quantities of cuprous oxide and further failure of the metal results. It was found that if the metal was annealed in an atmosphere free from hydrogen before rolling, no trouble was experienced in working it.—A. R. P.

Copper; Corrosion of —— *by salt solutions.* W. Müller. Z. Metallk., 1922, 14, 286—295.

The corrosive action of sea water and of its contained salts, sodium chloride, magnesium sulphate, magnesium chloride, and calcium sulphate, on annealed copper and on copper that has been subjected to different degrees of rolling, was studied over considerable periods and with differing strengths of solution, and the results are reproduced in a series of tables and graphs. The general effect of the chlorides is much more marked than that of the sulphates; sodium chloride is the most active corroding agent, causing after 48 hrs. a considerable deposit of basic copper chloride which is readily detached and so does not protect the metal from further attack. The resistance to corrosion by sodium chloride is decreased by rolling the metal, but rolling increases the resistance towards sea water, magnesium sulphate, and magnesium chloride.—A. R. P.

Aluminium; Solubility of gases in ——. J. Czochralski. Z. Metallk., 1922, **14**, 277—285.

Molten aluminium does not begin to dissolve any of the common gases until about 900° C., but at higher temperatures considerable amounts may be dissolved, and retained in the form of minute blowholes in the solid metal. The following table shows the amount of gas, in volumes per cent., dissolved at the high temperature and retained by the solid metal at ordinary temperatures:—

°C	N_2	O_2	Air	CO	CO_2	SO_2	H_2	Town gas
1200	0·4	2·5	1·3	1·3	2·5	5·4	6·5	5·5
1500	3	12	6	8	12	7	15	12·5

In the case of the first six gases very small amounts of the absorbed gases combine with the metal with formation of aluminium nitride (AlN), oxide, carbide (Al_3C_4) or sulphide, and the metal structure shows characteristic inclusions of these constituents. The mechanical properties of the metal after treatment with any of the above gases showed practically no change, but in all cases blisters and splitting of the edges occurred during rolling. The most suitable temperature for rolling metal containing many gas-pores was found to be between 300° and 350° C. —A. R. P.

Aluminium and alumina; Determination of small quantities of sodium in ——. R. Geith. Chem.-Zeit., 1922, **46**, 745.

Aluminium cannot be separated completely from sodium salts by precipitation with ammonia, as a little alumina invariably remains dissolved, probably in a colloidal form. The following electrolytic method gives good results: 2 g. of the metal is dissolved in a minimum of hydrochloric acid and any silica and copper removed by filtration. The clear liquor is transferred to a bottomless cylindrical vessel floating in a tray of mercury at the bottom of a glass trough which is filled with dilute, neutral sodium chloride solution to about ½ of the height of the vessel containing the assay. A carbon anode is suspended in the assay solution and a current of 0·15 amp. at 3·5 volts is passed between the carbon and the mercury for 2—3 hrs., whereby all the sodium is deposited in the mercury as amalgam and passes out of the cell, the sodium dissolving in the weak salt liquor as sodium hydroxide which may be determined volumetrically. Four nickel wires are suspended in the mercury outside the cell, forming a couple, which ensures rapid solution of the sodium in the chloride liquor, and the gases evolved from the electrolysis are removed by suction as fast as they are formed. The determination of sodium salts in alumina, such as that prepared for the manufacture of aluminium, is effected by evaporating 1 g. of the material 2 or 3 times to dryness with sulphuric acid, extracting the residue with water and electrolysing the filtered extract with 0·2—0·3 amp. at 4—5 volts, using a platinum anode.—A. R. P.

Tin; Simple and rapid estimation of —— in bearing metal and like alloys. J. Nagel. Chem.-Zeit., 1922, **46**, 698.

From 0·5 to 1·0 g. of the alloy is introduced as filings into a 300 c.c. titration flask covered with a watch-glass, together with 2·3 g. of potassium chlorate and 100—150 c.c. of concentrated hydrochloric acid, and heated as long as chlorine is evolved. The solution is then diluted with 30 c.c. of distilled water, and 5—7 g. of sodium chloride added to raise the boiling point. A nickel plate about 3 mm. thick and 10 sq. cm. area, bent into the form of a ring, is then placed in the liquid and the flask heated for about 1 hr. Stannic chloride is reduced to stannous chloride, whilst antimony is precipitated in flakes upon the nickel. The liquid is then boiled to expel air and a current of carbon dioxide passed through it while cooling. The stannous chloride is then titrated with iodine. The method is accurate in presence of antimony, copper, and lead.—C. I.

Strontium-lead alloys; Constitutional diagram of ——. E. Piwowarsky. Z. Metallk., 1922, **14**, 300—301.

Lead and strontium are practically immiscible in the solid state. The compound, Pb_3Sr, containing 12·35% Sr melts at 676° C., and alloys containing less strontium begin to deposit crystals of this compound at progressively lower temperatures situated on a parabolic curve convex to the axis of temperature. In all the alloys a break occurs in the cooling curve at 327° C., indicating the presence of a eutectic. Alloys containing less than 12·35% Sr show dendritic masses of cubo-octahedral crystals of the compound disseminated throughout a ground mass of pure lead.—A. R. P.

Metals; Determination of gases in ——. H. L. Simons. Chem. and Met. Eng., 1922, **27**, 248—249.

The metal is dissolved in mercury and the evolved gases are collected first in a Geissler tube for spectroscopic examination, then in the usual gas apparatus for quantitative analysis. The apparatus consists of a dissolving flask connected with a Liebig condenser by means of a ground glass stopper, the upper end of the condenser being bent at right angles and closed with a stopcock. Between this and the Toepler pump a three-way stopcock is introduced connecting also with a source of pure dry oxygen. Between the two stopcocks a T-tube connects with the Geissler apparatus and between the condenser and the dissolving flask a second T-tube connects with the mercury reservoir. The apparatus is first exhausted, then filled with oxygen and again exhausted. Oxygen is once more admitted, the sample placed in the flask and all the joints closed with mercury seals. After again exhausting till a spark refuses to pass in the Geissler tube, the mercury is allowed to run on to the metal and heated until the sample dissolves. After cooling, the stopcock above the condenser is opened and the evolved gas examined in the Geissler tube, then transferred to the ordinary gas-analysis apparatus. —A. R. P.

Gas producers and blast-furnace practice. Korevaar. See IIA.

Ferrosilicon formation in carbide works. Hackl. *See* VII.

Reversible expansion of silica. Houldsworth and Cobb. *See* VIII.

Patents.

Steel; Process for the production of basic ——. Usines Métallurgiques de la Basse-Loire (Soc. Anon.). E.P. 163,693, 28.4.21. Conv., 18.5.20.

Pig iron containing more than the normal quantity of silicon is introduced into a converter which already contains a highly oxidised ferruginous slag together with all the lime required for the final operation. The slag bath oxidises the silicon immediately the molten iron is added, and undue projection during blowing is prevented.—C. A. K.

[Iron] ores; Process of reducing ——. Trent Process Corp. Assees. of W. E. Trent. E.P. 169,950, 13.4.21. Conv., 4.10.20.

Iron ore is ground with coal and the mixture heated to 300°—400° C. to obtain the maximum yield of oils and partially reduce the iron oxide to a compound which is magnetic or to metal. The material is then subjected to magnetic separation to remove the iron-bearing material in substantially pure form. The non-magnetic portion is mixed with water and part of the oil obtained in the first step to separate the carbonaceous material from the gangue constituents of the ore, and the resulting oily mass of carbon is mixed with the magnetic material and the mixture is smelted to give pure iron or, if desired, steel.—A. R. P.

Steels and the like; Annealing and hardening high and low carbon ——. F. J. Parr, J. Mawer, and W. Painton. E.P. 182,825, 3.1.21.

Steel is embedded in a material which is produced by artificially drying plants of the pea and bean varieties, and adding powdered charcoal, and is then annealed or hardened as usual.—C. A. K.

Iron or steel surfaces; Treatment for obviating the rusting or oxidation of ——. W. B. Brunskill. E.P. 182,988, 10.5.21.

Iron or steel is treated with a boiling solution of zinc di-hydrogen orthophosphate (about 1%), the article being in contact with metallic zinc and placed on a zinc support. Zinc dust may be added to the solution to give many points of contact. A hard grey coating of zinc is deposited on the metal with a minimum quantity of iron phosphate, and the colour of the coating is not altered when the deposit is permeated by oil. The preparation of the solution is described in E.P. 169,884 (J., 1921, 854 A).—C. A. K.

(A) *Iron; Treating ore to produce pure* ——. (B, C) *Process of extracting iron from its ores.* (D) *Process of extracting metals from their ores.* A. J. Moxham. U.S.P. 1,420,127—30, 20.6.22. Appl., (A) 8.1.19, (B, C) 5.4.19, (D) 2.11.18. (D) Renewed 13.12.21.

(A) Oxide of iron present in the ore is reduced and the iron is purified by electrolysis while the reduced material is in the form of fine particles in good conductive contact with each other. (B) An iron solution is subjected to electrolysis to separate the iron, the acid set free being caused to combine with a base other than iron, by which means re-solution of the iron is prevented. (C) Iron is dissolved from its ore with hydrochloric acid. Sulphuric acid is added, setting free the hydrochloric acid for re-use and forming iron sulphate, from which the iron is separated by electrolysis. (D) A metallic constituent (iron) is dissolved from ore and the gangue separated from the solution, which is subjected to electrolysis to separate the pure metal.—T. H. Bu.

Steel; Manufacture of open-hearth ——. H. C. Ryding and A. W. Allen. U.S.P. 1,423,031, 18.7.22. Appl., 6.7.17.

A complete charge of molten blown metal is introduced into a bath of highly heated complete oxidising slag containing lime in an open-hearth furnace. An entirely new slag is used for each heat of metal.—C. A. K.

Silicon-manganese-chrome steel; Method of producing ——. G. Gufstafson, A. A. Jungmarker, and K. A. Caspersson. U.S.P. 1,423,847, 25.7.22. Appl., 17.3.21.

A charge of molten basic open-hearth steel is treated successively with ferromanganese and a previously melted decarburised alloy of ferrochrome and ferrosilicon.—C. A. K.

[Iron;] Process and apparatus for the operation of cupola furnaces [for smelting ——*]*. H. Koppers. G.P. 348,384, 29.3.19. Addn. to 341,637. (*Cf.* U.S.P. 1,357,781; J., 1921, 16 A, and G.P. 343,944; J., 1922, 470 A.)

The molten iron and slag are allowed to flow away slowly from the furnace so that the surface of the slag is maintained in the neighbourhood of the tuyères, whereby the carbon that is dipping in the slag attains a very high temperature, rapidly reduces the oxides therein and causes the sulphur to combine readily with the lime to form calcium sulphide; owing to the low wind pressure in the cupola, the slag readily flows away while a simultaneous evolution of a part of the contained gases takes place. The collecting tank furnace for the molten iron is provided with a regenerator which is heated by means of the gases evolved through the slag overflow. In this way the metal is raised to such a temperature as to allow of the necessary additions of alloying elements according to the use to which the metal is to be put.—A. R. P.

Iron; Process for making —— *capable of being hardened.* R. Walter. G.P. 353,623, 6.11.18.

Soft or cast iron is rendered capable of being hardened by the addition of small quantities of boron; the effect is noticeable with 0·001% B. Boron increases the mechanical strength and causes a decrease in the grain size of the metal.—A. R. P.

Refractory oxides; Method of producing high temperatures for reducing ——. A. Pacz. E.P. 160,427, 18.3.21. Conv., 19.3.20.

An alloy of the rare earth elements and aluminium is produced by reducing the double sodium fluoride of the rare earth element with aluminium over a bath of molten aluminium according to E.P. 160,426 (J., 1922, 637 A). The resulting alloys are broken up and used instead of aluminium in the alumino-thermic reduction of refractory oxides, such as those of zirconium or boron. The temperature of the reaction is much greater than when aluminium alone is used and good yields of alloys with a high content of the refractory element are obtained.—A. R. P.

Furnace; Open hearth ——. Miami Metals Co. Assees. of G. L. Danforth. E.P. 182,399, 7.12.21. Conv., 26.9.21.

In a reversible open-hearth furnace dampers are introduced between the air and fuel ports and the furnace chamber which enable the effective passage area between the ports and the melting chamber to be varied. The air ports are situated on each side of the fuel port, so that the air streams are directed by the dampers towards the central fuel stream. The dampers are removable from the outgoing end of the furnace, and may be introduced through the furnace roof or laterally from each side.—T. H. Bu.

Blast furnaces and the like; Process for sealing cracks in the linings of ——. T. Kennan. U.S.P. 1,423,332, 18.7.22. Appl., 14.1.22.

The stock level in the furnace is raised above the level of the crack and a flow of air is concentrated in the material adjacent to the crack so that fluxing occurs and molten material enters and fills the crevice.—C. A. K.

Light metals [e.g. magnesium and aluminium alloys]; Process for recovering —— *from scrap.* Chem. Fabr. Griesheim-Elektron, and A. Beielstein. E.P. 182,948, 15.4.21.

Magnesium or aluminium or their alloys, in the form of scrap mixed with non-metallic impurities, such as oxides of the metals, sand, or graphite, are introduced into a heated pot fitted with a stirrer carrying a number of arms. As the metal melts down a quantity of anhydrous magnesium chloride, approximately equal in weight to the impurities present, is slowly stirred in, and stirring is continued until the liquid chloride has disappeared from the surface of the metal and the impurities have agglomerated into nodules which absorb the chloride. At this stage stirring is stopped and the agglomerated masses of impurity sink to the bottom of the pot carrying with them all the magnesium chloride added. The temperature is then raised to that required for pouring and the purified metal is poured away from the impurities. Magnesium chloride may be replaced by carnallite or may be made *in situ* by passing chlorine into the melting metal.—A. R. P.

Mineral particles of different degrees of specific gravity; Separating mixed ——. *Differential flotation separator.* W. H. Peck. U.S.P. (A) 1,420,138 and (B) 1,420,139, 20.6.22. Appl., 20.7.21.

(A) The materials are subjected to the floating action of an aerated emulsion of water, oil, and a flotation reagent, and to the action of centrifugal force of such intensity that the heavier particles are precipitated through the emulsion while the lighter particles are floated by the emulsion. (B) A vessel containing a liquid flotation medium is rotated and is so arranged that during operation the flotation medium presents a substantially unobstructed flotation surface facing the direction of the axis of rotation. On feeding in particles of different specific gravities, the energy of the flotation medium and the centrifugal energy of the particles act in opposite directions. Means are provided to supply pneumatic agitating currents from the bottom of the vessel at the periphery.—T. H. Bu.

Pulverulent material; Concentrating ——. F. Ondra, Assr. to Concentrators, Ltd. U.S.P. 1,421,984, 4.7.22. Appl., 28.1.20.

The material is mixed with a fluid under pressure and projected in a stream inclined at an angle to the vertical. The particles are collected in predetermined zones as they fall due to their weight. Fractions of gangue and mineral particles of the same weight, but varying as to size, are thus obtained, and are subsequently separated according to size of particles.—T. H. Bu.

[Lead and iron sulphide] ores; Concentration of —— *by flotation.* G. E. Sheridan and G. G. Griswold. U.S.P. 1,421,585, 4.7.22. Appl., 13.1.21.

The ore is treated with a cyanide and an alkaline salt and subjected to a flotation operation. Lead sulphide is recovered in large part in the resulting froth, the flotation of iron sulphide being largely inhibited.—T. H. Bu.

Metals [e.g. copper]; Process for recovering or dissolving ——. H. Bardt, Assr. to Sociedad Hidro-Metalurgica. U.S.P. 1,423,069, 18.7.22. Appl., 17.9.21.

An ore, matte, alloy or cupriferous waste is dissolved in a mixture of sulphuric and nitric acids, in the presence of a catalyst, under a pressure produced by electrolysing the solution in a closed vessel.
—A. R. P.

Alloy and method of producing same. C. A. Laise, Assr. to General Electric Co. U.S.P. 1,423,338, 18.7.22. Appl., 13.9.20.

An alloy containing a predominating amount of tungsten, together with gold and about 0·1% of vanadium is claimed.—A. R. P.

Arc welding; Electrical ——. J. Churchward, Assr. to Wilson Welder and Metals Co. U.S.P. 1,423,914, 25.7.22. Appl., 14.1.20. Renewed 3.2.22.

An electrode made of tungsten is used for electric arc welding.—C. A. K.

Autogenous cutting and welding; Process for ——. Rheinisch-Westfälische Kupferwerke A.-G. G.P. 353,597, 18.8.20.

An extremely hot flame is obtained by introducing in a finely divided form into the oxygen stream solid or liquid substances, such as manganese, calcium, aluminium or wood charcoal, which have a high heat of combustion. The process is suitable for removing sows from blast-furnaces by introducing into the taphole a mass of finely divided wood-charcoal and playing a stream of oxygen on to it, whereby the sow is rapidly melted away.
—A. R. P.

Brass; Process for the manufacture of ——. P. Dutoit, Assr. to A. Boever. U.S.P. 1,423,922, 25.7.22. Appl., 10.9.19.

Zinc and copper are introduced, a little at a time, into a bath of a molten salt the sp. gr. of which is intermediate between that of the alloy and that of any slag formed, so that the latter rises to the surface and may be readily removed.—A. R. P.

Zinc; Process for the preparation of pure —— *from crude zinc.* Metallbank und Metallurgische Ges. A.-G. G.P. 301,727, 16.10.14.

Crude zinc is slowly redistilled from a retort the depth of which is several times as great as the diameter at the surface of the metal, *e.g.*, the Kipp retort in which rich zinc skimmings are usually distilled. The retort is charged with metal up to its narrow upper part and heated just above the distillation temperature, fresh zinc being added as the purified metal distils off, while the lead-rich alloy, containing any silver present, sinks to the bottom and is removed from time to time. The process is more efficient the smaller the surface from which the zinc distils.—A. R. P.

Zinc and other volatile metals; Process and apparatus for recovering —— *from ores etc. Process for the reduction of [ores of] zinc and other volatile metals and for calcining marble, dolomite, magnesite and the like.* H. Koppers. G.P. (A) 350,521, 17.4.18, and (B) 351,352, 29.5.18.

(A) The distillation is carried out in two stages; in the first the more volatile impurities are removed by distillation and in the second comparatively pure zinc. The process is carried out in retorts each separated from the others by double heating-walls and each connected with its own regenerator so that each is a separate unit. Each retort is provided with two gas-collecting flues arranged in such a manner that one may be used for the gases evolved in the first stage (steam, carbon dioxide, carbon monoxide, and cadmium vapour) and the other for collecting the zinc. The mixture of zinc vapour and carbon monoxide from the latter is passed up a long column with a cooler at the upper end so that liquid zinc falls down through the column of rising vapours, and a product is obtained which consists of zinc in the purest possible form. In order to obtain good results the vapour must pass into the rectifier at the highest possible temperature; the column is therefore built directly above the furnace. (B) The ore charge is made into large prismatic briquettes which are packed into the centre of the furnace chamber and the space between the walls and the charge is filled with carbon bricks so that the whole charge is enveloped in carbonaceous reducing agent, thereby protecting the walls of the furnace from any fluxing action by the constituents of the charge.

For calcining marble, magnesite, and the like, the material is charged into a brick container of the same shape as the furnace and this is pushed into the latter, heated as desired and withdrawn with the residue at the end of the operation.—A. R. P.

Zinc, calcium, aluminium, silicon and the like; Process for the electrothermic recovery of ——. W. Neumann. G.P. 351,411, 2.10.20.

Elements such as zinc, calcium, and the like having boiling points near to the temperature at which their oxides are reduced, are obtained by smelting the ore mixture in an electric furnace and removing the gases from the top of the furnace and introducing them again at the bottom while the ore charge falls obliquely through the furnace. In this way a constant gas pressure is obtained, and the gases are forced through the charge, facilitating reduction and, in the case of zinc, reducing appreciably the amount of zinc dust formed. —A. R. P.

Zinc; Apparatus for the electrolytic production of ——. E. Langguth. G.P. 352,735, 3.11.20.

Zinc sulphate is electrolysed in a cell with a lead anode separated from the cathode by a porous partition which does not reach to the bottom of the cell. The anode or the cathode, or both, may be surrounded by porous pots having openings at the bottom. With this arrangement any solid particles that fall from the anode fall to the bottom of the cell and may easily be removed.—A. R. P.

Electrolytic cell for the electrolytic treatment of metals and ores. A. Barth. G.P. 351,408, 5.5.21.

A number of metal plates, inclined at a moderate angle, are arranged in a vessel upon a frame which is easily removable. The lowest plate serves as anode. the current passing to the material placed on the plate. The lower side of the next plate in the series acts as cathode, and the upper side, covered with material to be treated, acts as anode, this sequence being continued throughout the series of plates, the last of which serves as cathode. Metals or ores can in this manner be treated with the minimum of electrolyte in the smallest practicable vessel. Gaseous by-products and the concentrated solution are recovered automatically in a manner which prevents the gases liberated interfering with the process of solution, and secures that the solution when formed is not subjected to the further action of the current.—J. S. G. T.

Gold, silver, copper, etc.; Process and apparatus for the electrolytic separation of —— *from alloys.* B. Waeser. G.P. 351,410, 17.3.21.

Alloys containing chiefly gold, silver, and copper, together with smaller amounts of the platinum metals, lead, tin, iron, and other base metals, are electrolysed in a concentrated solution of copper sulphate and nitrate containing a small excess of acid. The electrolysis is carried out in a divided cell in which the electrodes are arranged vertically. The reaction products from the anode compartment are continuously removed together with suspended anode slime and replaced continuously by a stream of the catholyte. The solution removed from the anode chamber is filtered into a drum-shaped precipitating tank, where it is treated with copper to remove silver and less electro-positive metals, which by vigorous agitation are detached from the copper and separated from the solution. The anode may consist of the original alloy in the form of plate, sheet, rods, turnings, or other scrap. —A. R. P.

Aluminium alloys; Manufacture of ——. S. Henlein and E. Motkenlin. G.P. 351,739, 30.3.21. Addn. to 314,999 (J., 1920, 270 A).

The tin content of the alloys specified in the chief patent is kept within the limits 2 and 4%. The resulting alloys may be worked cold or hot and rolled or drawn into wire.—A. R. P.

Cerium and its alloys; Process for coating —— *with other metals.* E. Merck, Chem. Fabr. G.P. 351,750, 23.8.21.

Cerium or one of its alloys is coated with aluminium, magnesium, or zinc by heating it to a temperature below its melting point and then applying the coating metal, preferably in a finely powdered form, either alone or mixed with carbon, sand, or the like, and continuing the treatment for a considerable time.—A. R. P.

Galvanised or tinned metal; Production of coloured coatings on ——. R. Kirchhoff. G.P. 351,981, 31.8.18.

The articles are treated with a paste made from a solution in dilute acids of ferric oxide, or minerals containing it, mixed with sufficient specular iron ore, stibnite, or zinc white to give the articles the shade of colour desired. Graphite may, if desired, be incorporated in the coating mixture. The coatings obtained are resistant to weathering and dirt does not adhere to them.—A. R. P.

Alloys of lead with light metals and cadmium. W. Stockmeyer and H. Hanemann. G.P. 352,471, 8.2.16.

Small quantities of cadmium, not exceeding 5%, reduce the brittleness without deleteriously affecting the chemical resistance of lead alloys containing sodium, magnesium, calcium, and the like. Small quantities of copper may be added to increase the hardness.—A. R. P.

Copper containing bismuth; Process of rendering —— *suitable for technical use.* K. L. Meissner. G.P. 352,685, 6.3.21.

Molten copper containing bismuth is treated with a small quantity of a metal of the alkali, alkaline-earth or rare earth group together with at least 3% of manganese or nickel. The added metals form compounds with bismuth which do not segregate round the copper crystals and cause red-shortness as bismuth alone does.—A. R. P.

Magnesium compounds; Reduction of ——. L. Waldo. E.P. 167,164, 18.7.21. Conv., 31.7.20.

See U.S.P. 1,379,886 of 1921; J., 1921, 548 A.

Tin; Treatment of ——. A. E. White. From American Smelting and Refining Co. E.P. 183,507, 24.2.21.

See U.S.P. 1,397,222 of 1921; J., 1922, 20 A.

Electric heating appliances; Alloy for use in ——. G. H. Lofts. U.S.P. 1,425,111, 8.8.22. Appl., 21.9.20.

See E.P. 171,019 of 1920; J., 1921, 895 A.

Atomising fusible metals; Apparatus for ——. F. G. Herkenrath. E.P. 161,194, 6.4.21. Conv., 6.4.20.

Refractory lining for crucible furnaces. E.P. 183,219. *See* VIII.

Metallic moulds for glass articles. E.P. 183,582. *See* VIII.

Zinc retorts. U.S.P. 1,424,120. *See* VIII.

XI.—ELECTRO-CHEMISTRY.

Carbon-electrode industry; Technology of the ——. C. L. Mantell. Chem. and Met. Eng., 1922, 27, 161—164, 205—210.

The characteristics of the raw materials entering into the manufacture of carbon electrodes are briefly reviewed, and the calcination process discussed critically, various forms of electric and gas heated calciners being described. In general, a denser coke or calcined product is produced in electric calciners. Gas-fired units have lower operating costs. In electric calciners, there is a tendency to graphitise some of the charge, so that a calcined product of lower resistivity is produced than is possible with gas retorts.—J. S. G. T.

Carbon-electrode industry; Technology of the ——. IV. Grinding, mixing, moulding, and extrusion. C. L. Mantell. Chem. and Met. Eng., 1922, 27, 258—264.

The calcined materials, coal, coke and petroleum coke, as discharged from the calciner are ground from 3 in. down to 1 in. size by means of corrugated rolls equipped with reciprocating plate feeders and then further ground in roller pulverisers and the fines separated by air levigation. The product is then graded and a mixture of the desired sizes of particles is made into a stiff paste with the necessary binder, tar or pitch, in a steam-heated, mechanically stirred mixing vessel. The mass is discharged from the mixers into presses where it is either pressed or extruded into the desired shape, the latter method being used for small electrodes. A description of several presses and of a typical installation is given, and the factors governing the production of good quality electrodes and reasons for obtaining faulty carbons are discussed.—A. R. P.

Graphite; Researches on natural and artificial ——. K. Arndt and F. Körner. Z. angew. Chem., 1922, 35, 440—443.

The specific resistance of rods pressed from different varieties of natural and artificial graphite has been determined. The results show that the specific electrical resistance of graphite depends principally on the grain-size and ash content, while the shape of the grains has also a slight influence. The resistance increases with increasing ash content and decreases with increasing size of the grains. In the case of graphitised electrodes the resistance depends chiefly on the volume of the pores and on the actual graphite content, a decrease in the former and an increase in the latter reducing the resistance. A curve has been constructed for the specific resistance of mixtures of graphitised and ungraphitised gas carbon compressed into rods, from which, by observing the resistance of a graphitised anode of unknown composition, a rough idea of the amount of contained graphite may be obtained. The resistance of a number of mixtures of graphite and powdered manganese dioxide, such as are used in battery anodes, is represented graphically; the addition of the manganese dioxide very slightly increases the resistance up to a content of 50—60%, after which an exceedingly rapid increase is observed.—A. R. P.

Platinum film electrodes; Preparation and applications of ——. A. Eilert. Z. angew. Chem., 1922, 35, 445—446, 452—455.

Details are given of the preparation of platinum film electrodes suitable for use in electro-analysis, conductivity measurements, and titration processes, and for use as hydrogen electrodes. The films are deposited upon the external surface of glass tubes by heating a solution of "Glanzplatin Ia" (Koehler, Leipzig) with which the tubes are coated. (According to Kundt a "Glanzplatin" solution is composed of 3 g. of platinum chloride dissolved in 10 c.c. of absolute alcohol and treated with 30 c.c. of a concentrated alcoholic solution of boric acid and twice the quantity of a mixture of Venetian turpentine and lavender oil.) Only in the case of film electrodes used in the electro-analysis of metals do the films require periodical renewal. A simplified method of electrometric titration of solutions of salts of weak acids is described.—J. S. G. T.

Conductivity of glass. Bush and Connell. *See* VIII.

Patents.

Conductors for making electrical connection with mercury. The British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 183,683, 30.6.21.

A wire of oxidisable refractory metal, *e.g.*, tungsten, molybdenum, etc. is tipped with iron or nickel or other metal, the oxide of which may be reduced by hydrogen. The wire is sealed into a glass envelope and the tip makes contact with mercury.—J. S. G. T.

Ozone generator. H. B. Hartman, Assr. to Electric Water Sterilizer and Ozone Co. U.S.P. 1,423,658, 25.7.22. Appl., 24.1.20.

An ozone generator comprises a casing consisting of separable sections provided with vertical radial ribs and central chamber-forming members, and a generating unit consisting of spaced dielectric members together with an intermediate electrode disposed between the members and the separable sections. A terminal plug is arranged in one of the chambers, and electrical connexion is made at the central part of the electrode of the generating unit.—J. S. G. T.

Electric storage battery. H. Bardt, Assr. to Soc. Hidro-Metalurgica. U.S.P. 1,425,163, 8.8.22. Appl., 17.9.21.

See G.P. 329,787 of 1919; J., 1921, 267 A.

See also pages (A) 697, *Electrical precipitation* (E.P. 183,768; G.P. 350,259). 708, *Carbon bisulphide* (E.P. 174,040). 711, *Electro-fining glass furnace* (E.P. 161,192); *Refractory lining for electric furnaces* (E.P. 183,219). 716, *Arc welding* (U.S.P. 1,423,914). 717, *Electrolytic cell* (G.P. 351,408).

XII.—FATS; OILS; WAXES.

Liver oils; The sulphuric acid reaction for ——. J. C. Drummond and A. F. Watson. Analyst, 1922, 47, 341—348.

The substance present in liver oils which is responsible for the well-known purple coloration with sulphuric acid was found in the following species: man, horse, ox, pig, cat, monkey, rabbit, guinea pig, chicken, duck, pigeon, rat, mouse, frog, shark, cod, haddock, ling, coal fish, dog fish, sprat, and skate. The substance appears to be a normal constituent of the liver and is not derived from the bile or from products of autolysis or putrefaction. Evidence is presented to show that it is probably derived from the food. The chemical nature of the substance has not been ascertained. It forms a low proportion of the unsaponifiable fraction, is not cholesterol and probably not a member of the lipochrome pigments. It is thermostable in the absence of air or oxygen, but is rapidly destroyed by oxidation. The few properties of the substance which are known, as well as the available data regarding its distribution in natural products, show certain resemblances to the unidentified dietary unit known as vitamin A. The colour test cannot be regarded as specific for liver fats although they usually give the most intense reactions. The body fat, and fat from other organs of animals, especially if they have been fed on liver oils, may give the reaction.—H. C. R.

Perilla oil. K. H. Bauer. Farben-Zeit., 1922, **27**, 2756—2757.

The fatty acids of a sample of perilla oil were investigated. The oil had the following characters: Sp. gr., 0·9280 at 20° C.; $n_D^{20}=1·4830$; saponif. value, 187·4; iodine value (Hanus), 204·3; hexabromide value, 50·8. The mixed fatty acids separated by the lead salt-ether method gave 12% of saturated acids and 88% of unsaturated acids. The saturated portion consisted mainly of palmitic acid. The unsaturated acids were oxidised by Hazura's method and gave a hexahydroxystearic acid (m.p. 165° C.). A tetrahydroxystearic acid of m.p. 135°—140° C. was also found. The fatty acids of perilla oil would therefore seem to consist of a mixture of palmitic acid, a linolic acid, and several geometrically isomeric linolenic acids.—H. C. R.

Naphthalenesulphonic acids as agents for hydrolysing fats. E. Trepka. Przemysl Chem., 1922, **6**, 49—56. Chem. Zentr., 1922, **93**, IV., 265—266.

The α- and β-naphthalenesulphonic acids and 1.5-, 2.7-, 1.6-, and 2.6-naphthalenedisulphonic acids were tried as fat-hydrolysing agents. The position and number of sulphonic groups have no influence on the course of the reaction and the presence of these naphthalenesulphonic acids does not accelerate the hydrolysis of fats unless other compounds are present, which form complexes with the sulphonic acids. For instance the presence of Turkey-red oil considerably increases their fat-hydrolysing properties.—H. C. R.

Clupanodonic acid. M. Tsujimoto. Chem. Umschau, 1922, **29**, 261—262.

The highly unsaturated acid, clupanodonic acid, to which the peculiar odour of fish oils is probably due has the formula $C_{22}H_{34}O_2$ and not $C_{18}H_{28}O_2$, although a small quantity of an acid having the latter formula occurs in Japanese sardine oil (*cf.* Schmidt-Nielsen, J., 1922, 300 A). Majima and Okada (J., 1914, 362) found that the acids obtained by the debromination of the ether-insoluble bromides from Japanese sardine oil gave mainly behenic acid on hydrogenation. Clupanodonic acid has been obtained almost pure by fractionating the methyl esters obtained from the highly unsaturated acids from Japanese sardine oil by the lithium-salt-acetone method. It has the following properties:—A pale yellow liquid not solidifying at −50° C., thick like vaseline at −78° C.; sp. gr. 0·9398 at 15°/4° C.; neutralisation value, 172·5; iodine value (Wijs) 390 (theoretically 384·3); $n_D^{15}=1·5040$. Clupanodonic acid is one of the most widely distributed compounds in nature, occurring in the oils of all fresh and salt water fish, reptiles, and amphibious animals.—H. C. R.

Paraffin hydrocarbons and fatty acids; Catalytic oxidation of saturated ——. A. H. Salway and P. N. Williams. Chem. Soc. Trans., 1922, **121**, 1343—1348.

The catalytic oxidation of hexadecane and stearic acid by means of oxygen in presence of 2% of manganese stearate at 120°—130° C. gives rise to a complex mixture of substances, including monocarboxylic acids of the fatty series, dicarboxylic acids of the malonic series, together with lactones, lactonic acids, formic acid, and carbon dioxide. The paraffin hydrocarbon is probably first converted into a fatty acid, which is then further attacked at several points in the carbon chain with the formation of hydroxy-acids and lactones and these, in turn, are further oxidised and degraded. In the oxidation of stearic acid the volatile products amounted to about 5% of the original acid, the acids soluble in water to 8%, and the insoluble portion, containing only very small quantities of true fatty acids of lower mol. wt., to 86%—G. F. M.

Oils and fats; Rate of saponification of —— *by aqueous alkali under various conditions.* M. H. Norris and J. W. McBain. Chem. Soc. Trans., 1922, **121**, 1362—1375.

When neutral oils are boiled with alkali, the rate of saponification follows no simple formula but is greatly influenced by stirring, emulsification, and by the manner and degree of the salting-out of the soap. The rate is at first exceedingly slow, then rapid, and in the final stage again very slow, presumably due to the highly viscous nature of the medium towards the end of the reaction. The reaction depends largely on the surface of the oil exposed, and vigorous stirring increases the initial rate nearly twenty times. When once the oil is emulsified and sufficient soap has been produced to stabilise the emulsion, the reaction proceeds quite as quickly without stirring. Increase of the concentration of the alkali, insufficient to cause salting-out, increases the rate of saponification. Salting-out greatly reduces the rate, but further addition of alkali increases the rate almost in the proportion of the amount added; hence a large increase in concentration of alkali gives the highest rate. It is possible to saponify an oil to the extent of 99·8% within a few hours.—J. B. F.

Soap; Effect of an electrolyte on solutions of pure ——. *Phase-rule equilibria in the system sodium laurate, sodium chloride, water.* J. W. McBain and A. J. Burnett. Chem. Soc. Trans., 1922, **121**, 1320—1333.

A soap solution, from the phase-rule standpoint, may be regarded as a single phase when considering its equilibria with other solutions or solids. Soap solutions, such as solutions of sodium laurate, to which salt has been added may be regarded as three-component systems, involving water, sodium laurate, and sodium chloride. Three liquid layers may exist in equilibrium under suitable conditions, viz., concentrated liquid known as "neat" or "fitted" soap; liquid of moderate concentration known as "nigre"; liquid containing very little soap, known as "lye." The concentrations in these three layers are:—Sodium laurate $1·0N_\omega$, 0·5—$1·0N_\omega$, and $0·01N_\omega$; sodium chloride 1—$2N_\omega$, 2·5—$3N_\omega$, and 2·5—$6N_\omega$ respectively. Salt added to solutions of sodium laurate reduces the solubility of the soap in a regular manner highly dependent on temperature and concentration. All soap systems can be brought into the form of one homogeneous liquid at sufficiently high temperatures if decomposition is prevented. If the concentration of the sodium chloride is above $2N_\omega$, on cooling, a temperature will be reached at which two liquid layers are formed, but if the concentration of the soap, and particularly of the salt, is high enough, the ultimate result is the formation of a curd floating on a lye containing only traces of sodium laurate. Portions of the equilibrium diagram have been worked out for the system sodium laurate, sodium chloride, water.—J. B. F.

Patents.

Synthetic waxes; Manufacture of ——. G. Schicht A.-G., and A. Grün. E.P. 183,186, 17.3.21.

Aliphatic hydrocarbons of high molecular weight are oxidised by means of an excess of oxygen or gases containing oxygen at a temperature of at least 150° C. The products of oxidation are divided into a solid and a semi-solid portion by pressing or by means of organic solvents. For example, a paraffin melting at 52° C. gave a synthetic wax having the following characters: acid value, 21; saponif. value, 75·6; iodine value, 4·7. The synthetic waxes closely resemble beeswax.—H. C. R.

Soaps; Process for making odourless —— from marine animal oils. F. Fischer. G.P. 353,571, 14.3.19.

The soaps are dissolved in water, treated with alkali, and gases containing oxygen are then passed through the solution under increased pressure. For instance, compressed air at 30 atm. is passed into the aqueous soap solution at 170° C. in an autoclave. The air is afterwards found to be poor in oxygen and rich in carbon dioxide. In a comparatively short time odourless soaps are obtained, having great lathering power.—H. C. R.

Hydrocarbons from fish oils. E.P. 170,264. *See* IIa.

Fatty acids from hydrocarbons. G.P. 350,621. *See* XX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Naphthalene-formaldehyde condensation products; Preparation of —— and their suitability for the varnish industry. P. Folchi. Chem.-Zeit., 1922, **46**, 714—715.

Condensation products of naphthalene with formaldehyde, suitable for use in the lacquer or varnish industry, are prepared as follows: 100 g. of naphthalene is added to 80 c.c. of 30% formaldehyde, 100 c.c. of sulphuric acid (66° B., sp. gr. 1·84) gradually added, and the mixture heated under a reflux condenser on a water bath at 80° C. for 1½—2 hrs. with agitation. The contents of the flask are poured into water at 80°—90° C. and the melted condensation product washed with water, dilute alkali, and water again. The mass is then dried at 80° C. for 4—5 hrs. For use as lacquer the material is melted with a small quantity of turpentine and mixed with refined tar. By strict attention to the above reaction conditions a yield of 100—110% of the naphthalene used may be obtained. The hardness of the product varies with the temperature of formation. If the condensation product is granular this can be rectified by melting with turpentine and then washing with water. If the acid is not completely removed the mass will not dry satisfactorily. An alternative method is to use 100 g. of naphthalene, 80 g. of 40% formaldehyde, and 120 g. of sulphuric acid, heating for 3 hrs. at 90°—95° C.; in this case the yield is 80—90%. It appears to be a rule that formaldehyde condensation of unsaturated aliphatic hydrocarbons produces substances resembling caoutchouc, that of aromatic hydrocarbons materials of the bakelite type.—C. I.

Patents.

Carbon black and method of producing same. A. S. Cooper. U.S.P. 1,423,193, 18.7.22. Appl., 19.1.22.

Brown bitumen-bearing sand is powdered, and the finely divided bitumen is removed by a blast of air and heated to obtain carbon black.—D. F. T.

Paint vehicle. Paint composition. Pigment composition for paints. Oil. W. N. Blakeman. U.S.P. (a) 1,423,389, (b) 1,423,390, (c) 1,423,391, and (d) 1,423,392, 18.7.22. Appl., (a) 16.4.21, (b, c, d) 5.10.21.

An oil mixture (d) is obtained by blending tung oil and coconut oil. By mixing this with an anhydrous pigment a paste (c) is formed, which, by the further addition of a fatty oil and a mineral oil, yields a paint composition (b). A paint vehicle (a) is made by adding a mineral oil to the mixture of coconut oil and tung oil.—D. F. T.

Coating or sealing composition. M. J. Strauss. U.S.P. 1,423,821, 25.7.22. Appl., 31.1.21.

The precipitate obtained on adding sulphuric acid to a solution of shellac in aqueous sodium hydroxide is dissolved in alcohol. This solution when mixed with inorganic fibrous material yields permanently flexible coatings.—D. F. T.

Resinous masses; Process for the production of ——. Wenjacit Ges.m.b.H. G.P. 351,104, 17.8.15.

A small amount of benzoic, salicylic, or other easily fusible acid is stirred into a mixture of phenols, soaps, and aldehydes that has been heated until it has become a viscous mass, whereby polymerisation is arrested at the gummy stage. The mass is cast into moulds and then subjected to a known hardening process. For example, 2—3% of salicylic acid is added to the gummy mass obtained by heating 100 pts. of crude carbolic acid, 50 pts. of soft soap, and 100 pts. of formalin, and the product is cast into moulds. The resulting mass remains soft for more than six months, and may be used as a substitute for vulcanite.—A. R. P.

Artificial resin; Preparation of a white insoluble ——. Plauson's Forschungsinstitut G.m.b.H. G.P. 351,349, 20.10.20.

A mixture of 1 mol. of a ketone and 6 mols. of formaldehyde in aqueous solution, or the equivalent amount of one of its polymers, *e.g.*, paraformaldehyde, or of one of its condensation products, *e.g.*, hexamethylenetetramine, is condensed in the presence of alkalis. Acetone and formaldehyde in this way yield a white powder, $C_8H_{12}O_4$, which is tasteless, odourless, infusible, insoluble in organic solvents, and unattacked by acids and alkalis. It is also difficultly combustible, and is a good electrical insulator.—A. R. P.

Resins, pitch, and the like; Process of hardening ——. Plauson's Forschungsinstitut G.m.b.H. G.P. 352,521, 4.5.20.

Soft resins or pitches are heated, in the presence of mineral or organic acids, with furfural or its homologues, or with materials which form these compounds, under a reflux condenser or under pressure, and the resulting product is washed, dried, and melted, or recovered by extraction processes. The melting point of the hardened resin may be raised by melting it in a vacuum or by blowing air through it at 180°—350° C.—A. R. P.

Resins and resinous substances; Production of —— from cellulosic materials. Zellstoff-fabr. Waldhof, and V. Hottenroth. G.P. 353,380, 25.12.19.

Material containing cellulose, in addition to resins and the like, is treated with moderately concentrated sulphuric or hydrochloric acid, or mixtures of the same, and the solution is subsequently diluted with water and boiled, the cellulose being converted thereby into soluble dextrins and sugars. After filtration the residue, which contains resinous constituents together with lignin, is washed, dried, and extracted with resin solvents at normal or moderately high temperatures. The final residue may be distilled to obtain decolorising charcoal, methyl alcohol, and other products.—L. A. C.

Pigments; Process of making ——. L. R. Baker. U.S.P. 1,425,436—7, 8.8.22. Appl., 16.7.19 and 13.8.20.

See E.P. 161,280 of 1920; J., 1921, 399 a.

Coatings on galvanised or tinned metal. G.P. 351,981. *See* X.

Linseed oil substitute. G.P. 352,008. *See* XX.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Smoked sheet [rubber]; Effect of mould on quality of ——. H. P. Stevens. Bull. Rubber Growers' Assoc., 1922, 4, 330—331.

Although the grey-green, moss-like type of mould which develops normally in daylight has a retarding effect on the rate of vulcanisation, the black and yellow pin-head type which develops in the dark has an accelerating effect. With a slight surface mould the effect is inappreciable.—D. F. T.

[Rubber;] Additional tests with sodium silicofluoride [as a mould preventive for ——]. H. P. Stevens. Bull. Rubber Growers' Assoc., 1922, 4, 331—333.

The addition of sodium silicofluoride (*cf.* J., 1922, 510 A) to latex for the prevention of mould in the finished rubber, causes a reduction of 10—15% in the rate of vulcanisation of a simple mixture with sulphur (90:10); the physical properties of the vulcanised rubber are unaffected. The effectiveness of sodium silicofluoride, however, is limited, and rubber which was packed wet arrived in a mouldy condition, whatever the proportion of sodium silicofluoride used.—D. F. T.

Patents.

Rubber-containing latex; Process for treating ——. E. Hopkinson. E.P. 157,978, 11.1.21. Conv., 16.1.20.

In order to prevent premature coagulation the rubber latex is treated with 0·1% of ammonia, or if vulcanising agents or compounding ingredients are also added, with 0·1% of saponin, glycerin, or glue. The latex is then atomised by being delivered in a uniform stream against an air jet, the spray meeting a second stream of air heated to 200° F. (93° C.); the evaporation reduces this temperature almost immediately to about 130° F. (54° C.). The air carrying particles of rubber in suspension is led along a tortuous path, whereupon the rubber is deposited as a porous mass with as little as 0·6% of moisture; it can be compacted by hydraulic pressure. On account of the retention of the whole of the serum solids the yield of rubber is increased by approximately 10% (calculated on the rubber). The composition is roughly as follows, the bracketed figures giving the corresponding values for rubber prepared in the ordinary manner: Acetone extract, 5·2% (3·0%); ash, 1·5% (0·4%); water extract, 7·2% (0·3%); protein, 4·2% (2·0%); acidity expressed as acetic acid, 0·10% (0·02%). The new type of rubber on vulcanisation shows an increase of about 20% over the usual values for tensile strength and resistance to abrasion; the advantage can be still further increased by introducing the sulphur and other compounding ingredients into the latex before evaporation, thereby obviating the mechanical kneading involved in the ordinary mixing operation.—D. F. T.

Indiarubber; Improvement and regeneration of ——. E. Hug. E.P. 177,495, 20.2.22. Conv., 21.3.21.

Rubber articles, such as motor covers and inner tubes, are improved by successive immersion for half-hour periods, with 24-hour intervals, in an infusion of Roman camomile in castor oil at increasing temperatures, viz., 50°, 70°, and 80° C.
—D. F. T.

XV.—LEATHER; BONE; HORN; GLUE.

Gelatin; Dissolution of ——. F. Fairbrother and E. Swan. Chem. Soc. Trans., 1922, 121, 1237—1244.

Gelatin exists in solution in the liquid surrounding the gel, when the jelly is in equilibrium with water, dilute acid, or alkali. The solubility of gelatin in distilled water at 15°—17° C. is 0·05 g. in 100 c.c. A similarity exists between the solubility curves and the curves for the swelling and osmotic pressure of gelatin. The experiments indicate a minimum solubility of 0·01 g. and 0·03 g. per 100 c.c. for a concentration of 1 millimol. per litre of hydrochloric and sulphuric acid respectively, *i.e.*, less than for pure water. In general, however, gelatin dissolves to a greater extent in dilute acids or alkali than in water, whilst neutral salts decrease the solubility. The gelatin was estimated by precipitation with tannic acid. The acid and alkali solutions were first neutralised with potassium hydroxide or hydrochloric acid respectively. When electrolytes were absent, 1 c.c. of $N/20$ potassium chloride was added to 20 c.c. of the solution, since it was found that in the presence of salts the precipitate was coagulated, less gelatinous, and was more easily filtered. It was found that the ratio of gelatin to tannin was not constant, but varied with the concentration.—J. B. F.

Gelatin solutions; Gel-strength and viscosity of ——. E. T. Oakes and C. E. Davis. J. Ind. Eng. Chem., 1922, 14, 706—710.

Gel-strength is measured by a "plunger" method. A plunger is attached to the under-side of a balance-scale pan, on which is placed a beaker. The whole is counterpoised and water added to the beaker until the plunger is forced into a gel, placed below, to an arbitrary depth indicated by the deflection needle of the balance. The effect of the p_H value on gel-strength was determined, and also the relationship of gel-strength to viscosity. The molecular weight of gelatin was determined by acid titration over a definite p_H range. The figure varied very considerably between 1000 and 2000. The form of the gel-strength-p_H curve was the same for different concentrations. The maximum gel-strength coincided in p_H value with the maximum increase in viscosity for ageing solutions. Additional data were obtained in favour of the gelatin-acid combination theory.—A. G. P.

Patents.

Tanning skins; Process for ——. P. Ringbauer. G.P. 344,325, 16.11.20. Addn. to 321,343 (J., 1920, 666 A).

The pressure of the air in the tanning vessel before the introduction of the tanning liquid is not reduced to so great a degree as specified in the main patent, nor for as long a period of time. During the tanning process, on the other hand, the pressure is further reduced and for a longer period. The skins are by this means more thoroughly and rapidly tanned and after the subsequent stretching on frames the permanent extension of the fibres of the skin is more regular than that obtained according to the main patent.—H. C. R.

Skins and hides; Process for bating ——. C. H. Boehringer Sohn. G.P. 351,015, 13.4.17.

Pure or crude saponified bile acids or their salts, or mixtures of them, alone or in combination with other bating materials not containing bacteria or enzymes, are used as bating materials. Saponified bile acids, such as cholic, choleic, or desoxycholic acids, possess the advantages as bating agents that they contain neither undesirable impurities such as calcium salts of fatty acids and proteolytic enzymes, nor useless filling materials, such as dissolved or emulsified fats, fatty acids, or cholesterol. They are without odour, and can be accurately analysed. Saponified desoxycholic acid also has the property of forming with fats, fatty acids, and cholesterol crystalline compounds, alkali salts of which are easily soluble in water. The natural tauro- and gluco-desoxycholic acids lack these properties. The presence of bacteria and enzymes is not necessary in the bating process. The presence of other bating agents suitable for removing lime, such as sodium lactate, is, however, sometimes desirable.—H. C. R.

Skins; Process for tanning ——. Gerb- und Farbstoffwerke H. Renner und Co. A.-G. G.P. 353,076, 23.8.16.

Chloranil is mixed with such quantities of organic or inorganic dispersing media, *e.g.*, phenols, alkali or alkaline-earth hydroxides, as to produce a colloidal solution in which the skins are steeped. The chloranil may be produced from trichlorophenol by treating it with oxidising agents, such as bichromates, and the impure chloranil used without further treatment. Any excess of phenols is to be avoided, as otherwise the colloidal solution is converted into a true solution having no tanning action. If hydroxides of alkali or alkaline-earth metals are used as dispersing medium, part of the chloranil is converted into alkali or alkaline-earth salts of chloranilic acid. These salts are soluble and have a peptising action on the unaltered chloranil. To make up such a tanning solution finely divided chloranil is shaken with 200 times its weight of water in the tanning vessel and a quantity of phenol, amounting to one-tenth of the chloranil used, is added. The concentration of the liquor can be varied. The tanning action of chloranil solutions is considerably greater than that of solutions of quinone and its substitution products. If the chloranil is produced by the oxidation of trichlorophenol with bichromate, the tanning action of the chromium compounds is available also. Colloïdal chloranil solutions can also be used in conjunction with all known natural or artificial tanning agents.—H. C. R.

Chrome leather; Process for neutralising ——. O. Röhm. G.P. 352,285, 18.11.16.

Sodium carbonate or other alkali or alkaline-earth carbonate is used in conjunction with formaldehyde or alkali or alkaline-earth salts of the lower fatty acids or oxyacids. The formaldehyde prevents the basic chromium salt becoming too strongly attached to the grain of the leather, with resulting ropiness and brittleness of the latter. Chromium salts of the lower fatty acids are produced and these are more strongly basic and consequently better for tanning than chromium salts of mineral acids. Wet chrome-leather is neutralised, for example, by treating it with aqueous sodium carbonate and formaldehyde, or with water, calcium carbonate, and sodium formate in the fulling-mill. Acetates or lactates of alkali or alkaline-earth metals can be used instead of the formates.—H. C. R.

Fish refuse and the like; Production of a plastic mass from ——. Plauson's Forschungsinstitut G.m.b.H. G.P. 352,534, 30.6.20.

Fish meal, fish guano, etc. is treated with acids, separated from large foreign particles and is re-precipitated by the addition of a large quantity of water or of a calculated quantity of alkali, the precipitate being rendered insoluble either by heating to 100°—180° C., or by warming with an aldehyde (formaldehyde or furfural) or with tanning materials, and then mixed with fibrous or pulverulent materials, such as wood meal, cellulose, asbestos, and the like. During the process for rendering the precipitate insoluble, it may be mixed with a small quantity of a ketone, or phenol, or tar oils, pitch, wax, resin, rubber, colouring matter, etc. Unless powdered material is added the material has no appreciable resistance to breakage.—A. G.

Material resembling horn; Production of ——. Ges. f. Technik m.b.H. G.P. 352,594, 3.9.15.

Phenols and aldehydes are heated together in the presence of sodium benzoate or salicylate until a product is formed having the consistency of castor oil, and the product is hardened by heating in closed moulds to 120°—140° C.—L. A. C.

Leather; Process for the impregnation and currying of ——. H. Burger. E.P. 157,929, 10.1.21. Conv., 14.5.14.

See G.P. 303,204 of 1914; J., 1921, 442 A.

Oxalic acid from leached tan-bark. G.P. 352,576. *See* XX.

XVI.—SOILS; FERTILISERS.

Ammonium bicarbonate; Manufacture and employment of —— *as a fertiliser.* W. Gluud. Chem.-Zeit., 1922, 46, 693—697, 715—717.

The present economic situation in Germany and in particular the dearness and scarcity of sulphuric acid have directed attention to the possibility of replacing ammonium sulphate for fertiliser purposes by ammonium bicarbonate. A series of field trials carried out in the summer of 1921 with equivalent quantities of the two compounds applied to rye, oats, potatoes, roots, and meadow, gave the general result that the bicarbonate approached the sulphate in value and in some cases equalled it. No serious loss from volatilisation seems to have occurred, at any rate when the manure was raked or harrowed in. The bicarbonate does not render the soil acid, and in view of recent work on the fertilising value of carbon dioxide its content of the latter should be beneficial. The salt can be prepared in a condition suitable for sowing and does not cake. The main difficulty has always been its volatility, but while some loss always occurs it is believed to be mainly carbon dioxide, a sesquicarbonate being first formed. Packed in second-hand casks the salt lost 2·75% of its weight in 30 days. In paper bags treated externally with soluble coumarone-resin the loss in the same period was 0·5%. The material may be advantageously compounded with superphosphate. Gasworks and coke ovens working the indirect or semi-direct ammonia recovery process can be easily adapted to manufacture bicarbonate. 20% ammonia liquor is run into a water-jacketed horizontal cylinder fitted with an agitator, and a current of carbon dioxide derived by distillation from the dilute crude liquor from the washer is blown through for 10—12 hours. Traces of ammonia carried forward are absorbed in acid, and at the end of that time the contents are run off and the separated salt is centrifuged. This process is not readily applied to those coke-ovens working the Otto direct recovery method, and such will probably continue to make sulphate. Cost figures show a saving by the production of bicarbonate, after allowing for a 5% loss in storage, compared with the process at present in use. While there is not such an inducement to the synthetic nitrogen industry to manufacture bicarbonate on account of the existence of plants deriving sulphuric acid from gypsum and the great advantages of urea, yet even in such cases the bicarbonate will be the cheapest form of nitrogen compound to produce.—C. I.

Nitrogen losses from dung and urine during storage; Studies in methods to prevent ——. N. V. Joshi. Agric. J. India, 1922, **17**, 367—374.

Fresh samples of dung and of urine were collected and stored in jars, some of which were sealed and others left open to the air. The nitrogen content of the samples was determined at intervals. The nitrogen losses from dung, under both aerobic and anaerobic conditions were small; whilst urine lost considerable amounts of nitrogen when stored aerobically. By storage under anaerobic conditions, *e.g.*, by covering with paraffin or other oils, nitrogen losses were prevented. The addition of sulphuric acid, superphosphate and formalin prevents loss of nitrogen from stored urine, but the cost is excessive. Very great losses were observed when urine was absorbed in soil beds or in straw. It is advisable to store animal dung and urine in separate pits.—A. G. P.

Azotobacter chröococcum; Influence of humus on the sensitiveness of —— towards boron. J. Voicu. Comptes rend., 1922, **175**, 317—319.

Cultures of the organisms were treated with boric acid in varying quantity, and measurements were made of the rate of nitrogen fixation in the presence of humus. In the absence of humus the action of boric acid on the rate of nitrogen fixation is insignificant, but the addition of humus increases both the amount of nitrogen fixed and the toxicity of the boric acid.—A. G. P.

Elimination of borates from American potash. Ross and Hazen. *See* VII.

Iron and aluminium in phosphates. Nydegger and Schaus. *See* VII.

Patents.

Plants; Prevention of damage to ——, especially by nematodes. H. Stoltzenberg. G.P. 351,300, 21.7.20. Addn. to 316,503 (J., 1920, 290 A).

A product suitable for preventing the growth of nematodes is obtained by subjecting saturation scum from sugar refining to destructive distillation, and mixing the distillate, which contains hydrocyanic acid, with the retort residue. The percentage of hydrocyanic acid in the distillate can be increased by adding molasses or vinasses to the saturation scum prior to distillation.—A. B. S.

Dibasic calcium phosphate; Means for reducing the amount of acid required in the production of ——. Bayerische A.-G. für chem. und landwirtschaftl. chem. Fabrikate, and H. Hackl. G.P. 352,782, 12.2.20.

The amount of acid usually required is reduced by adding finely ground bone-meal and water to the monobasic calcium phosphate produced in the customary manner.—A. B. S.

Fertiliser; Production of a ——. C. Kroseberg. G.P. 353,371, 8.6.21.

A solution of magnesium chloride, *e.g.*, waste liquor from the potash industry, is heated with an excess of aqueous ammonia in a closed vessel under pressure. The product is filtered, and the filtrate, after addition, if necessary of the requisite quantity of sulphuric acid or ammonium sulphate to react with any undecomposed magnesium chloride still present, is evaporated to dryness.—A. B. S.

XVII.—SUGARS; STARCHES; GUMS.

Moisture absorptive power of different sugars and carbohydrates, under varying conditions of atmospheric humidity. C. A. Browne. J. Ind. Eng. Chem., 1922, **14**, 712—714.

Various carbohydrates were exposed to a moist atmosphere at various temperatures and degrees of saturation and the rate of absorption of water measured. At 20° C. and 60% humidity, starch was the most absorptive, followed by cellulose and agar. Lævulose was relatively low in the series, and dextrose, mannitol, and sucrose were the least absorptive. In a saturated atmosphere lævulose showed the greatest absorptive power. When allowed to stand under ordinary atmospheric conditions, after exposure to a saturated atmosphere, all substances lost moisture except lactose and raffinose, which continued to gain for many months. Where water was absorbed in excess of the amount required to form a monohydrate the excess was lost on exposure to a drier atmosphere. No definite relationship between percentage of humidity and absorptive power was found.—A. G. P.

2.3.6-Trimethylglucose. J. C. Irvine and E. L. Hirst. Chem. Soc. Trans., 1922, **121**, 1213—1223.

The isolation and physical properties of 2.3.6-trimethylglucose, one of the hydrolysis products obtained from trimethylcellulose, and indirectly from lactose and cellobiose, has been further studied. As no crystalline derivatives of the sugar could be obtained, its identification depends primarily on its isolation in a pure crystalline condition from the mixed hydrolysis products. Of all the methods examined the most satisfactory consisted in separation of most of the sparingly soluble alkylated galactose by fractional crystallisation of the anilides, regeneration of the sugar from the more soluble anilides, conversion into the corresponding methylglucosides, and fractionation of these in a high vacuum. The middle fraction consists mainly of trimethyl-methylglucoside, and after hydrolysis and crystallisation from ether the pure substance is obtained in well-formed needles, m.p. 122°—123° C. A dimorphic form crystallising in short prisms, m.p. 92°—93° C., was also obtained. This did not consist of the β-form of the sugar. Other constants observed were $n_D = 1{\cdot}4743$ (of the syrup), $[\alpha]_D$ in methyl alcohol $= +117{\cdot}7° \rightarrow 88{\cdot}6°$ (no catalyst), $[\alpha]_D$ in water $= +90{\cdot}2° \rightarrow 70{\cdot}5°$ (no catalyst). The final optical value in aqueous solution agrees with that obtained on hydrolysis of the methylglucoside, which latter is a colourless mobile syrup, b.p. 150° C. at 0·07 mm. The constitution of 2.3.6-trimethylglucose was further confirmed by its oxidation with nitric acid to a dimethylsaccharic acid.—G. F. M.

Dextrin; Specific heat and heat of wetting of ——. Sprockhoff. Z. Spiritusind., 1922, **45**, 217.

The specific heat was determined calorimetrically by mixing with petroleum. The average figure was 0·355 for anhydrous yellow dextrin and 0·363 for the white variety. The "heat of wetting" was obtained by moistening the dextrin directly with water or by adding water to a petroleum suspension of dextrin. An average figure of 16·5 cals. per g. was found. Experiments with starch showed that the greatest heat evolution occurred on the addition of the first 1% of water.—A. G. P.

Patents.

Sugar; Process for refining —— without producing molasses. A. A. Holland. G.P. 351,376, 27.9.18. Addn. to 348,064 (J., 1922, 386 A).

The sugar is dissolved in water, the solution filtered, and the filtrate dried by means of hot air. A product of high quality is obtained and the whole of the sugar is recovered. The clear solution may be sprayed from nozzles or atomised by centrifugal methods, while being subjected to the action of the hot air.—H. C. R.

Starch; Process for making a —— which forms a paste with cold water. F. Supf. G.P. 351,870, 24.10.19.

The starch is treated with concentrated alkali hydroxide below 0° C., so that no paste is formed, and the quantity of alkali hydroxide is so regulated that on allowing the temperature to rise the reaction which takes place causes the disruption of the starch granules without gelatinisation. It is not necessary to suspend the starch in water-repelling liquids before treating it with the alkali hydroxide. The product can be used with advantage in the textile industry for finishing, as a thickening agent in calico printing, as a size, or for wall-papering.—H. C. R.

Preventing growth of nematodes. G.P. 351,300, *See* XVI.

Sugar from wood. E.P. 164,329. *See* XVIII.

XVIII.—FERMENTATION INDUSTRIES.

Saccharomyces Odessa, nov. spec. H. Schnegg and F. Oehlkers. Z. ges. Brauw., 1922, 45, 92—96, 106—107, 111—113.

This yeast, isolated from the beer of an Odessa brewery, consists normally of almost round or slightly oviform cells and on 8—10% beer wort forms a slight film and a ring growth which gradually extends to the rim of the culture vessel. Both the film and the ring contain many long, sausage-shaped cells and occasional giant cells. The organism readily forms from 1 to 3 spores per cell, these being obtained better on filter paper than on plaster blocks and in greater abundance if the yeast is previously grown in a strong rather than in a weak wort. The giant colonies formed on wort-gelatin closely resemble those obtained with Frohberg yeast. The degree of fermentation obtained with 7·9% wort is about 62%, and the yeast ferments sucrose, dextrose, lævulose, maltose and mannose readily, galactose and raffinose slightly, and lactose, mannitol, dextrin, glycerol, amygdalin and inulin not at all. The organism is distinctly thermophilic and reproduces most rapidly at 32° C. The spores exhibit extremely high refractivity, and under suitable conditions some of the mother cells containing spores are capable of germination without the spores themselves undergoing alteration.—T. H. P.

Fermentation accelerators. Inouye. Woch. Brau., 1922, 39, 191—193.

The author has repeated with Japanese bottom fermentation brewery yeast, both fresh and dried, and with the pressed juice prepared therefrom, the experiments of Neuberg and his collaborators on the effect of certain aldehydes, ketones, diketones, disulphides, etc. on the velocity of the fermentation. The stimulating action observed is most marked with the pressed juice and least marked with the dried yeast. Contrary to Neuberg's result, vanillin is found to have a distinct, although slight, accelerating action on fermentation by yeast juice. With juglone, fenchone, and irone the effect is more pronounced. Neutral organic salts exert no action, although Von Euler and Casel observed activation by such compounds. Shikimic, abietic and cholic acids cause slight activation. The fact that acetaldehyde effects permanent acceleration of fermentation supports Neuberg's scheme for the mechanism of fermentation. Xylose and uric acid also accelerate fermentation.—T. H. P.

Yeast; Development and nutrition of ——. A. Tait and L. Fletcher. J. Inst. Brew., 1922, 28, 597—618.

Fermentation experiments have been carried out at 65° F. and under varying conditions as regards amounts of seed yeast, nitrogenous nutrients, etc. Confirmation is obtained of A. J. Brown's observation that the quantity of new yeast formed is practically independent of the proportion of seed yeast used. The shape of the vessel employed exercises a marked influence in laboratory fermentations. As regards nitrogenous nutrition, the results obtained by Stern (J., 1899, 933) with artificial nutrients are so much at variance with everyday practical observations that they must be regarded as abnormal and as controlled by a dominant factor other than those specified. Similar abnormality has been encountered by the authors in experiments in which the nitrogenous pabulum of the yeast consisted of asparagine, and it is found that growing yeast, in its search for nitrogenous food, breaks down asparagine with final production of malic acid, which acts as a poison and inhibits reproduction when its concentration attains a certain value. When, however, asparagine is used in conjunction with other amphoteric substances, it is possible for yeast to assimilate a greater proportion of nitrogen. The favourable influence exerted on the assimilation of nitrogen and the development of yeast by addition of calcium carbonate to an asparagine medium is only slight and less than was expected; the cause of this lies partly in a mechanical clogging of the yeast by the particles of carbonate with consequent diminution of the diffusion surface. Certain other substances, such as barium sulphate and kaolin, exhibit a similar effect. The fact that asparagine is not a suitable food for *Saccharomyces cerevisiæ* furnishes an explanation of the formation of thin, unstable beer of poor flavour when the use of slack or forced malt gives rise to an excessive proportion of amino-acids in the wort. Yeasts grown in presence of widely different proportions of nitrogenous compounds vary considerably in nitrogen content and the fermentative power varies approximately linearly with the nitrogen content. If, then, two portions of the same wort are pitched with equal quantities of two yeasts of the same species, one of high and the other of low fermentative power, the resulting crops exhibit to a considerable degree the parental fermentative characteristics; this apparent heredity is, however, observable only when the number of generations of yeast produced is very small.—T. H. P.

Enzymo-chemical observations. I. Action of foreign enzymes on yeast invertase. II. Rôle of phosphates in the degradation of carbohydrates. H. von Euler and K. Myrbäck. Arkiv Kemi, Min. Geol., 1921, 8, No. 17, 1—15. Chem. Zentr., 1922, 93, III., 524.

Treatment of invertase for some days with a culture of either *Bacillus macerans* or *Aspergillus oryzæ* or with the digestion juice of *Helix Pomatia* results in the removal of part of the impurities of high molecular weight but leaves the invertase unweakened. In the esterification of dextrose and maltose under similar conditions, approximately double as much phosphate remains non-esterified in the latter as in the former case. As regards the course of fermentation in presence of toluene, sucrose and maltose exhibit the same behaviour, the toluene retarding the liberation of carbon dioxide only at the commencement of the reaction. In germinating and ripening seeds, extensive isomerisation of the carbohydrates takes place, dextrose being transformed into lævo-rotatory sugar and partially re-formed; in this process, which is intimately connected with the combination of phosphate, a part is probably played by a sugar-isomerising enzyme.—T. H. P.

Starch; Estimation of unsaccharified —— in brewers' grains. H. Weiss. Z. ges. Brauw., 1922, **45**, 122—124.

The following sedimetric method for the estimation of unsaccharified starch in brewers' grains yields accurate results in far less time than saccharification by means of diastase or malt extract and subsequent determination of the quantity of extract thus removed from the grains; 10 g. of the wet grains is well triturated with 10 c.c. of water in a porcelain casserole and then heated carefully to boiling during 10 minutes with 80 c.c. of calcium chloride solution (1 part of the anhydrous chloride and 1 part of water); if alkaline to phenolphthalein, the calcium chloride solution must be neutralised by addition of acetic acid before use. The contents of the casserole are transferred quantitatively by means of hot water to a 100 c.c. flask, cooled, made up to volume, mixed, and filtered through a dry pleated filter paper. A starch solution is also prepared by heating 1 g. of barley (or wheat) starch, dried at 100° C., with 10 c.c. of water and 50 c.c. of the calcium chloride solution in a 100 c.c. flask and afterwards treating in the same way as the wet grains. Of the two solutions thus obtained 10 c.c. is mixed with 1 c.c. of $N/2$ iodine solution in two sedimentation tubes having the narrowed bottom portion graduated. After a short time the starch iodide should separate out and the supernatant liquid should be, not colourless or blue, but distinctly yellow. The tubes are then centrifuged for 10 minutes at not less than 1200—1400 revs. per minute, and the percentage of unsaccharified starch in the grains calculated from the volumes occupied by the starch iodide in the two cases. Where no suitable centrifuge is available, 10 c.c. of the starch solution from the grains is diluted in a 200 c.c. cylinder with 100 c.c. of water and the liquid treated with very dilute iodine solution until the maximum blue coloration is attained. The solution of pure starch is treated similarly and the coloration of the one or the other liquid adjusted by dilution to equality with that of the other.—T. H. P.

Patents.

Sugar; Process for the manufacture of [fermentable] —— from wood and other cellulose-containing substances. A. Classen. E.P. 164,329, 1.6.21. Conv., 4.6.20. Addn. to 142,480 (*cf.* J., 1921, 405 a).

The wood is converted into sugar by means of a mixture of hydrochloric acid and sulphuric acid (the former acid preferably predominating and the mixture being sufficient for the conversion), with the addition of a catalyst consisting of a small amount of an acid or an acid salt or a mixture of both. Protective substances, such as metals or metallic oxides, may also be added.—J. R.

Yeast; Process of drying ——. E. Klein. E.P. 175,622, 10.2.22. Conv., 15.2.21.

Whilst moist yeast is being reduced by mechanical means to the greatest possible fineness, warm air is circulated through it. The dry yeast powder is carried away by the warm air current and deposited in a separate vessel.—J. R.

Glycerin; Process of recovering —— [from fermentation products]. J. A. Steffens, Assr. to U.S. Industrial Alcohol Co. U.S.P. 1,423,042, 18.7.22. Appl., 19.11.19.

Glycerin is recovered from materials subjected to alcoholic fermentation by precipitating the organic materials with an acid, distilling off the water, leaching with a liquid, and recovering the glycerin from the liquid by distillation.—T. A. S.

Beer containing lecithin; Process for brewing ——. W. Schmitz. G.P. 353,734, 22.6.13.

Lecithin is rendered soluble in water and largely freed from its fatty acid components by treatment with alcoholic potassium hydroxide, and is added to the mash together with the usual albuminous residue. The addition of the lecithin during the brewing causes the formation of lecithin-albumin and lecithin-peptone, which remain in solution in the beer.—H. C. R.

XIXa.—FOODS.

Milk analysis by semi-microchemical methods. H. Lührig. Milchw. Zentr., 1922, **51**, 157—159, 169—172.

Slight modifications of existing methods of milk analysis are given, whereby only 1 g. or less of milk is required for each determination. The following determinations are dealt with:—Sp. gr., fat, dry matter, sp. gr. of milk serum, ash of milk serum, qualitative test for nitric acid, acid value, total nitrogen, lactose.—H. C. R.

Condensed milk; Analytical investigations on the ageing of ——. G. Viale and A. Rabbeno. Biochem. Terap. Sperim., 1921, **8**, 325—352. Chem. Zentr., 1922, **93**, IV., 263.

Condensed milk was examined after keeping for periods of from ½ to 8 years. The sp. gr., dry matter, and conductivity showed no constant changes with time. The viscosity increased with the age of the sample. The total acidity in most cases showed an increase in the older samples, but was subject to considerable variations. No oxidases or reductases were found in the condensed milk. The time of coagulation with rennet was considerably greater with condensed than with fresh milk. The total nitrogen corresponded to an average albumin content of 8·65%, which indicates a concentration of 1:3. The mean content of casein was 8·35% and this was not altered by time. The very low content of non-albuminous nitrogen in fresh milk is more than doubled by condensing and still further increased by keeping the condensed milk. The amino-acids are decreased and only amount to 0·0068—0·021%. Polypeptides, absent in fresh milk, show a marked increase on keeping condensed milk. In old samples tyrosine can be detected. The increased acidity causes a slow hydrolysis of the proteins. The samples analysed contained 6—13·7% of lactose and 32—40% of sucrose. The older samples showed a decrease of lactose to half the original figure and a decrease in sucrose to about 15%. A partial inversion of disaccharides took place. This can be ascribed to the increase in acidity. The fat content in fresh samples was 8·6%, and fell after keeping for several years to 3·43%. The free fatty acids increased slightly, while the volatile fatty acids slightly decreased. The relation between saturated and unsaturated fatty acids showed no constant change, nor did the quantity of cholesterol present, which was about 0·024—0·12%. The milk loses sweetness and becomes brown after storage for several years owing to the oxidation of amino-acids (tyrosine) or to decomposition of the sugars.—H. C. R.

Nitral; Biological action of —— and its bearing on the hygiene of nutrition. H. Bart. Arch. Hyg., 1922, **91**, 1—40. Chem. Zentr., 1922, **93**, IV., 259.

Nitral is purified moist nitrous oxide. Although this gas in the dry state possesses no bactericidal action, the moist gas at increased pressures kills all vegetative forms of bacteria, but not spores and conidia. Fresh milk treated with nitral at 30—35 atm. can be preserved so as to keep for at least a month without special cooling or precautions even at 18°—37° C. Living pathogenic germs other than *B. tuberculosus hom. and bov.*, suspended in milk, when treated with nitral at 48 atm. and 37° C., after 5 days treatment were weakened to such an extent that they no longer gave a reaction on a medium of lactose, litmus and nutritive agar. For tubercle bacilli a nitral concentration corresponding to a pressure of 50 atm. at 37° C. was necessary. After 8 days treatment guinea pigs could no longer be infected with the cultures. The original properties of the milk are fully retained after treatment with nitral. Meat can also be preserved in the same way as milk. Meats of the most varied kinds after treatment with nitral at 38 atm. pressure, all kept for at least a month at 18° C.—H. C. R.

Jams; Detection of apple juice in ——. C. F. Muttelet. Ann. Falsif., 1922, **15**, 196—200.

The acidity of red and black currants, raspberries and strawberries is due to the presence of citric acid, that of apples and pears to malic acid; cherries also contain malic acid. It is proposed to base the detection of apple juice in jams made with the first-mentioned fruits on the determination of the quantity of malic acid in the mixture. One hundred g. of the sample is warmed with 50 c.c. of water, cooled, treated with 150 c.c. of alcohol, then diluted with water to 300 c.c., and filtered after some hours; if the filtrate is highly coloured it must be decolorised with well-washed charcoal. The total acidity is titrated in a portion of the filtrate; another portion of 100 c.c. is mixed with 200 c.c. of 95% alcohol, neutralised by the addition of the required quantity of $N/1$ potassium hydroxide solution, and 30 c.c. of 5% barium bromide solution (in 85% alcohol) is added. After a few hours the precipitate of barium citrate and malate is collected on a filter and washed with 80% alcohol until free from soluble barium salts. It is then washed with water into a flask, the volume made up to 100 c.c., the mixture heated at 100° C. for 1 hr., cooled, filtered, and the filtrate treated with 50 c.c. of 95% alcohol; barium citrate is precipitated and is collected on a filter. The filtrate from this precipitate is evaporated to 50 c.c., cooled, and treated with 25 c.c. of alcohol; the last traces of barium citrate are thus precipitated and are collected. The filtrate is then evaporated to 25 c.c., cooled, and 50 c.c. of 95% alcohol is added; the precipitated barium malate is collected, washed with 66% alcohol, then dissolved in water and the barium precipitated and weighed as barium sulphate. Barium sulphate × 0·574 = malic acid. Apple and quince jellies examined by this method yielded 0·172—0·310% of malic acid, but the presence of this acid was not detected in currant and raspberry jams.—W. P. S.

Pectin; Study of the relation of —— and acidity in jelly making. L. Singh. J. Ind. Eng. Chem., 1922, **14**, 710—711.

The effect of acid concentration on the amount of sugar required to produce the "jellying" of fruit juice is considerable, an increase from 0·05 to 2·05% of acid reducing the sugar required by over 30%. If jelly is prepared below 65% sugar concentration the product and container must be pasteurised. Within certain limits the higher the amount of pectin in the juice the lower is the quantity of sugar needed to produce a jelly. If much more than 2% of pectin be used the excess separates and remains inactive on the surface. Waste lemon peels from citric acid factories were found to be extremely rich in pectin.—A. G. P.

Patent.

Iron and other magnetically permeable metals; Apparatus for separating —— from flour, grain, and the like. F. King. E.P. 183,940, 4.5.21.

XIXb.—WATER PURIFICATION; SANITATION.

Tubercle bacillus; Action of tribromoxylenol on ——. T. Duboc. Comptes rend., 1922, **175**, 326—328.

Tribromoxylenol, added to emulsions of tubercle bacilli, caused the separation of the organisms in a layer at the surface of the liquid, and their gradual disappearance, leaving the liquid perfectly clear. Bovine, avian, and human organisms were examined, and the time of final disappearance was found to vary with the strain, and previous treatment. (*Cf.* J.C.S., Sept.)—A. G. P.

Patents.

Deaerating of liquids [boiler-feed water]; Heating and ——. D. B. Morison. E.P. 183,534, 15.4.21.

In a method of deaerating liquids by heat treatment (*cf.* E.P. 173,524; J., 1922, 193 A), the deaeration effect is enhanced by re-circulating the warm deaerated liquid after mixing it with the inflowing liquid of lower temperature and higher aeration.—J. R.

Sewage water; Apparatus for the treatment of ——. V. Lamy. E.P. 167,504, 8.8.21. Conv., 7.8.20.

The sewage is fed to the bottom of a tank through a "trompe-blowing" device (water-jet pump), and, together with the entrained air, rises in a tube surrounding the fall tube of the pump, and overflows into a space enclosed by a cylindro-conical baffle concentric with the tubes. After flowing under the lower edge of the baffle, the liquid rises in the space between the baffle and the wall of the tank and is discharged. The tank is provided at the bottom with an outlet for settled sludge. In its passage through the apparatus the sewage is strongly aerated and agitated in the presence of the fine particles of sludge, whereby the major portion of the colloidal substances present is precipitated. The space between the tube and baffle is of such size that the time of circulation of the sewage corresponds to the time necessary for fermentation to be completed.—J. R.

Purification of [phenol-]contaminated liquors. The Koppers Co., Assees. of R. L. Brown. E.P. 161,976, 11.4.21. Conv., 30.4.20.

The waste liquor from ammonia stills, or other liquor containing phenol, is passed through a settling tank and a filter containing iron oxide. A suitable filtering medium is spent blast-furnace slag resulting from the treatment of mine water by the Heckman process. The still waste may be also treated for the removal of cyanogen compounds. It is then slowly passed through a filter composed of peat or other humus material mixed with coke so as to permit of free access of air and containing aerobic bacteria which oxidise the phenols and thiocyanates. In starting a filter the aerobic bacteria are supplied by means of activated sewage sludge or farmyard manure. About 85% of the filtrate is returned, so as to reduce the phenol concentration in the filter to 1—2 parts per 10,000.
—H. Hg.

Arsenical dust; Production of ——. J. D. Riedel A.-G. G.P. 301,686, 3.7.15, 302,406, 8.9.15, and 302,407 17.7.15.

A mixture of arsenic oxides with aluminium, or a mixture of aluminium with metallic oxides and substances containing arsenic, is ignited, and burns like thermite, with production of free arsenic, which is immediately oxidised, and forms a dense heavy fog, which rapidly settles. The mixture may be used for killing wild rabbits etc., its poisonous nature being increased by the addition of highly calcined alkali sulphide, as when this is present, and the mixture is ignited, arsenites are formed, which are much more poisonous than the oxide. The addition of ammonium chloride also increases the poisonous nature of the material, as arsenic chloride and hydride are then formed.—A. B. S.

Disinfectants; Manufacture of ——. Chem. Fabr. Griesheim-Elektron. G.P. 354,593, 14.12.20.

A tar oil phenol or mixture of phenols, pure or mixed with neutral tar oil, is mixed with carbon tetrachloride and soap in such proportions that a fluid or semi-solid product is obtained, from which on treatment with water neither the carbon tetrachloride nor the phenol or phenol and tar oil will separate. Glycerin or similar substances may also be added. The products, unlike lysol, are stable in presence of water containing lime.

Treatment of sewage sludge. E.P. 183,180. *See* IIa.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Aucubin and sucrose; Presence of —— in the seeds of Melampyrum arvense, Linn. M. Bridel and M. Braecke. J. Pharm. Chim., 1922, **26**, 129—134.

The seeds of *Melampyrum arvense* contain in addition to the glucoside, aucubin, which has previously been found in the leaves and stems of this plant, and which is hydrolysed by emulsin but not by invertase, a considerable quantity of a disaccharide, hydrolysable by invertase and giving polarisation figures closely corresponding to those of sucrose. Aucubin, isolated from the alcoholic extract, was obtained in colourless needles, m.p. 181° C., $\alpha_D = -174{\cdot}85°$. When hydrolysed by emulsin or sulphuric acid a black insoluble product is formed, which is characteristic of this glucoside, and also of rhinanthin, a glucoside occurring in *Rhinanthus Crista-Galli*, Linn., and it is possible that the two substances may be identical.—G. F. M.

Isoferulic acid; New syntheses of——. F. Mauthner. J. prakt. Chem., 1922, **104**, 132—136.

Isoferulic acid (3-hydroxy-4-methoxycinnamic acid) has been synthesised by reducing 4-methoxy-3-nitrocinnamic acid to 4-methoxy-3-aminocinnamic acid, m.p. 179°—180° C., and then replacing the amino group by hydroxyl. Another synthesis is from isovanillin, prepared by partial methylation of protocatechuic aldehyde, by condensation with malonic acid in acetic acid solution. Carbon dioxide is lost spontaneously, and isoferulic acid is formed. (*Cf.* J.C.S., Sept.)—W. O. K.

Mellitic acid, pyromellitic acid, and their production from carbon by oxidation. E. Philippi. Annalen, 1922, **428**, 286—287.

An introduction to the accompanying papers (*cf. infra*).—C. K. I.

Mellitic acid, pyromellitic acid, and their production from carbon by oxidation. I. Oxidation of carbon by nitric acid. E. Philippi and G. Rie. Annalen, 1922, **428**, 287—295.

The purification of the crude product of this reaction is a difficult matter, and the chief value of the process lies in the fact that pyromellitic acid can be obtained in 30% yield from the crude product by heating with sulphuric acid and bisulphate. —C. K. I.

Mellitic acid, pyromellitic acid, and their production from carbon by oxidation. II. Oxidation of carbon by sulphuric acid. E. Philippi and R. Thelen. Annalen, 1922, **428**, 296—300.

For the preparation of pyromellitic acid, finely powdered wood charcoal (100 g.), commercial sulphuric acid (1200 g., sp. gr. 1·76—1·80), and one globule of mercury, are heated during 3 hours to 250° C., during a further half-hour to 295° C., and then gradually to 315° C., at which temperature the mass is maintained until frothing ceases. The product is then distilled from a retort with the addition of 30—40 g. of potassium bisulphate, the pyromellitic anhydride being collected in water. The yield of pyromellitic acid is 6—7 g. (*Cf.* J.C.S., Sept.)—C. K. I.

Mellitic acid, pyromellitic acid, and their production from carbon by oxidation. III. Synthesis of pyromellitic acid from commercial xylene. E. Philippi, R. Seka, and N. Froeschl. Annalen, 1922, **428**, 300—306.

Commercial xylene is converted by means of acetyl chloride and aluminium chloride into a mixture of acetylxylenes, which are reduced to ethylxylenes. These are re-acetylated in the same manner, and the mixture of acetylethylxylenes reduced to diethylxylenes, which on oxidation by nitric acid give pyromellitic acid. (*Cf.* J.C.S., Sept.)—C. K. I.

[Fatty] acids of low molecular weight; Catalytic decomposition of ——. A. Mailhe. Bull. Soc. Chim., 1922, **33**, 681—687.

Acetic, isobutyric, butyric, isovaleric, and pelargonic acids were heated to about 600° C. in contact with copper-aluminium and the resulting products examined. Carbon monoxide, carbon dioxide, methane, and hydrogen were produced in different proportions in each case. With the exception of acetic acid, each substance also yielded some other paraffins and some olefines. With the acids of higher molecular weight, liquid products were also obtained; this was most marked in the case of pelargonic acid. It is shown that in each case the corresponding ketone (acetone, isobutyrone, butyrone, isovalerone, nonylone) is an intermediate product and by its decomposition forms certain of the end products.—H. J. E.

Trimethylene isomerism. Velocity of ring fission in gases. M. Trautz and K. Winkler. J. prakt. Chem., 1922, **104**, 53—79.

Measurements have been made of the reversible reaction, propylene$\rightleftarrows$trimethylene. The mixture obtained by passing pure trimethylene or propylene through a tube at a definite temperature of about 600° or 700° C. was analysed by finding the density of the product in the liquid state at −79° (*cf. supra*). The result had to be corrected for the polymerised material also formed. The equilibrium mixture consists very largely of propylene. The isomerism of trimethylene to propylene is unimolecular, and its speed is influenced by the shape of the containing vessel and the material of which it is made, though these effects decrease in magnitude with rise of temperature. The heat of the reaction at 550°—650° C. is calculated to be 63900 cals. At higher temperatures the reaction proceeds further, and carbon, methane, and hydrogen are formed from propylene.—W. O. K.

Terpin; Identification of —— in a complex mixture. Denigès. Bull. Soc. Pharm. Bordeaux, 1922, [2]. Ann. Chim. Analyt., 1922, **4**, 239—241.

The presence of terpin in a complex powder was established microchemically as follows: The powder was moistened with a drop of 85% alcohol on a microscope slide, and the liquid flowing beyond the limits of the powder and evaporating left characteristic tufts of prismatic needles of terpin hydrate. Characteristic needles of anhydrous terpin were obtained by micro-sublimation of the powder on to a drop of water hanging on the under side of a cover glass. The m.p. of the crystals was determined by floating a cover glass, on which was a sublimate of the terpin, on a bath of mercury which was gradually heated, and observing the temperature at which the initially white sublimate became transparent. The terpin was further identified by the carmine red colour which was developed when one or two drops of a 1% solution of sucrose or lævulose in 25% alcohol was added to a mixture of an alcoholic extract of the powder and concentrated sulphuric acid.—G. F. M.

Terpenes, phytosterols, and resins. I. Amyrin; Extraction of amyrin. K. A. Vesterberg. Annalen, 1922, 428, 243—246.

A bibliographical and historical note.—C. K. I.

Terpenes, phytosterols, and resins. II. Separation of α- and β-amyrin; Preparation of α-amyrilene. K. A. Vesterberg and S. Westerlind. Annalen, 1922, 428, 247—251.

Details are given for the preparation of crude amyrin, $C_{30}H_{49}OH$, for its separation into α- and β-amyrin by fractional crystallisation of the benzoates, and for the preparation of α-amyrilene, $C_{30}H_{48}$, by the action of phosphorus pentachloride on α-amyrin.—C. K. I.

Odour; Relationship of —— to molecular structure. R. Delange. Bull. Soc. Chim., 1922, 33, 589—630.

A general survey of the subject dealing with various theories which have been put forward and attempts to apply methods of quantitative measurement. A bibliography is given.—H. J. E.

Anthracene series. Barnett and Cook. *See* IV.

PATENTS.

Condensation products of formaldehyde and phenols; Process for the preparation of water-soluble alkali salts of ——. H. Bucherer. G.P. 350,043, 12.9.18.

The resinous condensation products of phenols and formaldehyde are dissolved in less than the equivalent quantity of alkali, the amount depending on the use to which the salts are to be put, and the solid alkali salts are salted out as a solid or soap-like mass by known methods. With the equivalent or greater quantities of alkali a solid salt cannot be salted out. The compounds are soluble in water, but the solutions are decomposed by carbon dioxide, or, on heating, with partial precipitation of the condensation product. The salts find application in the textile industry.—A. R. P.

Acetyl chloride and its homologues; Process for the preparation of ——. Chem. Fabr. vorm. Weiler-ter Meer. G.P. 350,050, 3.2.20.

Acetic acid, its anhydride, or an anhydrous acetate, or homologues of these substances are heated with benzoyl chloride to a temperature above the boiling point of the required aliphatic acid chloride. As by-products, benzoic acid or benzoic anhydride, together with hydrochloric acid or sodium chloride, are produced.—A. R. P.

Fatty acids; Process for the preparation of —— from hydrocarbons. W. Mathesius. G.P. 350,621, 11.3.16.

Hydrocarbons are heated to a high temperature under pressure with water and oxygen or gases containing oxygen, preferably in the presence of alkalis or alkali carbonates to prevent further oxidation of the fatty acids. Catalysts may be used to increase the yield which, under favourable conditions, is about 60%.—A. R. P.

Diethyl sulphate; Process for the preparation of ——. A. Wohl. G.P. 350,808, 31.3.18.

Ethylsulphuric acid is distilled under a high vacuum, and the more volatile by-products, e.g., alcohol, ether, and water, are condensed by cooling to -80° C., or by absorption in films of cold concentrated sulphuric acid. Diethyl sulphate, under these conditions, distils at about 110° C., even from ethylsulphuric acid containing an excess of sulphuric acid, without the formation of substitution or oxidation products.—A. R. P.

α-Chlorocrotonaldehyde; Process for the preparation of ——. Chem. Fabr. vorm. Weiler-ter Meer. G.P. 351,137, 18.12.20.

Crotonaldehyde is treated with chlorine and the αβ-dichlorobutyraldehyde produced is treated with water, the solution neutralised with lime, and the α-chlorocrotonaldehyde formed is distilled in steam, dried, and rectified. It is a colourless liquid boiling at 147°—149° C. and may be used for the preparation of butyrochloral hydrate.—A. R. P.

Ethers of homologues of hydroxybenzyl alcohols containing methyl groups attached to the nucleus [linseed oil substitutes]; Process of making ——. M. Melamid. G.P. 352,003, 28.4.20.

Solutions in 20% caustic soda of the hydroxy alcohols made from *m*- or *p*-cresol or technical cresol mixtures and formaldehyde are heated to 100° C. with allyl or vinyl bromide. The product is diluted with water and the solution extracted with ether or acetone. After distillation of the latter a viscous, light brown liquid is obtained which rapidly dries in the air and may be used as a substitute for linseed oil.—A. R. P.

Oxalic acid; Process for the preparation of —— from leached tan bark. A. Wipfler. G.P. 352,576, 2.10.20.

The residue from extracting pine bark for tanning purposes is transferred while still hot from the extraction apparatus and allowed to absorb as much of a hot mixture of potassium and sodium hydroxides as possible. The resulting mass is dried while vigorously stirring and slowly heated for 1 hr. to 220° C., then for ½ hr. to 240° C. The cold mass is leached and the oxalic acid present extracted by known methods. The yield is about 70—90% of the dry bark after extracting the tannin.—A. R. P.

Colloidal silver halides; Production of solid ——. J. D. Riedel A.-G. G.P. 352,656, 16.5.19. Addn. to 350,097.

Colloidal silver halides, prepared as described in G.P. 350,097 (J., 1922, 392 A), are converted into the solid state by precipitation with organic solvents—A. B. S.

Arylsulphonic acid esters of halogenated aliphatic alcohols; Process for the preparation of ——. G. von Kereszty and E. Wolf. G.P. 353,195, 29.5.19. Conv., 24.3.19.

Into a cold solution of the arylsulphonic acid chloride in the halogenated alcohol a concentrated solution of caustic alkali is stirred, drop by drop, until, after vigorous shaking, the alkaline reaction still persists. Benzenesulphonyl chloride and glycolchlorhydrin when treated in this manner yield chloroethyl benzenesulphonate, b.p. 184° C. at 8—11 mm.—A. R. P.

Formaldehyde; Manufacture of ——. The Barrett Co., Assees. of G. C. Bailey and A. E. Craver. E.P. 163,980, 16.3.21. Conv., 26.5.20.

See U.S.P. 1,383,059 of 1921; J., 1921, 637 A.

Silver alcosols; Process for production of —— *with aid of organic bodies.* Soc. Chim. Usines du Rhône. E.P. 173,733, 2.9.21. Conv., 5.1.21.

See U.S.P. 1,413,151 of 1922; J., 1922, 438 A.

Vinyl halides; Manufacture of ——. H. Plauson. U.S.P. 1,425,130 8.8.22. Appl., 13.1.21.

See E.P. 156,117 of 1920; J., 1922, 436 A.

Phosphoric esters; New liquid —— *and processes of making same. New mixed phosphoric esters and processes of making same.* A. L. Laska and H. H. C. Prillwitz, Assrs. to Chem. Fabr. Griesheim-Elektron. U.S.P. 1,425,392–3, 8.8.22. Appl., 12.4.21.

See E.P. 181,835 of 1921; J., 1922, 647 A.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Patents.

Photography; Multicolour screens for ——. J. H. Christensen. E.P. 163,311, 12.5.21. Conv., 15.5.20.

Decrease in brilliancy and clearness on mordanting the dyes of a multicolour screen is avoided by comminuting (*e.g.*, emulsifying) liquids containing dye and mordant in such a form that precipitation does not take place, so that mordanting occurs only after the particles of liquid have been applied to the underlayer and dried. The underlayer consists of a basic cellulose derivative, such as collodion containing a little soap.—W. C.

Colour kinematography. R. O. P. Humphery and C. H. Friese-Greene. E.P. 183,150, 4.11.21.

Different sections of panchromatic or colour-sensitive film are exposed alternately through a special moving shutter to white light with a colour phase on the blue side of the spectrum and to coloured light on the red side of the spectrum. The area of the colour phase is less than that of the white light, and the density of the red colour filter should preferably diminish from one end of the filter to the other.—W. C.

Tricolour photography; Method of producing photographic plates for indirect ——. E. A. Lage. E.P. 183,189, 19.3.21.

Three silver halide emulsion films, each sensitised for different spectrum colours, are superimposed directly upon each other and brought into optical contact by expressing the intervening air from between the films by the pressure of spring-actuated or yielding rollers.—W. C.

Photographic plates; Process for preparation of ——. H. Schreiber. G.P. 350,658, 24.5.21.

Plates which can be developed in fairly bright light without treatment with an aqueous solution of desensitiser are prepared by treating the dry, exposed plate, before development, with an alcoholic solution of Phenosafranine. On drying, a thin film of desensitiser forms on the surface, and on contact with water it reacts with the silver bromide in the film. The sensitiveness of the plate is so reduced that further treatment can be carried out in moderately bright light.—W. C.

Photographic material for production of positives. H. Schreiber. G.P. 350,659, 24.5.21.

A silver-emulsion layer, the sensitiveness of which is lowered by addition of desensitisers is placed on a suitable support (glass, celluloid, or paper). On this coating is placed a transferable emulsion coating of high sensitiveness. The combination is exposed and the upper film can be developed without the lower layer being affected. From the negative so obtained, a positive is produced in the lower coating by a second exposure, and the two films are then separated.—W. C.

Multicoloured screen-plates; Process for the preparation of ——. F. W. May. G.P. 351,763, 22.3.21.

To a film support covered with a gelatin layer a coating is applied warm, in the form of lines. The film is hardened and coloured in the free spaces, the surface is treated with formalin, ferric chloride or aluminium acetate; the cover film is then washed off and the process repeated for the other colours. Printing-oil colours, removable by benzene, are used for the cover layer. The screen on a celluloid base is coated with a colour-sensitive emulsion, and is then ready for use.—W. C.

[Photographic] transfer films. Farbenfabr. vorm. F. Bayer und Co. G.P. 351,904, 13.8.20.

Paper is coated with hardened gelatin or other colloid (glue, fish-glue, casein), and a rubber film, and then with a photographic emulsion, so that the microscopic projecting fibres of the paper cause the transferable film to adhere in the developing, fixing and washing baths. The paper is exposed, fixed and washed like an ordinary plate. After drying, the negative is cut round the edges and one corner is cracked, after which it becomes detached from its support, and can be easily removed. For hardening the gelatin, formalin or potash alum can be used in addition to chrome alum.—W. C.

[Photographic] brown-tone printing-out emulsions. Farbenfabr. vorm. F. Bayer und Co. G.P. 351,905, 8.3.21.

Brown tones are obtained by adding an element of the sulphur group to the prepared emulsion and fixing in an ordinary acid fixing bath. In the case of collodion emulsions a solution of sulphur in carbon tetrachloride is added; to gelatin P.O.P. emulsions is added a solution of sulphur in carbon tetrachloride together with an oil. Selenium and tellurium have the same action.—W. C.

Tungstic acid; Production of non-phosphorescent, highly fluorescent compounds of —— *[for X-ray photography].* E. Tiede. G.P. 353,075, 14.5.20.

Non-phosphorescent, highly fluorescent compounds of tungstic acid, particularly alkaline-earth compounds, are prepared by using tungstic acid of high purity, made by repeatedly crystallising ammonium paratungstate, and precipitating with pure nitric acid. By the use of non-phosphorescent compounds intensifying screens are obtained which are superior to those ordinarily used both for visual examination and for the production of radiographs. —A. B. S.

[Photographic] transfer films; Process for preparation of ——. Mimosa A.-G. G.P. 354,294, 21.9.20.

On a temporary support is laid a collodion film containing rubber or resins, to which the sensitive emulsion is applied either directly or with a reinforcing layer. By this method gelatin, baryta, cellulose-ester film, etc. can be used as substrata instead of rough paper.—W. C.

[Photographic] fixing-bath; Regeneration of ——. P. Orywall. G.P. 354,295, 29.4.19.

Molecular quantities of alkaline-earth sulphides and anhydrous sodium carbonate, together with

2—5% of paraformaldehyde are added to the fixing-bath, in amount corresponding to the silver content of the latter. The silver is precipitated and the bath regenerated. This method has advantages over the use of sodium sulphide.—W. C.

Colour-photography; Process for atomising colloids, with exception of soaps, free from bubbles, for preparation of colour screens for use in ——. M. Obergassner. G.P. 354,389, 7.5.14.

Colloid solutions are atomised by means of such gases or vapours as are soluble in the colloid or colloid solution.—W. C.

Photographic plates. K. Wiebking. G.P. 354,432, 15.2.21.

To the glass side of plates is applied a coating containing a desensitiser, such as Safranine, the coating being soluble in cold water, or capable of yielding up the desensitiser to water. When the Safranine has dissolved the exposed plates can be developed in bright yellow light.—W. C.

XXII.—EXPLOSIVES; MATCHES.

Patents.

Cellulosic colloids; Method of controlling the stabiliser content of ——. G. Rocker, Assr. to E. I. du Pont de Nemours and Co. U.S.P. 1,424,212, 1.8.22. Appl., 17.12.20.

The colloid is washed with a solution containing the stabiliser and afterwards with a liquid in which the stabiliser is insoluble, but which is miscible with the solvent in which the stabiliser is dissolved.—H. C. R.

Cartridge for blasting with liquid air and process for producing the same. A. Kowastch. U.S.P. 1,424,488, 1.8.22. Appl., 19.7.20.

Peat is combined with the usual components of a cartridge for blasting with a liquefied gas.
—H. C. R.

Solvents; Recovery of —— from the raw material for smokeless powder etc. Westfälisch-Anhaltische Sprengstoff A.-G. G.P. 307,077, 26.9.17.

The material is stored with charcoal. The volatile solvents are absorbed by the charcoal and can be recovered from it by known distillation processes. The process has the advantage of great simplicity.
—H. C. R.

Nitrocellulose; Process for dissolving ——. Köln-Rottweil A.-G. G.P. 352,905, 27.11.18.

Mixtures of benzene with methyl alcohol, to which in certain cases small quantities of gelatinising agents, such as acetone, amyl acetate, pyridine, and nitrobenzene, are added, are used instead of the customary benzene-alcohol mixture. The above gelatinising agents may also be added to mixtures of benzene and ethyl alcohol, after which nitrocellulose can be completely dissolved in the mixtures. These solvents are of value in the manufacture of powders and of artificial silk.—H. C. R.

Detonating caps for mining and military purposes; Process for the manufacture of ——. W. Friederich. U.S.P. 1,424,462, 1.8.22. Appl., 15.12.20.

See E.P. 138,083 of 1920; J., 1921, 100 A.

XXIII.—ANALYSIS.

Nephelectrometer; The ——. I. N. Kugelmass. Comptes rend., 1922, 175, 343—345.

Changes in the degree of aggregation of a colloidal solution may be observed by determining the variations in its degree of transparency. The apparatus consists essentially of three parts—an electric lamp, a vessel to contain the solution, and a thermopile. The lamp, which gives weak but constant illumination, is placed in a metal box, the interior of which is blackened, and when coloured solutions are being examined the light is filtered to render it monochromatic. A lens is interposed between lamp and solution to obtain a parallel beam. The vessel containing the solution has parallel sides which are provided with circular transparent areas through which the light may pass. An aperture furnished with a ground stopper serves for the introduction of the solution to be examined. The diameter of the sensitive portion of the thermo-electric cell is of the same size as the transparent portion of the vessel. The apparatus is standardised by filling the vessel with distilled water and determining the number of seconds required to obtain a deviation of the needle of a millivoltmeter through 100 divisions. The colloidal solution is then placed in the vessel, and the deviation of the needle for the same number of seconds is noted. The variation in transparency can thus be measured quantitatively.—H. J. E.

Extraction medium [e.g., ether]; Recovery of a volatile —— in laboratory practice. A. B. Pichler. Chem.-Zeit., 1922, 46, 698.

If a large bulk of material has to be extracted with ether, or other expensive solvent, an economy is obtained by placing a thimble with its contents, after extraction, in a boiling tube and substituting this for the flask of a Soxhlet containing a fresh thimble. After boiling for 10 mins. in a water bath the ether contained in the residue has all passed up into the fresh material and the extracted thimble can be removed and dried.—C. I.

Titration of acids and bases. J. L. Lizius and N. Evers. Analyst, 1922, 47, 331—341.

The theory of titration is outlined and the dependence of the hydrogen ion concentration of the end product on the nature of the salt formed is explained. A list of newer indicators with their colour changes and the p_H range over which they are applicable is given, and four mixed indicators are suggested. A table of common titrations showing the hydrogen ion concentrations at the end-points, suitable indicators, and the colours obtained at the end-points is also given. By titrating to a definite shade of colour instead of to the colour-change of the indicator, an increase in the accuracy of titration results, and certain titrations are made possible which are impracticable by ordinary methods.—H. C. R.

Electrometric titrations with mercuric perchlorate. I. M. Kolthoff. Z. anal. Chem., 1922, 61, 332—343.

Electrometric titration with mercuric perchlorate solution affords a trustworthy means of determining chlorides, iodides, bromides, thiocyanates. cyanides, ferrocyanides, formates, acetates, monochloroacetates, lactates, benzoates, and salicylates; in the cases of chlorides, iodides, and bromides the end-point is very sharp, even in very dilute solution, but the method is not applicable to mixtures of these salts. The method cannot be used for the determination of trichloroacetates, owing to the ready hydrolysis of the mercury compound formed, nor is it applicable to the salts of polybasic aliphatic acids. The mercury perchlorate solution used is prepared by neutralising perchloric acid with pure mercuric oxide; when all the perchloric acid has been neutralised the solution on treatment with an excess of sodium chloride is neutral towards dimethyl-yellow (dimethylaminoazobenzene).
—W. P. S.

Gold; Estimation of small quantities of ——, *as colloidal gold, by the colorimetric method.* J. A. Muller and A. Foix. Bull. Soc. Chim., 1922, **33**, 717—720.

The gold to be estimated should have been previously separated from other metals; a brief account of the methods of separation used by the authors is given. It is then dissolved in *aqua regia*, the excess of the reagent evaporated, the solution diluted to a concentration not exceeding 1/40 mg. per c.c. and reduced by formaldehyde in presence of alkali. It is essential that the particles in the two solutions to be compared should be of the same size; this condition is satisfied if reduction is carried out in identical circumstances. The authors' results are reliable in the case of gold separated from arsenic, antimony, tin, molybdenum, and tungsten, but not in that of gold separated from vanadium.—H. J. E.

Phosphorus in minerals and coke ash; Colorimetric estimation of ——. G. Misson. Bull. Soc. Chim. Belg., 1922, **31**, 222—225.

One g. of the mineral is dissolved in 10 c.c. of nitric acid and 30 c.c. of hydrochloric acid, the solution is evaporated to dryness, the residue dissolved in concentrated hydrochloric acid and treated with successive quantities of pure nitric acid until free from all traces of chlorine. The residue is finally dissolved in 25 c.c. of nitric acid (sp. gr. 1·20), and the solution treated with 10 c.c. of permanganate solution (8 g. per litre) and boiled for 2 mins. Any precipitated manganese oxide is dissolved by adding 10 c.c. of a solution of sodium peroxide in nitric acid (40 g. of peroxide in 1 litre of 1:9 acid), 10 c.c. of ammonium vanadate solution is added and, after boiling, 10 c.c. of ammonium molybdate. The colour produced is compared with a standard. Modifications of the method are used for minerals having a phosphorus content above 0·2% and also for coke ash. Comparison of the results with those obtained by gravimetric methods shows that the colorimetric method is reasonably accurate, especially in the case of small percentages.—H. J. E.

Hydrogen; Estimation of —— *and its separation from gaseous paraffins by means of palladious chloride.* J. A. Muller and A. Foix. Bull. Soc. Chim, 1922, **33**, 713—717.

The gaseous mixture containing hydrogen is placed in a small flask over water and brought into contact with 138 mg. of palladious chloride dissolved in 1 c.c. of water for each 15 c.c. of hydrogen presumed present. The whole is heated to 50°—60° C. until absorption of the hydrogen is complete, the vessel being shaken from time to time in order to dislodge the particles of precipitated palladium from the surface of the liquid. Heating is continued until no further deposition of palladium occurs; the time required for complete absorption is about a week. The palladium is collected and weighed; a correction for occluded hydrogen must be made, and it is stated that 0·24 c.c. of hydrogen at 0° C. and 760 mm. pressure corresponds to 1 mg. of precipitated palladium. Experimental data are given for pure hydrogen and mixtures of hydrogen with methane and ethane respectively.—H. J. E.

See also pages (A) 697, *Efficiency of steam-pipe coverings* (Jakeman). 698, *Volatile matter in coal* (Deville). 699, *Volatility of oils* (Matthis). 706, *Bromide in potassium iodide* (Grossmann); *Iodates in potassium iodide* (Lachartre); *Sulphides* (Budnikow and Krause); *Iron and aluminium in phosphates* (Nydegger and Schaus). 707, *Monazite* (Wenger and Christin). 713, *Ferro-titanium* (Grandjean). 714, *Sodium in aluminium and alumina* (Geith); *Tin in alloys* (Nagel); *Gases in metals* (Simons). 718, *Sulphuric acid reaction for liver oils* (Drummond and Watson). 725, *Starch in brewers' grains* (Weiss); *Milk analysis* (Lührig). 726, *Apple juice in jams* (Muttelet). 727, *Terpin* (Denigès).

Patents.

Gas calorimeters. Igranic Electric Co., Ltd. From The Cutler-Hammer Mfg. Co. E.P. (A) 183,408 and (B) 183,409, 7.4.21.

(A) In gas calorimeters in which a stream of a test gas is burned in heat-exchanging relation with a stream of cooling fluid, error due to loss of heat during the heat exchange is eliminated by causing the stream of cooling fluid after it has absorbed heat liberated by the combustion of the test gas to flow in heat-exchanging relation with the incoming stream of cooling fluid before or during such absorption of heat, whereby the stream is preheated. (B) In gas calorimeters in which electrical resistance thermometers are subjected to temperatures the difference between which varies according to the heating value of the combustible gas employed, the temperature coefficients of resistance of the thermometers are adapted to vary according to the respective temperatures so that a constant relation, independent of the temperature at which the test is carried out, is maintained between the resistances of the thermometers, for a constant heating value of the combustible gas. Thus the resistance thermometers may be constructed of suitably proportioned sections of nickel and copper wires. —J. S. G. T.

Gas blowpipe burners [for use in laboratories, etc.]. H. G. Becker. E.P. 183,563, 23.4.21.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given; they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Bader, and British Cellulose and Chem. Manuf. Co. Separation of liquids from mixtures. 24,128. Sep. 6.

Buckley and Harvey. Centrifugal drying-machines. 23,946. Sep. 4.

Duckham, and Woodall, Duckham, and Jones. Annular muffle furnaces or ovens. 24,045. Sep. 5.

Fraser. 24,318. *See* II.

Hansen. 23,441. *See* VII.

Ionides. Mixing machines. 24,423. Sep. 8.

Jamieson. Apparatus for emulsifying liquids etc. 23,282. Aug. 28.

Lambert and Reed. Mixing machine. 23,758. Sep. 1.

Marks (Raymond Bros. Impact Pulverizer Co.). Pulverising apparatus. 23,451. Aug. 29.

Milliken. Apparatus for extracting dust and fume from gases. 24,179. Sep. 6. (U.S., 6.9.21.)

Povey. Machines for disintegrating and emulsifying. 23,921. Sep. 4.

Renault. Centrifuges. 23,462. Aug. 29. (Fr., 7.3.22.)

Rigby. Heating liquids or admixed solids and liquids in evaporative treatment. 23,911. Sep. 4.

Salerni. Apparatus for purifying gases etc. 23,581. Aug. 30.

Salerni. Distilling, heating, cooling, drying, evaporating etc. liquids. 23,583. Aug. 30.

Complete Specifications Accepted.

14,078 (1921). Welford. Cleansing and/or humidifying apparatus for air or other gases. (184,871.) Sep. 6.

14,152 (1921). Wade (Union Trust Co.). Regenerative furnaces. (184,877.) Sep. 6.

22,785 (1921). Oehm. Furnaces. (185,320.) Sep. 13.

23,575 (1921). Faber and Briscoe. Rotary kilns. (185,327.) Sep. 13.

26,584 (1921). Zynkara Co., and Cross. Compositions for preventing corrosion and removing incrustations in boilers etc. (185,035.) Sep. 6.

26,717 (1921). Clark, Dawson, and Dawson. Apparatus for pulverising, mixing, and grading. (185,037.) Sep. 6.

20,130 (1922). L'Air Liquide. *See* VII.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Alexander (U.S. Gasoline Manuf. Corp.). Producing hydrocarbon compounds. 23,289. Aug. 28.

Alexander. Motor spirit for internal-combustion engines. 24,340. Sep. 8.

Barker, Broadhead, and Hunt. Manufacture of combustible gases. 23,761. Sep. 1.

Barrett Co. Manufacture of coke. 23,963. Sep. 4. (U.S., 2.11.21.)

Beasley. 23,620. *See* XXIII.

Diamond. Motor spirit. 24,286. Sep. 7.

Engel and Masson. Clarifying and refining crude oils. 23,529. Aug. 30.

Farbenfabr. vorm. F. Bayer u. Co. Absorbing ethylene and its homologues. 24,410. Sep. 8. (Ger., 9.9.21.)

Farbw. vorm. Meister, Lucius, u. Brüning. Manufacture of methane. 23,561 and 23,674. Aug. 30 and 31. (Ger., 4.10.21.)

Fraser. Gas-washing apparatus. 24,318. Sep. 8.

Hackford. Manufacture of gas from oil and utilising resulting gas. 23,572. Aug. 30.

Laing and Nielsen. Distillation of carbonaceous etc. materials. 23,796. Sep. 1.

Meade. Gasification of coal. 23,398. Aug. 29.

Neath. Manufacture of gas from coal and oil. 32,869. Sep. 2.

Tinker. Production of petrol etc. 24,062. Sep. 5.

Complete Specifications Accepted.

6010 (1921). Reid. Production of gas and carbonaceous materials. (185,135.) Sep. 13.

6274 (1921). Seigle. Apparatus for cracking hydrocarbon or other oils. (185,140.) Sep. 13.

14,276 (1921). Umpleby and Powers. Gas generators and/or retorts. (184,887.) Sep. 6.

15,066 (1921). Stenning, Beasley, and Minerals Separation, Ltd. Production of coal briquettes. (185,216.) Sep. 13.

19,158 (1921). Lentz. Oven for semi-coking of fuels. (166,544.) Sep. 13.

20,374 (1921). Ehlers. Refining mineral oils obtained from earth oil. (184,991.) Sep. 6.

III.—TAR AND TAR PRODUCTS.

Applications.

Thompson (Klipstein and Sons Co.). Manufacture of derivatives of carbazols. 23,361. Aug. 29.

Thompson (Klipstein and Sons Co.). Manufacture of *p*-dichlorbenzene. 23,362. Aug. 29.

IV.—COLOURING MATTERS AND DYES.

Applications.

Thompson (Atack). Manufacture of azines and hydroazines of the anthraquinone series. 23,809. Sep. 2.

Thompson (Klipstein and Sons Co.). Manufacture of sulphide dyestuffs and processes of dyeing therewith. 24,002. Sep. 5.

Complete Specification Accepted.

6063 (1921). Atack and Soutar. Anthraquinone dyestuffs. (185,137.) Sep. 13.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Delahaye. Manufacture of viscose. 23,657. Aug. 31.

Mourlaque and Parent. Transforming vegetable matter into paper pulp. 23,671. Aug. 31. (Fr., 1.9.21.)

Perry. Treatment of materials containing cellulose. 23,295. Aug. 28.

Plauson's (Parent Co.), Ltd. (Plauson). Treatment of cellulose etc. 23,808. Sep. 2.

Reynard, Tapping, and Thornley. Manufacture of cellulose. 23,421. Aug. 29.

Ros, and Volos Manufacture. Treatment of fibrous material. 24,281. Sep. 7.

Ryberg and Schaanning. Grinding paper pulp. 24,321. Sep. 8. (Ger., 7.3.21.)

Soc. de Stearinerie et Savonnerie de Lyon. Manufacture of cellulose ether salts. 24,153. Sep. 6. (Fr., 29.7.22.)

Vielle. Rendering materials waterproof. 24,206. Sep. 7.

Vielle. Manufacture of tarpaulins, ropes, etc. 24,207. Sep. 7.

Complete Specifications Accepted.

14,033 (1921). Schulke. Production of wool-like yarns from artificial threads. (167,458.) Sep. 6.

18,462 (1921). Soc. du Feutre. Carrotting fur and hair. (167,748.) Sep. 13.

19,951 (1921). Zellstoff-fabr. Waldhof, Hangleiter, and Clemm. Recovery of sulphurous acid and heat from the waste gases from pulp boilers. (167,171.) Sep. 13.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

British Dyestuffs Corp., Green, and Saunders. Dyeing artificial silk etc. 23,543. Aug. 30.

Calico Printers' Assoc., and Fourneaux. Mercerising and finishing fabrics. 23,328. Aug. 28.

Thompson (Klipstein and Sons Co.). 24,002. *See* IV.

Complete Specifications Accepted.

14,441 (1921). Silbereisen. Apparatus for scouring, dyeing, etc. fabrics in the piece in continuous process. (176,306.) Sep. 6.

21,557 (1921). Calico Printers' Assoc., and Nelson. Printing textile fabrics. (185,007.) Sep. 6.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Belton and Dempster. Effluent value for ammonia liquor etc. plant. 23,264. Aug. 28.

Carpmael (Buckman). Titanium complexes and method of producing same. 23,427. Aug. 29.

Germot. Manufacture of oxide of antimony. 24,362. Sep. 8.

Goodwin. Manufacture of oxides of nitrogen and nitric acid. 24,008. Sep. 5.

Hansen. Treatment of containers etc. of iron for manufacture of sodium peroxide. 23,441. Aug. 29.

Jacobson. Manufacture of anhydrous metal chlorides. 23,473. Aug. 30. (U.S., 31.5.22.)

Price. Chemical compound. 24,315. Sep. 8.

Rawson. Treatment of hydromagnesite. 23,419. Aug. 29.

Complete Specifications Accepted.

5615 (1921). Amer. Zeolite Corp. Preparation of artificial base-exchanging bodies. (159,196.) Sep. 6.

14,035 (1921). Soc. Anon. de Produits Chim. Etabl. Maletra. Continuous production of sulphates. (163,706.) Sep. 6.

14,459 (1921). Casale and Leprestre. Apparatus for the catalytic synthesis of ammonia. (185,179.) Sep. 13.

16,619 (1921). Wilderman. Processes and cells for electrolytic decomposition of alkali salts. (184,938.) Sep. 6.

18,805 (1921). Schmiedel. Manufacture of sulphuric acid. (184,966.) Sep. 6.

4435 (1922). Blanc. Separation of chlorides of aluminium and potassium present in solutions obtained in treating leucite. (176,770.) Sep. 13.

13,466 (1922). Carteret and Devaux. Production of crystalline titanium oxide. (185,374.) Sep. 13.

20,130 (1922). L'Air Liquide. Separating the elementary constituents of air or other gaseous mixtures. (184,454.) Sep. 13.

VIII.—GLASS; CERAMICS.

Application.

Grace. Separation of micaceous etc. material from china clay. 23,318. Aug. 28.

Complete Specification Accepted.

14,189 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Refining clay, especially china clay. (184,880.) Sep. 6.

IX.—BUILDING MATERIALS.

Applications.

Burt, Boulton, and Haywood, and China. Preservation of timber. 23,560. Aug. 30.

Dyson. Concrete for flooring etc. 24,113. Sep. 6.

Munro. Manufacture of cement. 23,810. Sep. 2.

Wallace. Bituminous paving-material. 23,319. Aug. 28.

Complete Specification Accepted.

19,446 (1921). Soc. de Recherches et de Perfect. Indus. Impregnation of wood. (168,045.) Sep. 13.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Cadby and Sons, and Willing. Iridescent heat bronzing on metals. 23,495. Aug. 30.

Crawshaw. Apparatus for hardening and tempering steel etc. 24,195. Sep. 7.

Elektrizitätswerk Lonza. Iron alloys. 24,176. Sep. 6. (Switz., 10.9.21.)

Elektrizitätswerk Lonza. 24,271. *See* XI.

Evans and Lewis. Recovery of tin from tin-pot skimmings. 24,433. Sep. 9.

France. Mineral washing. 23,775. Sep. 1.

Germot. Direct obtainment of antimony. 24,361. Sep. 8.

Geyer. Aluminium alloys. 23,429, 23,430. Aug. 29. (Fr., 30.12.21, 2.5.22.)

Golby (Nelson). Soldering metals. 23,522. Aug. 30.

Hansen. 23,441. *See* VII.

Heenan. Electrolytic systems for preventing incrustation and corrosion of metals. 23,684. Aug. 31.

Herbert. Testing hardness of metals etc. 24,200. Sep. 7.

Leggo. Furnaces etc. for ore roasting etc. 24,059. Sep. 5. (Australia, 19.12.21.)

Saltrick. Alloys. 24,119. Sep. 6.

Saltrick. Metals and alloys. 24,120. Sep. 6.

Vautin. Production of copper. 24,288. Sep. 7.

Vivian. Treatment of ores etc. by flotation. 23,784. Sep. 1.

Complete Specifications Accepted.

11,310 (1921). Rogers (Calorizing Corp. of America). Furnace particularly for calorizing metals. (184,839.) Sep. 6.

11,311 (1921). Rogers (Calorizing Corp. of America). Metallic alloys. (184,840.) Sep. 6.

11,786 (1921). Skelley, Merson, and Continuous Reaction Co. Manufacture of ferrotungsten and ferromolybdenum. (184,843.) Sep. 6.

11,787 (1921). Skelley, Smith, and Continuous Reaction Co. Ferrous alloys. (184,844.) Sep. 6.

15,179 (1921). Turner. Manufacture of carbon-free ferromolybdenum. (184,912.) Sep. 6.

15,655 (1921). Cammell, Laird and Co., Allan, Hague, and Middleton. Cementation of iron, steel, and ferrous alloys. (184,920.) Sep. 6.

15,968, 19,249, 20,938, and 33,100 (1921). Sulman, Tapling, Perkins, and Picard. Treatment of ores containing copper silicate. (185,242.) Sep. 13.

17,499 (1921). Carteret and Devaux. Treatment of titanium ores containing iron. (184,948.) Sep. 6.

18,034 (1921). Usines Métallurgiques de la Basse-Loire. Production of basic steel. (184,957.) Sep. 6.

18,533 (1921). Barron and Barron. Annealing and/or other heat treatment of metals. (185,277.) Sep. 13.

21,662 (1921). Rushen (A.-G. Felder-Clement). Manufacture of tungsten carbides without free carbon for use as tools etc. (185,313.) Sep. 13.

22,216 (1921). Mulligan. Readily fusible alloys. (185,012.) Sep. 6.

XI.—ELECTRO-CHEMISTRY.

Applications.

Buffard. Recuperative electrolytic cell. 23,931. Sep. 4. (Fr., 15.9.21.)

David and Dutt. Dry batteries. 24,294. Sep. 7.

Elektrizitätswerk Lonza. Applying alloys of silicon and calcium in electrolytic processes. 24,271. Sep. 7. (Switz., 10.9.21.)

Foulds and Leblanc. Copper oxide cells. 24,279. Sep. 7. (Fr., 8.9.21.)

Freeth and Munro. Electric batteries. 23,824. Sep. 2.

Genese, Minchin, and others. Electric storage batteries. 23,646. Aug. 31.

Heenan. 23,684. *See* X.

Oldham, and Oldham and Son. Galvanic batteries. 24,274. Sep. 7.

Plews. Manufacture of storage-battery plates. 23,447. Aug. 29.

Powell. Primary batteries. 23,490. Aug. 30.

Scott. Electrolytic gas-generating systems. 23,977. Sep. 4.

Complete Specifications Accepted.

6011 (1921). Reid. Electric furnaces. (185,136.) Sep. 13.

9024 (1921). Wade (Hazelett Storage Battery Co.). Manufacture of storage batteries. (185,148.) Sep. 13.

9494 (1921). Smith. Storage batteries. (160,821.) Sep. 13.

11,375 (1921). Warnon. Electric battery. (184,841.) Sep. 6.

11,890 (1921). Pehrson. Furnaces for electric heating. (162,285.) Sep. 6.

16,619 (1921). Wilderman. *See* VII.

18,126 (1921). Lodge Fume Co. (Metallbank u. Metallurg. Ges.). Cleaning discharge electrodes in apparatus for precipitating suspended particles from gases. (184,959.) Sep. 6.

23,241 (1921). Fuller's United Electric Works, and Beswick. Manufacture of storage battery electrodes. (185,023.) Sep. 6.

29,117 (1921). Hansen. Electric furnaces. (171,096.) Sep. 13.

XII.—FATS; OILS; WAXES.

APPLICATION.

Dubuis. 23,693. *See* XX.

COMPLETE SPECIFICATIONS ACCEPTED.

14,413 (1921). Bolton and Lush. Regeneration of fuller's earth, charcoal, and like purifiers of fats and oils and of catalysts used in hydrogenating fats and oils. (185,174.) Sep. 13.

15,856 (1921) and 580 (1922). Maypole Margarine Works, and Michelsen. *See* XIX.

16,239 (1921). Feeny (Title Guarantee and Trust Co.). Treatment of fish and other oils. (185,247.) Sep. 13.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Girvan. Heat resisting paints etc. 24,043. Sep. 5.

Gundlach. Paint etc. kneading and mixing machines. 24,370. Sep. 8.

Holzapfel. Manufacture of coating-composition, paints, or varnishes. 23,673. Aug. 31.

Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of oil colours and printers' inks. 23,262. Aug. 28.

COMPLETE SPECIFICATIONS ACCEPTED.

18,479 (1921). Lorival Manuf. Co., and Drummond. Condensation of phenolic bodies with aldehydic compounds. (184,961.) Sep. 6.

20,170 (1921). Heinemann. Production of artificial resins. (184,984.) Sep. 6.

21,133 (1921). Ormiston. Metallic paint or coating. (184,999.) Sep. 6.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

APPLICATION.

Love and Robertson. Substitute for vulcanite etc. 23,877. Sep. 2.

XV.—LEATHER; BONE; HORN; GLUE.

APPLICATION.

Roth. Manufacture of sheets of gelatin etc. 24,213. Sep. 7.

COMPLETE SPECIFICATIONS ACCEPTED.

13,091 (1921). Minton. Imitation leather etc. (184,845.) Sep. 6.

17,826 (1921). Margotton. Tanning hides and skins. (184,955.) Sep. 6.

XVI.—SOILS; FERTILISERS.

COMPLETE SPECIFICATION ACCEPTED.

10,315 (1921). Monaco. Manufacture of nitrogenous manures. (184,833.) Sep. 6.

XVII.—SUGARS; STARCHES; GUMS.

APPLICATION.

Geveke. Treatment of sugar-cane. 23,695. Sep. 1.

COMPLETE SPECIFICATION ACCEPTED.

7962 (1921). Young. Production of ethers of carbohydrates. (184,825.) Sep. 6.

XVIII.—FERMENTATION INDUSTRIES.

APPLICATION.

Wooldridge. Brewing beer. 23,426. Aug. 29.

COMPLETE SPECIFICATION ACCEPTED.

13,924 (1921). Bryant. Aeration of brewers' wort etc. (184,860.) Sep. 6.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

APPLICATIONS.

Clark, and Pearson and Co. Production of a potent preparation of vitamin A. 23,944. Sep. 4.

Gamble. Purification of sewage. 23,405. Aug. 29.

Herrero. Purification of water. 23,753. Sep. 1.

Koch and Scheib. Production of preserving-means, and preservation of meat, vegetables, etc. 24,129. Sep. 6.

Loring. Manufacture of flour. 23,999. Sep. 5.

Moss. Compound for use in making bread. 23,505. Aug. 30.

COMPLETE SPECIFICATIONS ACCEPTED.

5615 (1921). Amer. Zeolite Corp. *See* VII.

15,136 (1921). Nielsen. Sterilising milk. (185,221.) Sep. 13.

15,514 (1921). Torrance. Manufacture of chocolate or cocoa products. (185,237.) Sep. 13.

15,856 (1921) and 580 (1922). Maypole Margarine Works, and Michelsen. Manufacture of margarine. (185,241.) Sep. 13.

XX.—ORGANIC SUBSTANCES; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

APPLICATIONS.

Arima. Production of preparation from tubercle bacillus. 23,243. Aug. 28.

Calvert. Manufacture of substances containing a methyl radicle. 23,571. Aug. 30.

Dubuis. Manufacture of solvent for perfumery, oils, etc. 23,693. Sep. 1.

Marks (Parke, Davis and Co.). Compounds of silver iodide and protein substances. 23,448. Aug. 29.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

APPLICATIONS.

Gevaert Photo-Producten. Photographic films. 23,360. Aug. 29. (Belg., 29.8.21.)

Roth. Colour photography. 24,214. Sep. 7.

XXII.—EXPLOSIVES; MATCHES.

APPLICATIONS.

Brown. Matches. 23,379. Aug. 29.

Segay. Explosives. 23,542. Aug. 30.

XXIII.—ANALYSIS.

APPLICATION.

Beasley. Recording gas calorimeters. 23,620. Aug. 31.

I.—GENERAL; PLANT; MACHINERY.

Pure gases; Preparation of —— by the application of the principle of the hydraulic compressor. C. Heirich. Z. kompr. u. fl. Gase, 1922, **22**, 3—7, 21—22, 43—44. Chem. Zentr., 1922, **93**, IV., 305.

Where water power is available highly compressed gases can be most cheaply obtained by allowing the water to fall down a long vertical pipe, 300—400 m. high. Air or other gas is entrained with the water, separated at the bottom in a closed receiver under a pressure equal to the head of water, and the water allowed to pass away by an ascension pipe. By the use of flue gases in place of air the gases may be separated into carbon dioxide and nitrogen in this apparatus. It can also be applied to the purification of sulphur dioxide, ammonia, hydrogen, and oxygen, also of producer-gas and the like.—C. I.

Thermal conductivity of liquids, insulators, and metals; Measurement of the ——. M. Jakob. Z. Ver. Deutsch. Ing., 1922, **66**, 688—693. Chem. Zentr., 1922, **93**, IV., 606.

A mass of the material under investigation was heated above electrically and cooled below by a liquid. Heat losses were reduced by employing a vacuum jacket. The axial gradient of temperature in the slab was measured by means of thermocouples. The thermal conductivity of toluene was 0·000443 c.g.s. unit. The temperature coefficient of the thermal conductivity of a transformer oil was found to be 3%. The thermal conductivity of aluminium containing 1·13% of impurities is given in terms of the temperature by the relation $\lambda = 0{\cdot}447 (1+0{\cdot}0012_5 t)$. The corresponding result for nickel steel containing 30·4% Ni, 0·84% Mn, 0·26% C, and 0·14% Si is $\lambda = 0{\cdot}0277 (1+0{\cdot}0017_5 t)$, and this relation was unaltered by heating to about 700° C. or cooling to −30° C. or −78° C. The value of λ was increased about 2 to 4% by cooling to −185° C.
—J. S. G. T.

Boundary lubrication. Hardy and Doubleday. *See* IIa.

Suspended matter in gases. Katz and Smith. *See* XXIII.

Patents.

Chemical reaction; Process for effecting —— in the interior of [air] compressors. M. Brutzkus. E.P. 155,776, 22.12.20. Conv., 22.12.19.

The process consists of using a compressor, or vacuum pump, to control the pressure and temperature of reacting substances, so that the reaction will take place under the most economical conditions. With this object in view, as the reaction proceeds, the piston should be moved so as to keep the pressure as uniform as possible. A gradual admission of one or more of the reacting substances is sometimes desirable, and sometimes also the addition or withdrawal of heat is required if the above conditions are insufficient. Details are given showing how the process can be applied to exothermic and endothermic reactions in which the number of molecules remains constant or is either reduced or increased. Examples are given showing how it may be used in the synthetic production of ammonia, in cracking oils, and in hydrogenation.—S. G. U.

Steam boilers; Method of preventing incrustation in ——. A. Pessi. E.P. 163,013, 6.5.21. Conv., 6.5.20.

The disincrustant is a mixture of crude pyroligneous acid (20—40%), acetates or pyrolignites of alkalis or alkaline-earths (3—6%), sodium carbonate (10—30%), and arsenious anhydride (0·5—1·5%).—H. H.

Boilers and the like; Preparation for removal of scale from —— and for preventing its formation. J. H. Dine and S. H. Sieff. E.P. 182,545, 1.4.21.

Linseed is immersed in water and the temperature raised to a little below the boiling point. A viscous liquid is produced which can be added to the boiler feed water, the quantity recommended being 1 gall. for every 1000 sq. ft. of heating surface every eight hours. It is claimed that this preparation, in addition to preventing the formation of scale, causes any scale present in the boiler to fall to the bottom and break up into a fine mud which can be easily blown off.—S. G. U.

Cooling, condensing, or heating apparatus. E. Barrs. E.P. 183,195, 6.4.21.

Mounted on a flange on the top cover of a cylindrical vessel, provided at the top with a side inlet and at the bottom with a central opening for removal of the condensed material, is a vertical cylindrical cooling chamber. This chamber is fitted with a number of loose-fitting perforated plates which are kept at suitable distances apart by a series of vertical baffle plates the breadth of which is about three-quarters of the diameter of the containing cylinder. These baffles are so arranged that they cause the ascending material to follow a spiral or alternating path through the cooler. One quadrant of each of the partitioning plates is perforated by large holes, whilst the remaining quadrants are perforated with smaller holes. Long rods, screwed at either end, pass through these perforations from the top to the bottom plates, and are kept in position by nuts binding on the top and bottom plates. A side outlet is provided at the top of the cooler, and the arrangement of partition plates, baffles, etc., is supported on a ridge at the lower end of the cooler casing. Tubes may be used instead of rods, and arrangements may be made for flooding these tubes internally with water.
—S. G. U.

Cooling a gas; Means for ——. E. Jordan, Assr. to Soc. L'Air Liquide. U.S.P. 1,425,019, 8.8.22. Appl., 17.4.22.

The gas is passed through tubes extending through the shell of a heat-exchanging apparatus from an inlet chamber to an outlet chamber, and the shell is provided with an inlet and an outlet for the cooling gas. Superposed trays within the shell are provided with openings of slightly larger diameter than the tubes. These openings receive the tubes, and liquid is delivered to the uppermost tray and withdrawn from below the lowermost tray.—H. H.

Cooling vapours expelled from a solution in a distilling plant; Apparatus for ——. Akt.-Ges. der Maschinenfabriken Escher, Wyss u. Co. G.P. 350,913, 27.6.19.

The fluid to be cooled is supplied to a heat interchanger, the walls of which are for the most part covered with cooling fluid. By means of a compressor, vapour is withdrawn from the interchanger so that the saturation temperature of the cooling fluid is sufficiently low to permit interchange of heat to occur. This vapour is then compressed and further heat interchange effected between the compressed vapour and the fluid to be distilled. In order to secure brisk circulation of the cooling medium in the heat interchanger, if desired, a tube may be arranged external to the interchanger so as to permit circulation of that part of the cooling fluid not converted into vapour.
—J. S. G. T.

Absorption tower and cooler; Combined —— [*e.g., for hydrochloric acid*]. Deutsche Ton- u. Steinzeugwerke A.-G., and F. Plinke. G.P. 353,553, 8.5.20.

In a combined absorption and cooling tower, the walls of the tubes suspended in the tower and supplying cooling water thereto are wholly or in part permeable to water. The device is applicable to all processes of absorption in which heat is liberated, *e.g.*, the absorption of hydrochloric acid gas. The acid is rapidly absorbed by the water on the external surface of the tubes and the heat liberated carried away by the water flowing inside the tubes. The hydrochloric acid solution collects in the tower and is withdrawn at intervals. —J. S. G. T.

Mixing and/or disintegrating machines. C. E. Gardner. E.P. 184,433, 1.3.21.

Inner and outer helical blades rotate concentrically in opposite directions within a trough or casing; the outer edges of the outer blades are serrated. The trough is provided with one or more fixed serrated bars of which the teeth register with the spaces between the teeth on the blades, and such bars may be adjustably or removably secured at each side of a cleaning opening in the bottom of the trough normally closed by a hinged door. The inner blades rotate at a higher peripheral speed than the outer blades, and may be de-clutched during discharge of the material. The discharge outlet may be at one end or in the bottom of the trough and an outlet for continuous discharge may be provided in one end of the trough above the axis of the blades. Radial arms on the shaft of the blades may carry scrapers to remove material from the end walls of the trough and wings to sweep the material back to the outlet.—H. H.

Mixing solid materials with liquids; Method and apparatus for ——. O. D. Cunningham, Assr. to National Aniline and Chemical Co. U.S.P. 1,422,421, 11.7.22. Appl., 21.8.20.

A jacketed chamber, fitted with coils to regulate the temperature, is connected at its base with a centrifugal pump. A second opening on the side of the chamber communicates with the top of a small jacketed mixing chamber which is fitted with an agitator. The bottom of this mixer is coupled to the suction side of the centrifugal pump. Solid material is fed into the mixer, and the reaction products are forced by means of the pump into the cooling chamber, from which they can flow by gravity back to the mixing chamber. When the reaction or mixing is completed the products can be delivered from the pump direct to a receptacle. —S. G. U.

Mixing solid materials and treating the same with gases; Apparatus for ——. [*Roasting zinc blende.*] H. Reinhard. G.P. 352,657, 21.2.20.

The substance is treated with gases, *e.g.*, air, in a rotary drum divided longitudinally by partitions into a number of compartments. Commencing at the charging end of the drum the number of compartments is increased in a series of steps and then diminished in steps towards the discharging end. The device permits the use of air at a lower temperature than is customary in roasting zinc blende with heated air.—J. S. G. T.

Drying method and means. E. F. White. U.S.P. 1,424,969, 8.8.22. Appl., 24.1.21.

A long passageway, open at both ends, is provided with means for drawing in air near one end and for discharging the air near the other end. Means are also provided for regulating the temperature of the air and, near the point of induction, for adjusting the flow of air and determining the direction of flow in the passageway and at the ends. —H. H.

Desiccation apparatus; Spray ——. H. J. Zimmermann, Assr. to R. Stutzke Co. U.S.P. 1,426,030, 15.8.22. Appl., 25.10.18.

A centrifugal fan, with its axis vertical, is mounted below a vertical drying chamber, the central axial inlet of the fan forming the bottom of the chamber. A vertical cyclone dust collector is mounted in proximity to the fan and a duct affords communication between the tangential outlet of the fan and the tangential inlet of the dust collector.—G. F. M.

Drying, evaporating, etc. substances containing or yielding free alkali or acid; Process of ——. J. Rudolf. G.P. 352,343, 18.4.19.

The substances are treated in a rotating tube the inner surface of which is provided with an adherent coating of material resistant to the action of alkali or acid. Thus potash or soda lyes may be regenerated or calcium chloride lyes calcined in a rotating tube which has been provided with a lining of nickel or bronze by the Schoop spraying process. A lead lining similarly produced is suitable for drying sodium bisulphate and for evaporating sulphite and aluminium sulphate lyes. An aluminium lining is suitable for drying vegetables, fruits, foods, and condiments.—J. S. G. T.

Evaporator. W. H. P. Creighton. U.S.P. 1,424,992, 8.8.22. Appl., 30.12.20.

A vacuum pan is heated by a steam belt disposed between transverse tube-plates connected by tubes for passage of the liquid. The steam space is divided by radial plates into chambers, each containing a group of tubes. Steam is supplied to the outer portions of these chambers, and withdrawn from the contracted inner portions.—H. H.

Evaporating liquors; Method of —— *and apparatus therefor.* W. Gensecke. U.S.P. 1,425,005, 8.8.22. Appl., 27.4.20.

A container for the liquid is arranged in heat-exchanging relation with a chamber for the heating medium, and is provided with a pipe for withdrawal of the vapour. Mixed vapour and condensed liquid are withdrawn from the chamber and are separated by a trap which is connected with the vapour pipe of the container by a passage of adjustable section. The vapours from the chamber and the container meet in this passage and are together compressed and conveyed to the heating chamber.—H. H.

Evaporating liquids; Apparatus for ——. A.-G. Kummler u. Matter. G.P. 352,849, 21.12.20.

Liquid to be concentrated enters from below into a chamber arranged at the bottom of the apparatus and passes thence through a series of vertical annular channels through which it flows in ziz-zag fashion, passing over and being heated by a number of cylindrical heating devices in the annular spaces. The concentrated liquid then passes into a central chamber and out through the bottom of the apparatus.—J. S. G. T.

Atomising process for separating and drying substances in solution. W. Salge u. Co., Technische Ges.m.b.H. G.P. 352,781, 3.6.20.

Atomisation is effected by a stream of hot air or gas passing upwards through a vertical tube, which is connected through an intervening shock-absorbing device with a fall tube, in which separated material descends and is dried and cooled by the stream of gas likewise flowing in a downward direction. The process is more especially suitable for use with substances which can be exposed to a high temperature for a short time only, and which besides must be cooled gradually.—J. S. G. T.

Evaporating (concentrating) liquids without employing a vacuum; Apparatus for ——. A. Wurm. G.P. 354,860, 23.11.18.

Bucket wheels rotate within the vessel containing the liquid to be evaporated, the vessel being preferably double-walled and heated by steam or a water-bath. The buckets are so constructed and follow one another in such manner that the liquid which is lifted up by the scoop of one bucket flows back into the vessel over the back of the opposite scoop, whereby a large surface of liquid is exposed to the atmosphere.—J. S. G. T.

Catalyst and method of preparing the same. J. C. Clancy, Assr. to The Nitrogen Corp. U.S.P. 1,425,576, 15.8.22. Appl., 8.5.20.

The product of thermal decomposition under oxidising conditions of the cyanamides of a number of metals of the type of silver and copper is used as a catalyst.—H. H.

Discharge electrodes for precipitating systems. O. H. Eschholz, Assr. to Westinghouse Electric and Manuf. Co. U.S.P. 1,425,637, 15.8.22. Appl., 15.2.19.

In a precipitating system, a portion of the discharge electrode extends beyond the collecting electrode and is tapered. The discharge electrode is arranged so that its narrowest part is at a greater distance than any other part from the collecting electrode. Pre-ionising means are integrally associated with the projecting part of the electrode.—J. S. G. T.

Electrical precipitation of suspended matter from electrically insulating fluids, especially gases; Process and apparatus for ——. E. Möller. G.P. 349,737, 20.7.20. Addn. to 277,091 (*cf.* F.P. 449,337; J., 1913, 495).

The protective medium used to envelop and clean the discharge electrodes is supplied in the direction of the length of the electrodes. This may be effected by means of nozzles disposed at either one or both ends of the discharge electrodes. In the latter case, the two oppositely directed streams of air impinge upon one another and are very effective in removing any deposited dust from the discharge electrodes. —J. S. G. T.

Electrical purification of gases, employing precipitating electrodes of the plate form. Metallbank u. Metallurgische Ges. A.-G. G.P. 352,901, 18.7.20.

The gas flows in the direction of the length of the discharge electrodes, and the precipitating electrodes, arranged transversely to the stream in step formation, are disposed so that gas is uniformly distributed over the slots between the plates. The corners of the plates swept by the gas stream are reduced or bevelled, and the slots are divided up into cells by means of partitions. The precipitating surface is thus increased, and the structure both in form and operation resembles the customary tubular apparatus, but effects a more uniform distribution of the gas to be treated.—J. S. G. T.

Electrical precipitating plants; Arrangement of insulators in ——. Siemens-Schuckertwerke G.m.b.H. G.P. 354,783, 12.2.20. Addn. to 332,805 (*cf.* E.P. 164,680; J., 1921, 550 a).

In an electrical precipitating plant, operated according to the original patent, a jacket extending into the high-tension field surrounds the insulator, and the bottom of this jacket projects into a wider conducting jacket extending to the other pole, or earthed. Discharge between the two jackets is prevented by suitable choice of their respective diameters and by avoiding the presence of any sharp edges and corners on the surfaces of the jackets. —J. S. G. T.

Washing insoluble powders; Apparatus for ——. P. W. Prutzman, Assr. to General Petroleum Corp. U.S.P. 1,426,099, 15.8.22. Appl., 20.8.21.

A solvent is circulated upwards through a mass of the powder contained in a shell, and means are provided for carrying off the overflow solvent from the shell.—H. H.

Charcoal; Process of producing vacua by means of ——. Verein Chem. Fabr. in Mannheim. G.P. 326,385, 15.11.17.

Charcoal used in the production of vacua is prepared from wood or similar material, which prior to carbonisation is impregnated with salts or like substances.—J. S. G. T.

Treating liquid, powdered, or gaseous materials; Rotating hollow disc for use in —— by atomising in a stream of air or gas. Metallbank u. Metallurgische Ges. A.-G. G.P. 349,844, 17.7.20.

The interior of the hollow rotating disc for treatment of material in accordance with G.P. 345,805 (J., 1922, 317 a) is divided into a number of separate compartments corresponding to the number of rings of jets employed. In this manner a number of substances, if necessary together with gases or vapours, may be centrifuged, without any mixing of the various substances occurring within the interior of the rotating disc. Separate delivery of material to the various rings of jets disposed one above another is, in many cases, necessary and advantageous, as when a gas or vapour is to be centrifuged between atomised strata of liquids or powders.—J. S. G. T.

"Molecular filters"; Process of preparing ——. G. Alefeld. G.P. 351,084, 24.1.20.

Thin coatings of precious metals, oxides, acids or combinations of these, permeable only to certain molecules, are deposited upon a permeable support. For example, a silver mirror may be produced on the support or coatings may be produced according to the process practised in the ceramic industry for the production of lustres. Filters so prepared may be used as dialysers, or, if the support is an earthenware cylinder, may be used in centrifugal machines for separating chemical compounds or mixtures. Solutions of cuprammonium artificial silk, *e.g.*, may be freed from copper compounds, the latter passing through the filter, and then yield filaments which are stronger than those from which copper has been removed by a chemical process. —J. S. G. T.

Drum filters; Process of and apparatus for operating ——. G. Polysius. G.P. 353,135, 24.7.20.

Part of the sludge in the filter trough is periodically or continuously removed and distributed over a part of the filtering surface which is not immersed in the sludge. The sludge overflows or is run off or sucked from the trough and is delivered to a compressed air siphon, or alternatively the siphon itself may open into the trough.—J. S. G. T.

Crystals; Continuous process for producing well-formed, uniform —— from solutions. A.-G. der Chem. Produkten-Fabr. Pommerensdorf, and R. Siegler. G.P. 351,947, 26.7.19.

The solution to be crystallised flows through a long rotating tube of relatively small diameter surrounded by a heat-insulating jacket. The solution is cooled by a counter current of air, preferably introduced tangentially. Adherence of crystals to the walls of the tube is prevented by supplying heat to the bottom part of the space between the tube

and the jacket. The size of crystals is determined by the temperature, speed of rotation of the tube, initial concentration of the solution, depth of liquid in the tube and direction of travel.
—J. S. G. T.

Heating, evaporating, or distilling liquids or molten substances; Process of atomising and ——. A. Keller. G.P. 352,296, 9.12.20.

The apparatus consists of a heated vessel which contains only a small quantity of the material and is provided with a removable turbine device, the jacket of which is perforated or slotted. This turbine device sucks the material from the bottom of the vessel and then projects it in a finely atomised condition against the walls, so that the whole heated surface of the vessel is continuously covered with a layer of liquid. On account of the brisk circulation of liquid the thermal efficiency of the process is high, and the process more economical than those utilising a normal filling of the vessel.
—J. S. G. T.

Chemical reactions; Process of carrying out vigorous ——. Gewerkschaft des Steinkohlen-Bergwerks "Lothringen." G.P. 353,423, 25.7.17. Addn. to 349,330.

In a process for carrying out vigorous chemical reactions, and more especially for the production of salts from gases and liquids, *e.g.*, the production of ammonium salts from ammoniacal gases and acid liquids in accordance with G.P. 349,330 (J., 1922, 401 A), a portion of the liquor in the weakly alkaline section of the circuit is tapped off and completely neutralised by a fresh supply of acid. The temperature of the circulating liquor to be charged with gas is regulated in order to control the degree of saturation of the liquor with gas.
—J. S. G. T.

Acid-resisting lining for vessels. V. Zieren. G.P. 355,374, 30.6.20.

The lining is built up of a number of layers of acid-resisting material of various thicknesses, that immediately in contact with the wall of the vessel being impervious to liquid, while the inner ones are porous and take up the expansion occurring on heating. In this manner the outermost layer is better able to withstand the effects of variations of temperature.—J. S. G. T.

Kiln with heating chambers and cooling chambers. V. Gelpke, Assr. to Deutsche Evaporator-Akt.-Ges. U.S.P. 1,426,287, 15.8.22. Appl., 16.3.21.

See E.P. 179,674 of 1921; J., 1922, 490 A.

Condensers, preheaters, heat-exchangers and the like. P. Mather. E.P. 184,222, 5.5.21.

Exhaust steam; Process and apparatus for purifying and condensing —— and for purifying the condensate. M. Schull. E.P. 184,342, 6.7.21.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Short method for the ultimate analysis of ——. S. W. Parr. J. Ind. Eng. Chem., 1922, 14, 681.

The sulphur and carbon are determined by combustion of the coal with sodium peroxide in a calorimetric bomb, the carbonate formed being decomposed in a calcimeter and the carbon dioxide liberated measured. The heat evolved from the oxidation of the sulphur and the carbon is calculated, and when deducted from the total heat evolved in the combustion gives the heat liberated by the available hydrogen. This value, divided by 34,450, gives the weight of available hydrogen. The nitrogen is assumed to be constant for all coals at 1·25%, and by adding this to the quantities of hydrogen, sulphur, carbon, and ash (as determined by combustion) and subtracting from the total weight, the weight of oxygen plus combined hydrogen is obtained. The total oxygen is 8/9, and the combined hydrogen is 1/9 of this value. The total hydrogen may then be found and all the constituents of the coal can thus be determined without the usual ultimate analysis being carried out.—A. G.

Coal ash; Comparison of the standard gas furnace and micropyrometer methods for determining the fusibility of ——. A C. Fieldner, W. A. Selvig, and W. L. Parker. J. Ind. Eng. Chem., 1922, 14, 695—698.

The American Society for Testing Materials has tentatively defined the softening temperature of coal ash as the temperature at which a triangular pyramid, 0·75 in. high and 0·25 in. at each side of base, mounted vertically, has fused down to a spherical lump when heated in the reducing atmosphere of a gas furnace under definitely prescribed conditions (Proc. Amer. Soc. Test. Materials, 1920, 20, 796). Fulweiler has applied the micropyrometric method, using a heating element consisting of a platinum strip, 4 cm. long by 0·5 cm. wide and 0·008 cm. thick, held between iron rods which are connected through a spiral nichrome coil with four storage battery cells connected in series. Coal ashes showing a softening temperature below 2600° F. (1427° C.) by the gas furnace method will, in the majority of cases, give results agreeing withi 100° F. (55° C.) by the micropyrometric method i fused in a reducing atmosphere of combustion gase similar to that used in the furnace method. Some ashes show considerable differences, however, betwee the results obtained with the two methods. Ver refractory ashes, having a softening temperatur above 2800° F. (1537° C.) as determined by the ga furnace method, tend to give considerably lowe results by the micropyrometric method. In general the micropyrometric method shows a point in th fusion process at which the particles become rounde and coalesce. This point agrees fairly well with th "down point" of the cones in the other method fo ashes of low and medium fusibility (up to 2600° F. *i.e.*, 1427° C.), since such ashes form a fairly fusibl slag of short softening range. Refractory ashe form viscous slags with long softening intervals an the "down point" of the cone may be 100°—500° F higher than the fusing point as shown on th platinum strip. The micropyrometric method much quicker than the gas furnace method, and obviates the special incineration of a considerab quantity of coal. It is also much more comfortab for the operator. Owing to the discrepancies me tioned, however, it is not safe to accept this metho as an alternative one for the gas furnace metho in every case.—A. G.

Complete gasification [of coal] and carburatio Rincker processes of ——. P. Gregory. So Tech. Ind. du Gaz en France, June, 1922. G J., 1922, 159, 473—474.

A pair of generators are connected together so th the direction of gas flow may be periodically r versed for the manufacture of water-gas. Wh making carburetted water-gas a secondary supply is admitted near the top of the generat receiving air during the blow, in order to raise t temperature near the dome of the generat During the subsequent run oil is admitted at t top of the second generator. By connecting t tops of the generators with their respective wa flues the plant may be used for the complete gasific tion of coal as originally devised by Rincker (J., 1921, 73 a). The waste blow gases can be utilised for steam raising.—H. Hg.

Coal gas enrichment; Catalytic products for ——. P. Mallet. Soc. Tech. Ind. du Gaz en France, June, 1922. Gas World, 1922, **77**, 126. Gas J., 1922, **159**, 475—476.

Finely divided copper is mixed with heavy petroleum oil and the mixture heated at 600° C.; or the oil is passed through a heated retort the inner surface of which is coated with finely divided copper; the copper is alloyed with magnesium to make it more permeable. 1000 kg. of the oil yields 420 cub. m. of gas suitable for enrichment purposes, having sp. gr. 1—1·2 and calorific value 15,000 cals. (1685 B.Th.U. per cub. ft.). The gas contains about 40% C_2H_4 and practically no sulphur. The yield of spirit is 275 l., which gives the following results on distillation:—

Temp. °C.	70°	80°	90°	100°	110°	120°	130°	140°
Yield ..	3·6%	9·3%	18·4%	27·0%	38·0%	48·6%	58·4%	67·0%
Temp. °C.	150°	160°	170°	180°	190°	200°	210°	220°
Yield ..	75·1%	81·1%	86·5%	91·1%	94·6%	96·5%	98·3%	100%

The tar amounts to 184 kg.; undecomposed oil is separated from this by distillation for further use.

—H. Hg.

Gas producer; Marconnet ash-fusion —— for gasification of coke breeze. G. Rivière. Soc. Tech. Ind. du Gaz en France, June, 1922. Gas J., 1922, **159**, 424—425.

The producer is rectangular in plan and is provided with slag holes at the base. The lower portion of the vertical walls is water-jacketed and provided with openings for poking the charge and for the admission of air and steam. A number of weighted rods pass through the crown of the producer; these are lowered by gravity and raised by mechanical means in order to agitate the mass of fuel. During a test coke breeze containing from 14·8 to 34·3% of ash was mixed with limestone and iron ore and gasified at the rate of 405 kg. per sq. m. (83 lb. per sq. ft.) grate area per hour. The slag contained about 40% of silica, 21% of alumina, 34% of lime and 1—2·4% of iron. The gas contained CO_2 1·5%, CO 29%, and H_2 1·8%, and its heating value was 71·4% of that of the coke charged.

—H. Hg.

[Iron] oxides for gas purification; Valuation of ——. G. H. Gemmell. N. Brit. Assoc. Gas Managers, 7.9.22. Gas J., 1922, **159**, 471—473.

The quantity of sulphur which an oxide of iron will absorb after repeated foulings and oxidations is determined by placing 100 g. of the oxide in a glass tower up which passes a mixture of 1 pt. of air, 2 pts. of washed hydrogen sulphide, and 7 pts. of coal gas. The mixed gases are washed with water or dilute ammonia solution before entering the tower. When hydrogen sulphide escapes freely from the tower the oxide is removed, exposed to the atmosphere, and re-sulphided. After five foulings the weight and proximate composition of the spent oxide are determined. Results obtained with different natural bog ores and artificial oxides are given in detail. Tests with air-dried precipitated ferric hydroxide and with the same material heated to 100° C., 150° C., and a red heat showed that a high degree of hydration of the oxide is not essential for the absorption of sulphur. Exposure of a larger surface by mixing the oxide with sawdust did not increase the amount of sulphur absorbed.

—H. Hg.

Pyridine; Recovery of —— from coke ovens. W. Gluud and G. Schneider. Ber. Ges. Kohlentechn., 1921, [2], 93—111. Chem. Zentr., 1922, **93**, IV., 389, 513.

Pyridine suitable for denaturing alcohol can be obtained from crude benzol recovered in coke-oven works, by extraction of the first runnings with sulphuric acid. The pyridine-sulphuric acid should contain at least 20% of pyridine bases boiling under 160° C., and be practically free from resins and oils, free from other acids and salts, such as hydrochloric acid and sulphates, and practically free from iron salts. The analysis of the pyridine-sulphuric acid is carried out by evaporating 500—1000 g. for half an hour on the water bath, cooling, and making alkaline with 25% ammonia. The crude bases are separated and distilled up to 170° C. The distillate is dried with solid sodium hydroxide, separated, and re-distilled. The weight of bases passing over below 160° C. is determined.

—H. C. R.

Boundary lubrication; Temperature coefficient [of ——]. W. B. Hardy and I. Doubleday. Proc. Roy. Soc., 1922, **A 101**, 487—492.

The method previously described (J., 1922, 242 a) has been employed to measure the static friction between various clean and lubricated faces at temperatures ranging from 15° to 110° C. The physical state of the surface of glass is much altered by a relatively small rise of temperature. The friction of a face of quartz, steel, or bismuth, thoroughly freed from adherent films, is practically independent of temperature. The coefficient of friction of clean quartz is less than that of glass. In the cases of steel or quartz faces flooded with various lubricants, the friction was found to be independent of temperature. When the lubricant was solid over part of the range of temperature employed, the friction decreased with rise of temperature, becoming zero at the melting point. When the lubricant was completely melted, the friction suddenly attained a higher value than any previous value, and on the temperature being increased remained constant. When the temperature fell again, the friction remained constant until the melting point was reached, when the friction suddenly fell, but not to zero. Below the melting point the friction measured is that of the lubricant on itself, while above the melting point, the friction is that of solid faces modified by a primary film of the lubricant. When films of insensible thickness were deposited on the surfaces, the discontinuity of the friction at the melting point disappeared, the friction becoming constant over the whole range of temperature, whence it is concluded that the friction of quartz and of steel lubricated with various normal paraffins and the related normal acids and alcohols is sensibly independent of temperature. The results obtained in the neighbourhood of the melting points of the lubricants confirm the view that solid friction changes suddenly to fluid friction at a certain critical thickness of lubricating film. When lubricant is present in excess, an increase of friction may arise as the effect of surface tension.

—J. S. G. T.

Pure gases. Heirich. *See* I.

Carbon black. Neal and Perrott. *See* XIII.

Suspended matter in gases. Katz and Smith. *See* XXIII.

Patents.

Drying of lignite, peat, turf, and the like. K. W. J. H. Jacobs. E.P. 163,719, 5.5.21. Conv., 27.5.20.

The material is passed downwards through a closed chamber provided with a number of hot-air channels so arranged that the drying is effected slowly in the upper zone and more rapidly in the lower zone. The speed of drying may be controlled by varying either the quantity or the temperature of the air.

The air is forced through the channels and the material either under suction or under pressure. The dried product is suitable for coking.—H. Hg.

Coal; Art of treating —— [to obtain a smokeless fuel]. F. J. Root. U.S.P. 1,426,012, 15.8.22. Appl., 7.4.19.

Coal particles are compressed into blocks by a pressure of at least 3 tons per sq. in., applied in one direction only, and are meanwhile heated to 450° C. by surrounding retorts placed transversely to the direction of pressure.—A. G. P.

Peat, lignite, and other carbonaceous substances; Process and apparatus for the conversion of —— into artificial coal. O. A. Ford, Assr. to M. J. Thompson. U.S.P. 1,426,723, 22.8.22. Appl., 23.9.16. Renewed 4.11.21.

The material is passed through a dryer, a pulveriser, a second dryer, and a final pulveriser, all enclosed within a kiln body. A controlled mixture of air and hot products of combustion is passed through the dryers.—H. Hg.

Carbon; Production of ——. W. E. F. Bradley. U.S.P. 1,426,144, 15.8.22. Appl., 4.9.18. Renewed 15.6.22.

A hydrocarbon gas is passed, with exclusion of air, over iron oxide heated to 800°—1000° C., and the oxide is removed from the resulting mixture.
—A. R. P.

Coal briquettes; Process for producing —— without the addition of a binding material. O. Dobbelstein. G.P. 353,551, 23.2.21. Addn. to 346,242.

Coal is heated to a temperature at which evolution of volatile matter commences, and is then subjected to a high pressure. Even poor coals and mixtures of any kind of coal with fine-grained ore or furnace dust can be treated in this way.
—H. C. R.

Combustion of pulverised fuel; Process for the ——. C. E. Blyth. E.P. 184,250, 3.5.21.

An inflammable liquid such as paraffin, insufficient in quantity to prevent the subsequent diffusion of the product with air, is mixed with coal before treatment in the apparatus described in E.P. 175,301 (J., 1922, 243 A), or before or during pulverisation in other apparatus.—H. Hg.

Heat contained in the fuel residues of furnaces; Method and means for utilising the ——. J. S. Withers. From Deutsche Evaporator-A.-G. E.P. 184,211, 7.3.21.

Fuel is partly burnt on a primary grate with a mechanical feed and the residue is discharged on to a secondary grate arranged below the primary grate. Air is supplied under the secondary grate and, together with products of combustion from that grate, passes to the under side of the primary grate. All or part of the air may pass through flues in the side walls of the furnace immediately before entering the primary grate. In order to prevent passage of air to the upper side of the primary grate a horizontal wall is provided and so spaced as to permit the passage of fuel only from one grate to the other. The primary grate may be inclined and may deliver fuel to the secondary grate through an auxiliary grate which can be rocked and which has an adjustable ash passage. The air may be admitted to the grates through louvres or lateral sluices. The secondary grate may be so mounted that it can be oscillated. Part of the air required for combustion may be supplied direct to the primary grate.—H. Hg.

Gas producers. W. Climie. E.P. 184,323, 15.6.21.

The rotary air-blast cone of a water-sealed producer is composed of a number of superposed rings of double-angled cross-section spaced upon a conical framework so that slots are formed for the passage of air into the fuel bed. Each ring has projecting flanges such that when the rings are assembled the outer surface of the cone is provided with two or more continuous spiral ribs. The base of the cone is separated from the annular ash-pan by a water seal and the two may be rotated in the same or in opposite directions. An upwardly projecting blade may be fitted to the ash-pan so as to prevent formation of clinker between the lower edge of the cone and the inner wall of the generator. The cone is rotated in combination with a rake acting upon the upper surface of the fuel in the generator.
—H. Hg.

Vertical-retort gas-making apparatus. R. M. Searle, Assr. to The U.G.I. Contracting Co. U.S.P. 1,427,078, 22.8.22. Appl., 23.9.19.

A number of vertical retorts, each of which is surrounded by an independent heating chamber containing horizontal baffles, are arranged in a circle around a vertical flue which conducts the waste gases downwards to a regenerator. The combustion chamber is subdivided into a number of combustion chambers connected with the heating chambers.
—H. Hg.

Gas mixture; Continuous process for producing a —— from water-gas and the volatile matter from coal. H. Strache. G.P. 353,649, 9.2.21. Conv., 9.2.20.

The gases produced by the hot blast are led off from the middle of the gas producer through an open tube, whereas the hot-water gas is led through the annular space between this inner tube and the walls of the gas producer, which is filled with fuel. When fuel of high water content, such as lignite, is being used the hot blast gases may be burnt in the inside of the producer by passing air through a suitably arranged pipe. The hot blast gases are then passed either to the chimney or to a steam superheater. The water-gas passes through the annular space containing the fuel, carrying away the volatile matter with it through the top of the gas-producer to the gasometer.—H. C. R.

Gas washers. A. Florin. E.P. 184,060, 9.8.21.

The washing liquid is contained in a horizontal rotary casing mounted on the ends of two pipes forming gas inlet and outlet respectively, and flows in contrary direction to the gas. Two concentric perforated cylinders are fixed within the casing and rotate with it; the annular space between the cylinders is packed with washing bodies so as to present a large surface to the gas. Partitions parallel to the ends of the casing are provided with openings alternately at the circumference and at the centre so as to direct the gas along a zigzag path.—H. Hg.

Sulphur; Process for obtaining pure —— from gas-purifying materials. L. Hoffmann. G.P. 355,867, 26.2.21.

The contents of the scrubbers are extracted with a volatile solvent such as carbon bisulphide, the solution is mixed with a liquid which does not dissolve sulphur or tar and is not acted upon by the carbon bisulphide, and the latter is distilled off. An aqueous solution of a salt having no action on the substances named, and of a sp. gr. lying between that of the tar and that of the sulphur (*e.g.*, a solution of aluminium sulphate of sp. gr. about 1·3) is used. After the solvent has been

distilled off, the sulphur sinks to the bottom of the vessel and the liquid can be decanted off.
—H. C. R.

Hydrocarbons; Refining of liquid ——. A. E. Dunstan. E.P. 184,281, 12.5.21.

To remove sulphur compounds, liquid hydrocarbon oils are subjected to a preliminary treatment with liquid alkali, then agitated with an alkali hypochlorite solution, such as sodium hypochlorite, containing free alkali, and finally treated again with liquid alkali. The preliminary alkaline treatment removes some sulphur compounds and acidic compounds which would decompose the hypochlorite, whilst the final treatment eliminates the greater part of the sulphur compounds oxidised by the hypochlorite and not removed by it.—F. G. P. R.

Distilling [oils]; Process and apparatus for ——. J. T. Fenton. U.S.P. 1,424,998, 8.8.22. Appl., 29.3.21.

A still for use in topping oils is constructed with a bottom in the form of descending steps down which the oil flows in a thin stream. A weir at the top of the steps, having a vertically movable gate over which the oil flows, forms a preheating reservoir, whilst at the bottom is situated a well in which the depth and temperature of the oil are made to regulate valves on the oil inflow pipes leading into the preheating reservoir.—F. G. P. R.

Retort furnace and condensing apparatus for the eduction of oil and fuel gas from oil shales and sands. C. L. Buckingham. U.S.P. 1,425,074, 8.8.22. Appl., 1.2.21.

A horizontal retort of U-shaped cross-section is provided along its sides with longitudinal flanges which rest on brickwork walls composing the flue. A cover to the retort is provided with a number of gas domes with outlet pipes to condensers. The shale or sand is fed in at one end of the retort and continuously moved along to the other end by suitable means, such as a screw conveyor.
—F. G. P. R.

Motor fuel. F. W. Rohrs. U.S.P. 1,425,135, 8.8.22. Appl., 23.2.21.

A liquid fuel for internal-combustion motors is composed of 88% of a light petroleum distillate, 9% of benzol, and 3% of acetone to act as an oxygen carrier.—F. G. P. R.

Transformer oil; Process of purifying and dehydrating ——. C. H. Hapgood, Assr. to The De Laval Separator Co. U.S.P. 1,425,645, 15.8.22. Appl., 3.5.21.

Transformer and similar oils containing only a very small proportion of water are practically completely dehydrated by being subjected to centrifugal force whereby the water is carried to the periphery of the machine and there held as a surrounding film. The oil floats on the watery envelope thus formed and is drawn of at a point closer to the axis of rotation than the inner wall of the water film.—F. G. P. R.

Petroleum; Distilling —— *under high pressure.* C. E. Stockford, Assr. to Standard Oil Co. of New York. U.S.P. 1,425,712, 15.8.22. Appl., 8.5.15.

The fire chamber and flue beneath a horizontal, high-pressure still are so arranged that the whole length of the still bottom is exposed to direct flame and fire gases. The distance between the bottom of the still and the top of the furnace bridge wall should be more than one third of the diameter of the still.—F. G. P. R.

Hydrocarbon oils; Process of treating ——. *Mineral-oil derivatives.* H. T. Maitland, Assr. to Sun Co. U.S.P. 1,425,882–5, 15.8.22. Appl., 15.4.19.

(A) An organic acid insoluble in water and capable of being saponified is made from petroleum oil by subjecting a heavy distillate, such as lubricating oil stock, to treatment with sulphuric acid and separating the acid sludge. The remaining oil is treated with alkali and the latter run off and acidified with a relatively weak acid whereby the alkali soaps are decomposed and insoluble organic acids liberated. (B) Acid sludge is agitated with a continuous supply of fresh hot water until the free acid content of the sludge is sufficiently reduced to leave the water-insoluble saponifiable oil described in (A). (C, D) The insoluble saponifiable organic acids described in (A) and (B) are claimed as new compounds, one being liquid and the other solid at ordinary temperatures. They are insoluble in water, practically odourless, do not become rancid and contain less than 1% of sulphur. They are readily saponifiable to substances soluble in water in all proportions and in mineral oils totally and partially respectively, and as such have the characteristics of soaps derived from animal and vegetable oils.—F. G. P. R.

Hydrocarbons; Process of producing light ——. C. R. Burke, Assr. to L. P. Burke. U.S.P. 1,426,149, 15.8.22. Appl., 16.1.12.

Heavy oil is distilled under atmospheric pressure and the vapours led into a compressor where they are subjected to a pressure sufficient to raise their temperature to that at which cracking takes place. By varying the pressure the degree of cracking can be regulated and a product of any desired specific gravity and character can be obtained at will.
—F. G. P. R.

Hydrocarbons; Process for the production of low boiling point ——. J. C. Black. U.S.P. 1,426,813, 22.8.22. Appl., 12.12.19.

Oil is heated in a tube still to cracking temperature and under a pressure of not less than 35 atm. whereby vaporisation is prevented. The heated oil is then passed into a larger chamber, kept completely filled with oil and under the same pressure as the still, wherein carbon is deposited, and thence passes to an atmospheric-pressure still where the light portions vaporise and are led to condensers. The heavier unvaporised portions are returned, together with fresh oil, to the cracking still.—F. G. P. R.

"Bath-oil"; Method for the recovery of —— *in the production of oils from peat.* Hochofenwerk Lübeck A.-G. G.P. 353,206, 25.5.21.

After distilling off the peat oils, the residue is mixed with tar and distilled to pitch. "Bath-oil" and anthracene oil distil over, and are subsequently separated by distillation. After drawing off the pitch, the anthracene oil together with the bath-oil may be run into the distillation vessel before charging it with peat, and the anthracene oil distilled off. On account of the recovery of the bath-oil only a small addition of foreign high-boiling oil is required in the process. The pitch produced is of good quality.—J. B. F.

Aluminium chloride; Separating —— *from heavy hydrocarbons.* C. O. Hoover, Assr. to The Hoover Co. U.S.P. 1,426,081, 15.8.22. Appl., 3.4.22.

To recover aluminium chloride from heavy hydrocarbon oils, *e.g.*, after it has been used as a catalytic agent in cracking, the product is dissolved in a suitable solvent and the mixture subjected to sublimation.—F. G. P. R.

Emulsifying agent for liquids insoluble in water. K. Daimler, and Farbw. vorm. Meister, Lucius, und Brüning. G.P. 352,860, 21.11.20.

The oxidation products obtained by treating fossil minerals of vegetable origin, such as coal or lignite, with nitric acid and air are treated with alkalis, ammonia, or sodium carbonate so as to form 5%—30% pastes and then stirred with the material to be emulsified, for example, paraffin oil, lubricating oil, castor oil, linseed oil, tar, or creosote. The emulsions obtained can be diluted and used as lubricants, water-soluble boring oils, disinfecting or other paints or adhesives.—H. C. R.

Fuel supplied to furnaces or the like; Drying ——. W. R. Wood. U.S.P. 1,427,045, 22.8.22. Appl., 25.3.19.

See E.P. 124,314 of 1918; J., 1919, 312 A.

Combustible gas; Process of producing —— and for carbonising coal. H. L. Doherty. U.S.P. 1,426,159, 15.8.22. Appl., 7.9.18.

See E.P. 132,488 of 1919; J., 1920, 684 A.

Oil stills; Damper control for ——. J. Primrose, Assr. to Power Specialty Co. U.S.P. 1,425,896, 15.8.22. Appl., 16.9.20.

See E.P. 176,100 of 1920; J., 1922, 284 A.

See also pages (A) 743, *Dehydrating emulsions* (G.P. 354,202). 747, *Fire-extinguishing etc.* (G.P. 355,107). 786, *Ichthyol oil* (E.P. 184,292). 791, *Calorific value of gas* (E.P. 184,025); *Gas analysis apparatus* (E.P. 184,279).

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Patents.

Retorts or furnaces [for distilling shale etc.]. J. P. B. Webster. E.P. 184,040, 20.7.21.

The shale etc. is fed, *e.g.*, by a valved hopper, to the trays, buckets, or the like of an endless conveyor which travels through a long casing open at the ends and heated throughout its length. The casing is sealed, *e.g.*, by water seals, at each end to prevent ingress of air and escape of vapours, and may be heated by flues above and below it, through which pass gases from a combustion chamber communicating with the lower flue through openings fitted with adjustable dampers. Spaced diaphragms, extending close to the trays etc., may be provided to divide the casing into compartments, some or all of which may be fitted with pipes leading to condensers.—H. H.

Wood products; Method and apparatus for obtaining —— [by destructive distillation]. E. Berthelon. U.S.P. 1,426,346, 22.8.22. Appl., 31.12.19.

The gases arising from the destructive distillation of wood are, while still hot, passed into a receiver, from which the air has been removed, where they meet a stream of water, whereby they are cooled and the condensable products are collected. The gases are then passed through a second vessel where the acidic constituents are extracted by means of alkalis; they then pass upwards through a column where they are again washed by a stream of descending water.—A. R. P.

Absorbent charcoal for gas masks; Method of preparation of ——. Chem. Werke Carbon G.m.b.H. G.P. 310,021, 15.1.18.

Coal, anthracite, or lignite in small pieces is treated at a red heat with slightly superheated steam, extracted with mineral acid, washed with water, dried, and heated strongly. The steam treatment may be discontinued before the end of the first heating, and there may also be a preliminary heating at a lower temperature, *e.g.*, 400° C., with or without steam.—C. I.

Charcoal; Process of manufacturing highly absorbent ——. Chem. Werke Carbon G.m.b.H. G.P. 310,022, 16.1.18.

Charcoal, more especially for use in gas masks, is prepared by heating coal in from three to ten times its quantity of molten caustic alkali, with or without addition of sodium chloride or other flux; the melt is washed thoroughly and the residue roasted for a long period.—J. S. G. T.

Decolorising carbon; Process of manufacturing ——. Chem. Werke Carbon G.m.b.H. G.P. 310,622, 4.5.18.

Any kind of carbonaceous matter or coal is mixed with an alkaline-earth sulphate and the mass calcined and then elutriated, the deposited carbon being extracted with acid. If desired the process is repeated. The alkaline-earth sulphate may be precipitated upon the coal employed.—J. S. G. T.

Mercury vapour lamp; Quartz ——. Quarzlampen-Ges. m.b.H. E.P. 165,081, 12.5.21. Conv., 17.6.20.

In a quartz mercury vapour lamp, the duration of the initial ignition period is reduced to 5—8 minutes by reducing the quantity of mercury employed in the lamp. This is effected as regards the cathode vessel by allowing the mercury to extend in a thin layer between the internal surfaces of the vessel and the surface of a quartz tube fused into the front wall of the vessel or inserted loosely and stayed against the inner wall of the vessel by studs or similar projections. In the anode vessel, adjacent to the point where the light-emitting tube is connected, a small cavity to contain exactly the quantity of mercury to effect ignition by tilting is formed.—J. S. G. T.

Electric lamps and the like; [Drawn wire filament for] incandescence ——. O. Oberlander and W. H. le Maréchal. E.P. 184,291, 20.5.21.

Uranium oxide, or a substance which on subsequent treatment yields uranium oxide, is incorporated with the material used for the production of drawn tungsten filaments. If desired, thorium oxide or boric acid, or both, may be also incorporated with the material. Thus ammonium uranate dissolved in very dilute nitric acid may be added to tungstic oxide so that, on reducing with hydrogen, the resulting material contains the equivalent of 0·87% of uranium dioxide. Alternatively the reduced material may contain about 0·75% of thorium oxide and 0·75% of uranium oxide. Filaments prepared from such material retain their ductility after prolonged heating at very high temperatures. —J. S. G. T.

Electric lamp with glow-discharge. J. Pintsch A.-G. G.P. 355,855, 13.12.17. Addn. to 355,288.

The lamp is filled with an inert gas with a small admixture of another gas or vapour, such as hydrogen, nitrogen, carbon dioxide, water vapour, or metallic vapours, in such proportion that the illuminating power is not affected but the disintegration of the electrodes is suppressed and the lighting of the lamp rendered easier. The additional gas may be added to the inert gas before filling or it may be evolved during use from the electrodes or from the incompletely de-gassed walls of the lamp. —A. R. P.

Tungsten wires. E.P. 163,014. *See* X.

III.—TAR AND TAR PRODUCTS.

Phosgene; Reactions of —— with benzene and m-xylene in the presence of aluminium chloride. R. E. Wilson and E. W. Fuller. J. Ind. Eng. Chem., 1922, **14**, 406—409.

Interaction between phosgene and benzene in the presence of anhydrous aluminium chloride yields benzoyl chloride and benzophenone, but no trace of anthraquinone, the production of which was the initial aim of the investigation. There are two stages in the reaction; an intermediate compound, $C_6H_5COCl,AlCl_3$ (which can be hydrolysed to give benzoic acid) is formed and this compound reacts rapidly with a further quantity of benzene, the final product being almost entirely benzophenone irrespective of change of temperature, method of mixing, ratio of reacting substances, etc. If carbon bisulphide is used as a diluent, a large part of the product can be obtained as benzoic acid owing to the slight solubility of the intermediate compound (in the diluent), which is thus removed before it can react with more benzene. With *m*-xylene phosgene yields a dixylyl ketone in which at least two of the methyl groups are in the ortho position with respect to the carbonyl group; attempts to convert this ketone into an anthraquinone derivative by oxidation were not successful.—W. P. S.

αγ-Quinolines; Preparation of ——. I. 2.4-Dimethyl-6-ethoxyquinoline: an improved method for the preparation. S. Palkin and M. Harris. J. Ind. Eng. Chem., 1922, **14**, 704—705.

The method of Mikeska, Haller and Adams (J., 1921, 75 A) was adapted to commercial needs. The reaction product is diluted with water and a current of steam passed through for ½ hr., and after cooling, and pouring off the supernatant liquid, the tarry residue is washed several times with dilute hydrochloric acid, the washings being added to the main liquid. The cool solution is treated with an excess of strong caustic soda, and after separation the aqueous layer is drawn off, and the oil distilled at 30—70 mm. pressure. The "crude base" distillate (up to about 225° C. at 30 mm.) is treated on the steam bath with an equal weight of acetic anhydride and poured into water. After filtering, the solution is neutralised with caustic soda, the precipitated base separated, dissolved in twice its weight of concentrated hydrochloric acid, and diazotised. After filtering the solution is treated with steam to decompose the diazo compounds, cooled, filtered through cotton, and neutralised. After about 1 hr. the precipitated base is filtered off, and purified by vacuum distillation and recrystallisation from hydrochloric acid solution. The pure base melts at 88°—88·5° C. (*Cf.* J.C.S., Oct.)—A. G. P.

Pyridine recovery. Gluud and Schneider. *See* IIA.

Patents.

Tar and other liquids; Process and apparatus for distilling ——. W. Glossop, L. Bradley, and R. P. Willsdon. E.P. 184,242, 2.5.21.

The interior of a still is provided with superposed plates inclined at an angle to one another, so that liquid delivered on to the top plate runs down and is delivered on to the higher part of the next plate which is inclined in the reverse direction. In this way the liquid is caused to follow a zigzag course in the form of a thin film, and when falling from one plate to the next produces a curtain of liquid through which ascending vapours must pass. By this means the latter are well scrubbed and also cause vaporisation of the light constituents of the liquid.—F. G. P. R.

Emulsions of tars and oils; Process for dehydrating ——. Badische Anilin- und Soda-Fabrik. G.P. 354,202, 20.7.18.

The emulsion is heated in a closed vessel under pressure and the water vapour removed by releasing the pressure, the heating being continued. By this means the water can be rapidly removed without danger.—H. C. R.

Amines; Manufacture of —— from phenolic compounds. W. L. Galbraith, W. V. Shannan, W. G. Adam, and N. E. Siderfin. E.P. 184,284, 13.5.21.

In the preparation of amines by heating an unsubstituted phenol with free ammonia and ammonium sulphite, the ammonium sulphite may be replaced by another ammonium salt (ammonium chloride) together with a fixed alkali sulphite such as sodium sulphite. In general, equimolecular quantities of phenol, alkali sulphite, and ammonium salt are required. Where the phenol is originally prepared by means of a caustic soda fusion process, the crude fusion product, containing the sodium phenoxide and sodium sulphite, may be used directly and the addition of an alkali sulphite omitted. For example, when 4800 g. of crude sodium-β-naphtholate melt, 2953 g. of ammonium chloride, 2617 c.c. of aqueous ammonia (sp. gr. 0·880) and 9280 c.c. of water were heated under a maximum pressure of 180 lb. per sq. inch for 14 hrs. at 170° C. there were obtained from the product, impure unchanged β-naphthol 6·6% and crude β-naphthylamine 90·6%, which gave 79·7% of β-naphthylamine purified by distillation. The process is especially suitable for the manufacture of β-naphthylamine.—A. J. H.

Aromatic alkylamino[anthraquinone] compounds; Manufacture of ——. W. N. Haworth and F. W. Atack. U.S.P. 1,426,380, 22.8.22. Appl., 19.1.20.

See E.P. 147,964 of 1919; J., 1920, 623 A.

IV.—COLOURING MATTERS AND DYES.

6.6′-Di-α-hydroxyisopropylindigo; Preparation of —— from p-cymene. M. Phillips. J. Amer. Chem. Soc., 1922, **44**, 1775—1780.

The *p*-cymene is obtained from spruce turpentine and is converted into mononitrocymene by a modification of the method of Andrews (J., 1918, 486 A). The nitro-compound is oxidised by potassum permanganate in the presence of sodium hydroxide into *o*-nitro-*p*-α-hydroxyisopropylbenzoic acid, m.p. 168° C. (corr.), which is reduced by ferrous sulphate and barium hydroxide to *o*-amino-*p*-α-hydroxyisopropylbenzoic acid, m.p. 158° C. (corr.). Condensation of the latter with chloroacetic acid gives *o*-aminoacetic-*p*-α-hydroxyisopropylbenzoic acid,

$$C(CH_3)_2(OH).C_6H_3(CO_2H).NH.CH_2.CO_2H,$$

m.p. 232·6° C. (corr.), which is transformed by fusion with potassium hydroxide at 180°—230° and subsequent oxidation of the aqueous solution of the melt by air into 6.6′-di-α-hydroxyisopropylindigo. The new dye closely resembles indigo in appearance. It gives greenish-blue shades on cotton from a hydrosulphite vat and compares rather favourably with indigo as regards fastness to light, acid, washing, and rubbing. It differs from indigo notably in its solubility in most organic solvents.—H. W.

Glucosides; Studies of ——. I. Constitution of indican. A. K. Macbeth and J. Pryde. Trans. Chem. Soc. 1922, **121**, 1660—1668.

Indican was converted by means of methyl iodide and silver oxide into the tetramethyl-derivative, and this was hydrolysed by methyl alcoholic hydrogen chloride solution to a mixture of the α- and β-forms of the tetramethylmethylglucosides possessing the ordinary butylene-oxide linking, together with certain indoxyl derivatives, including a product closely resembling the Indoxyl Brown of Perkin. The glucosides when hydrolysed by aqueous acid yielded a crystalline tetramethylglucose, readily identified as the 2.3.5.6 or butylene oxide compound. The molecule of *d*-glucose with which indoxyl is combined in indican is thus of the butylene oxide type. The optical properties of the glucoside and its behaviour towards enzymes indicate that it is a derivative of β-glucose. —P. V. M.

Pigment Chlorine GG (M.L.B.) and Lithol Fast Yellow GG (B.A.S.F.); Constitution of ——. F. M. Rowe and E. Levin. J. Soc. Dyers and Col., 1922, 38, 203—204.

Pigment Chlorine GG and Lithol Fast Yellow GG are readily obtained pure by crystallisation from glacial acetic acid, the former as yellow prisms of m.p. 224° C. and the latter as orange-yellow prismatic needles of m.p. 266° C. Analysis shows them to be isomerides having the formula $C_{13}H_{10}N_4O_4Cl_2$, and they are obtained by condensation of 2 mols. of a chloronitroaniline with 1 mol. of formaldehyde. Such condensation products of various chloronitroanilines with formaldehyde were prepared and purified by crystallisation from glacial acetic acid for comparison with the two dyes. The condensation product from 2-chloro-4-nitroaniline (m.p. 104°—105° C.) formed pale yellow needles, m.p. 282° C.; from 3-chloro-4-nitroaniline (m.p. 156°—157° C.) a yellow crystalline powder, m.p. 239° C.; from 2-chloro-5-nitroaniline (m.p. 117°—118° C.) yellow leaflets, m.p. 207° C.; from 3-chloro-6-nitroaniline (m.p. 125° C.) yellow prisms m.p. 224° C.; and from 4-chloro-6-nitroaniline (m.p. 72° C.) orange-yellow prismatic crystals, m.p. 266° C. Pigment Chlorine GG is thus derived from 3-chloro-6-nitroaniline and Lithol Fast Yellow GG from 4-chloro-6-nitroaniline. —A. J. H.

Substantive azo dyestuffs of the naphthalene series; Synthesis of ——. N. W. Woroshtzow. Ber. Poly. Iwanowo-Wosniessensk, 1921, 4, 95—108. Chem. Zentr., 1922, 93, III., 369—370.

Important direct cotton dyestuffs containing a naphthalene nucleus to which azo groups are attached in either the 1.4, 1.5, or 2.6 positions are analogous in their substantive dyeing properties to naphthaquinone compounds having :CO groups in the same positions and this suggests that the substantive dyeing properties of dyestuffs should be associated with molecular configuration rather than definite atomic groups. In these 1.5 and 2.6 azo dyestuffs, two and one azo groups are necessary respectively. One azo can be replaced by NO_2. 1.2-Compounds also show substantive dyeing properties and these are being further investigated. Naphthalene compounds analogous to benzidine are not naphthidines but naphthylenediamine and its derivatives. Substantive 1.5 dyestuffs were obtained by tetrazotising 1.5-naphthylenediamine-3.7-disulphonic acid and coupling with either naphthionic, Neville-Winther's, or H-acid. 1.5-Nitroaminonaphthalene and 1.5-naphthylenediamine also yielded substantive azo dyestuffs, but azo dyestuffs obtained from nitronaphthionic acid and 1-amino-5-acetaminonaphthalene-8-sulphonic acid had feeble dyeing properties. When coupled with naphthionic, Neville-Winther's, and H-acid, 2-amino-6-nitronaphthalene-8-sulphonic acid yielded good dyestuffs, but those similarly obtained from 2.6-naphthylenediamine-8-sulphonic acid were even better. (With K. A. Gribow).—The action of 1 mol. of HNO_3 on a solution of 2-naphthylamine-4.8-disulphonic acid in oleum (5% SO_3) at −5° to −6° C., yields a product (probably the 6-nitro compound) which could not be isolated in a pure state, but which on diazotisation in solution and coupling, yields substantive dyestuffs with marked affinity for vegetable fibres. Nitration of 2-nitronaphthalene-4.8-disulphonic acid yields mainly 2.5-dinitronaphthalene-4.8-disulphonic acid together with a small amount of the 2.6 isomer. The 2.5-acid dyes wool in bright yellow shades which are not fast to washing but which change to fast dark brown under the action of light. On reduction, 2.5-dinitronaphthalene-4.8-disulphonic acid gives 2.5-naphthylenediamine-4.8-disulphonic acid which yields, by tetrazotisation and suitable coupling, fast dyestuffs for wool and cotton. (With M. K. Besszubzew).—*p*-Nitrodiazobenzene couples with 1.5-naphthylenediamine-3.7-disulphonic acid in the 2.6 positions, but only the disazo dyestuff has an affinity for vegetable fibres.—A. J. H.

Toluidine Blue; Metachromism of ——. R. Schwarz and E. Herrmann. Kolloid-Zeits, 1922, 31, 91—94.

Toluidine Blue in aqueous solution constitutes a poly-disperse system made up of colloidal particles and molecular disperse particles. The different colouring effects (for example α-silicic acid gel is coloured blue and β-silicic acid gel red by Toluidine Blue) are due in the first place to the difference in the degree of dispersion of the adsorbent and in the second place to the electrical condition of the adsorbing surface, which is determined by the nature of the adsorbed ions. (*Cf.* J.C.S., October.)—J. F. S.

Colouring matter of Lithospermum Erythrorhizon. R. Majima and C. Kuroda. Acta Phytochim., 1922, 1, 43—65.

The violet colouring matter of shikon, the dried roots of *Lithospermum Erythrorhizon*, has been isolated in a crystalline state and is shown to be the monoacetyl derivative of shikonin, to which the constitution γ-methylpentenyl-2.5.8-trihydroxy-1.4-naphthoquinone is assigned. The latter gives a tri-acetyl, a penta-acetyl, and a dibenzoyl derivative and on heating is decomposed, giving shikazarin, which is identical with α-methylquinizarin.—W. G.

Patents.

Benzanthrone derivatives; Manufacture of ——. British Dyestuffs Corp., Ltd., A. G. Perkin, and G. D. Spencer. E.P. 183,351, 12.7.21.

Hydroxybenzanthrone is obtained by heating a mixture of benzanthrone (50 parts), anthraquinone (50 parts), alkali hydroxide (300 parts), water (50 parts), and sodium chlorate or sodium nitrate (35 parts), in an autoclave, slowly to 250° C. and then maintaining the temperature between 250° and 265° C. for 3 hours. The product is digested with boiling water and anthraquinone is removed by filtration. Hydroxybenzanthrone is precipitated from the filtrate by carbonic acid or a stronger acid. Aminobenzanthrone is prepared by gradually heating a mixture of hydroxybenzanthrone (25 parts) and ammonia (sp. gr. 0·880, 500 parts) in an autoclave to 200° C. and subsequently maintaining the temperature at 220°—230° C. for 7 hours. The product is diluted with water and filtered, whereby aminobenzanthrone is isolated as dull red crystals; unchanged hydroxybenzanthrone can be recovered by acidification of the filtrate.—H. W.

o-[Hydr]oxyazo dyestuffs. W. Herzberg and O. Scharfenberg, Assrs. to Akt.-Ges. f. Anilin-Fabr. U.S.P. (A) 1,426,189, (B) 1,426,190, 15.8.22. Appl., 5.11.21.

(A) Claim is made for the *o*-hydroxyazo dyestuff

$C_6H(2)OH(3.5.6)Cl_3.(1)N:N.(2)C_{10}H_5(1)OH(4)SO_3H$, a dark powder giving a reddish-violet aqueous solution which becomes bluish-red by addition of sodium carbonate, orange by addition of sodium hydroxide, and which yields a red precipitate when treated with acids. The dye is applied to wool after mordanting with chromium or by the metachrome or after-chroming processes and yields violet shades. (B) The *o*-hydroxyazo dyestuff $C_6H.(2)OH(3.5.6)Cl_3.(1)N:N(7)C_{10}H_4(1)NH_2.(2.4)SO_3H(8)OH$, is a dark powder giving a greenish-blue aqueous solution which becomes violet on addition of sodium carbonate, red on addition of sodium hydroxide, and reddish-violet when treated with acids. It yields greenish-blue shades on wool mordanted with chromium before or after dyeing.—A. J. H.

Acridine derivatives. G.P. 354,400. *See* XX.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Polysaccharides; Constitution of ——. V. Yield of glucose from cotton cellulose. J. C. Irvine and E. L. Hirst. Trans. Chem. Soc., 1922, 121, 1585—1591.

By conducting the acetolysis of cotton cellulose by Barnett's method (J., 1921, 8 T) using sulphuryl chloride as a catalyst, a 99—100% yield of pure triacetate containing no soluble sugars is obtained. For the conversion of the triacetate into methylglucoside the use of an autoclave is inadvisable. This stage is best carried out by digesting small quantities of the compound (1 pt.) for 60—70 hrs. at 125° C. with pure methyl alcohol (15 pts.) containing 0·75% of hydrogen chloride. Residual acid is neutralised with silver carbonate and the filtrate decolorised, if necessary, with charcoal. The whole of the filtrate is then evaporated to a syrup under diminished pressure, the last traces of solvent being removed at 100° C. at 10 mm. pressure by a current of dry air. A 95·5% yield of methylglucoside is obtained. Complete crystallisation is effected by dissolving in hot alcohol, standing for a few hours, and removing the solvent by distillation at 60°—70° C. The m.p., 125°—150° C., and the specific rotation of the product indicate that it is the equilibrium mixture of pure α- and β-methylglucosides. An overall yield from polysaccharide to hexose of 95·1% of the theoretical amount is obtained. The conclusion is drawn that cotton cellulose is composed entirely of glucose residues.—P. V. M.

Asbestos and cotton; Estimation of mixtures of ——. P. Heermann and H. Sommer. Mitt. Materialprüf., 1921, 39, 315—329.

A method in which cuprammonium solution is used as a solvent for the cellulose, has been found satisfactory for the quantitative analysis of technical products containing asbestos and cellulose. Microscopical examination does not yield accurate results. The loss of weight which occurred when different qualities of asbestos were ignited varied from 1·6 to 15·8%, so that mixtures of asbestos and cotton could not be estimated by the residue obtained after ignition. The well known method for estimation of mixtures of wool and cotton based on their different resistance to the action of concentrated sulphuric acid cannot be applied to mixtures of asbestos and cotton, since raw asbestos, when in contact with 80% and 1% sulphuric acid, loses 0·9—12·3% and 1·5—39·6% in weight respectively. This loss of weight is greater when the asbestos is more finely divided. Since the silica content of asbestos varies in different qualities, this was found to be an unsatisfactory measure of the asbestos present in its technical products. Cold cuprammonium solution, however, was found to attack five qualities of asbestos only to the extent of 0·1% during 24 hrs. The method of analysis finally adopted is as follows: 0·2—0·5 g. of the air-dry product is dried at 110° C. until of constant weight and the hygroscopic moisture (usually 0·5—2·4%) thereby determined. The fat content is then obtained by extraction of the dried material with ether, and afterwards the water-soluble substances such as salts, starch, etc., are removed by treatment in boiling water for 2 hrs. and estimated. The material is then immersed for 12 hrs., with frequent shaking, in 30 c.c. of a cold, freshly prepared cuprammonium solution (about 19 g. of Cu per l.), whereby the cellulose dissolves (this is usually complete in 2 hrs.) and the solution is filtered through a Gooch crucible, the residue of asbestos being then thoroughly washed with dilute cuprammonium solution, finally with dilute ammonia, and then dried to constant weight at 110° C. and weighed as pure asbestos. The filtrate is acidified with dilute sulphuric acid after the addition of salt so that the cellulose is precipitated in a form suitable for filtration in a Gooch crucible. After filtration, the residue of cellulose is dried at 110° C. and weighed. The method is accurate to about 1·5%.—A. J. H.

Cellulose; Saccharification of ——. P. P. Budnikow and P. W. Solotarew. Ber. Polyt. Iwanowo-Wosniessensk, 1921, 4, 119—128. Chem. Zentr., 1922, 93, IV., 324—325.

In the technical production of sugars from cellulose, the recovery of the sulphuric acid used and the strength of the solutions of glucose obtained are important factors. When the solution, obtained by dissolving 1 g. of Swedish filter paper in 7—8 c.c. of 72% sulphuric acid during 3 hrs., was diluted with water so that it contained not more than 3% H_2SO_4 and then heated for 2 hrs. at 120° C. in an autoclave, the concentration of the glucose solution thereby obtained was not greater than 0·6%. In similar experiments, except that the concentration of the acid in the cellulose solution was decreased by the addition of barium carbonate instead of water, it was found that with longer heating, some of the glucose formed decomposed into organic acids. In the fermentation of glucose, obtained by the action of an acid on cellulose, it is advantageous not to neutralise completely the excess of acid before addition of the yeast. By this method 85% of the theoretical amount of alcohol was obtained from paper, but a smaller yield was obtained when caustic soda instead of calcium carbonate was used for neutralising. The theoretical yield of alcohol cannot be obtained from the purest paper since, on account of hydrolysis, small quantities of non-fermentable sugars are formed. The sulphuric acid is recoverable electrolytically. In several experiments, 36·0% to 91·5% of the sulphuric acid was recovered by means of an electrolytic apparatus consisting of an earthenware vessel, containing the cathode and a solution containing 1% of glucose and 3% of sulphuric acid, which was immersed in a glass vessel containing the anode and water acidified with sulphuric acid. Using platinum electrodes, the total quantity of sulphuric acid in the system remained constant, but with carbon electrodes a small loss occurred. The total amount of glucose also remained nearly constant but about 6% was lost due to absorption by the cathode vessel and carbon electrodes. A disadvantage of the process is that about 7·215 kilowatts was required per kg. of H_2SO_4 recovered.—A. J. H.

Wood; Importance of the degree of disintegration in the digestion of ——. P. Waentig. Zellstoff u. Papier, 1922, 2, 152—155.

In investigating Bronnert's process (E.P. 170,964, U.S.P. 1,392,047; J., 1921, 808 A) for the manufacture of sulphite pulp after subjecting the wood to a preliminary treatment for 2—4 hours with 1% sulphuric acid at 115° C., it was observed that when the wood was prepared in the form of fine shavings a total physical breakdown of the fibre occurred and the cellulose subsequently obtained by the chlorination process had the brittle character of hydrocellulose, but when wood-chips were subjected to a similar acid treatment the cellulose fibre obtained was long and strong. The yields of cellulose were: from raw shavings or chips 50%, from chips previously boiled with acid, 48%; from shavings boiled with acid 41—42%. The difference between the yields from chips and from shavings is attributed to the transverse slicing of the fibres of the shavings whereby the interior of the cell-substance is exposed to the action of the acid. In spite of the above physical and chemical differences, the yield of "α-cellulose" was identical in all cases, namely 84—85%, whether from shavings or chips and whether the wood had been boiled with acid or not. The influence of the acid treatment, however, was shown in the viscosity of the viscose prepared from the cellulose, this being considerably lowered by the acid treatment to a similar extent in the strong cellulose fibre from the chips as in the disintegrated fibre from the shavings. The above peculiar behaviour of wood is attributed to the extremely heterogeneous constitution of the raw fibre, because normal sulphite-cellulose, after boiling with acid, was converted into brittle hydrocellulose and showed only 74·3% of "α-cellulose" after this treatment. Hence it is suggested that the increased chemical reactivity of the acid-treated wood is not directly connected as cause and effect, with the physical breakdown of the fibre substance.—J. F. B.

Wood pulp; Testing the degree of digestion of ——. H. Roschier. Pappers och Trävarutidskrift. Zellstoff u. Papier, 1922, 2, 184—186.

THE rate of reduction of permanganate under standard conditions is proposed as a rapid approximate measure of the degree of digestion of wood pulp and is particularly applicable for purposes of factory control. A $N/100$ solution of potassium permanganate is most suitable; this is kept in the neutral condition and acidified just before use. 2 g. of finely rasped wood pulp, or 6 g. of moist pulp squeezed out in the hand, is weighed out and rolled into a loose ball. 80 c.c. of $N/100$ permanganate is placed in a glass-stoppered bottle of 300—400 c.c. capacity, 1·6 c.c. of $N/1$ sulphuric acid is added, the ball of pulp is dropped in, the stopper is inserted, and a stop-watch is started. The bottle is shaken slowly and uniformly by hand and the liquid is kept under observation by slightly tilting the bottle. Immediately the red colour of the permanganate is discharged the time in seconds is noted. A standard temperature of 20° C. is maintained, since the rate of discharge is greatly influenced by differences in temperature. The following grades have been established: easy bleaching pulp, 70 secs.; slowly bleaching, 50—70; medium strong, 35—50; ordinary strong, 25—35; very strong and hard, 25 secs. The values have been co-ordinated with the chlorine-absorption values determined by Sieber's method (J., 1921, 382 A).—J. F. B.

Straw; Digestion of —— by the Steffen process. T. E. Blasweiler. Papierfabr., 1922, 20, 1025—1028, 1061—1064, 1101—1103.

IN a detailed test of the Steffen process for the digestion of straw, 630 kg. of rye straw was steeped in a solution of 63 kg. of caustic soda in 819 l. of water. The liquor was completely absorbed by the straw, which was then charged into a vertical digester provided with a perforated false bottom and circulation ducts. Steam was admitted at the bottom and the air expelled, then the pressure was allowed to rise quickly to 3 atm., which was maintained for one hour. On blowing off the steam, ammonia was evolved; only 10 l. of condensed water had accumulated at the bottom of the boiler. The digested straw was covered with 2500 l. of boiling water and boiled for 30 mins. under a steam pressure of 2—2½ atm. This liquor was blown out and followed by six washes of 1800 l. of hot water, each being brought to the boil and discharged under a slight steam pressure. The washed pulp discharged from the digester contained 16—17% of dry fibre, which was increased to 42% after pressing. The yield of digested pulp, calculated on dry substance, was 59·25%; it showed on analysis 60·92% of cellulose, 30·00% of pentosans, and 9·08% of lignin. This pulp did not give lignin reactions and was similar in quality to straw digested for fodder purposes. It was also suitable for paper making and could be bleached with a consumption of 12·7% of active chlorine. The Steffen process compares favourably with other processes, such as the Oexmann process, in current use for the preparation of digested straw fodder. The treatment is complete in 4—4½ hours and the total quantity of water used is 21 times the weight of the raw material or 40 times that of the pulp obtained, as against 63 and 110 times respectively in the case of the Oexmann process.—J. F. B.

Rosin sizing. R. Sieber. Zellstoff u. Papier, 1922, 2, 99—103, 134—139. (*Cf.* J., 1921, 842 A.)

WITH regard to the influence of calcium and magnesium salts on the composition of the precipitated resinates, the quantity of alkaline-earth in the precipitate is larger the longer the interval between the addition of the earth salt and that of the aluminium sulphate. The sizing efficiency of such mixed precipitates is probably less than that of precipitates formed with aluminium sulphate alone. In the presence of free sulphuric acid, aluminium sulphate has no precipitating value and the acid resin precipitates contain no aluminium. It is not perfectly certain whether pure cellulose is capable of dissociating aluminium sulphate and fixing aluminium hydroxide by colloidal adsorption. Commercial paper pulps, however, always contain inorganic constituents, generally of a basic function, which certainly can produce this result by simple chemical decomposition. Sulphite wood pulp is capable of fixing more aluminium hydroxide in this way than mechanical pulp, and beaten sulphite pulp more than unbeaten. Well-washed gelatinous aluminium hydroxide will adsorb large quantities of rosin from a fine suspension of pure rosin in water. If pure filter paper be treated with aluminium sulphate for 24 hours, then thoroughly washed and immersed in a highly dilute suspension of rosin, particles of rosin are deposited on the fibres, whereas with untreated fibres the deposition of rosin particles is barely perceptible. These particles can be seen as bright points on the surface of the fibres under the ultramicroscope, and in the case of treated fibres they are observed particularly on the fine fibrillæ. The sizing process may best be defined partly on a chemical and partly on an electro-colloidal hypothesis. The fibre and the rosin suspension may be regarded as endowed with negative charges and the aluminium hydroxide, produced by the chemical decomposition of the soap with aluminium sulphate, is positively charged. There is no direct tendency for the fibre to adsorb the rosin emulsion since both carry the same kind of charge, but the rosin emulsion and the strongly positive aluminium hydroxide have a powerful attraction to form a colloid in which the positive charge of the aluminium is predominant, and this positive complex is then discharged on the negative fibre to produce the sized pulp. No doubt the absolute and relative concentrations of the components play an important part. This hypothesis explains the importance of the trivalent ion in the sizing process. This ion is so strongly positive that it is able to reverse the charge of the rosin emulsion, carrying it over from the negative, through neutrality, to the positive side, whereas other coagulating agents, such as acids and salts of sodium, calcium, and magnesium, simply coagulate the emulsion and discharge it, without imparting to it any electro-colloidal affinity towards the negative fibre.—J. F. B.

Sulphate pulp mills; Absorption of malodorous gases in ——. C. G. Schwalbe. Zellstoff u. Papier, 1922, 2, 175—178. (*Cf.* J., 1921, 807 A.)

The principal sources of malodorous gases in sulphate (soda) pulp mills are the digesters and the soda-recovery furnaces. These furnaces discharge not only mercaptans, hydrogen sulphide, and sulphur dioxide, but also large quantities of solid dust particles, consisting largely of sodium sulphide, sulphite and other salts, in the flue gases. It is calculated that the losses of sodium salts, expressed as sulphate, in the furnace gases amount to 15—23% of the cellulose produced, and this is the principal source of loss of alkali in the process. Based on the discovery that wood or straw is an effective deodoriser of malodorous gases of an acid nature, the author proposes to pass the waste gases through a rotating horizontal or inclined cylinder filled with waste wood trimmings or other refuse from the pulp mill. In the case of straw pulp mills knotty refuse from the straw may be used for charging the cylinder. The same arrangement also serves as a trap for the solid salts in the flue gases, and the salts may be recovered subsequently by washing the wood refuse. The action of the wood is rather that of a "contact" substance than of an absorbent, and it is presumed that the mercaptans etc. become concentrated in the pores of the wood and then oxidised. The deodorisation may be assisted, if desired, by passing chlorine together with the sulphurised gases through the material. On similar lines, the gases discharged from the digesters may be passed through the wood chips stored in the silos ready for charging the digesters. The steam which passes off together with the digester gases may be condensed and the hot water used for washing the wood in the deodorisers attached to the soda furnaces.
—J. F. B.

Effluent from strawboard mills. Hommon. *See* XIXb.

Ion concentration measurements. Keeler. *See* XXIII.

Patents.

Wool, fur, etc.; Insecticide, more especially for protecting —— against moth. Chem. Fabr. Griesheim-Elektron. G.P. 353,682, 30.5.20.

Dichloroethane, either alone or mixed or in solution with other indifferent or insecticidal substances, is employed. The insecticide may be either strewn in powder form or dissolved in acetone or carbon tetrachloride and sprinkled over the material. It does not evaporate so quickly as dichlorobenzene and has a more pleasant smell.
—J. S. G. T.

Fulling; Method of improving and shortening the process of ——. Diamalt A.-G. G.P. 355,104, 13.10.16.

A mixture of organic colloids with inorganic protective colloids is added to the fulling liquid. Extracts of lichens and algæ, gum tragacanth, linseed, or fleabane seed mucilage etc. may be used. Their solutions are mixed with colloidal silica and dried *in vacuo*. By the addition of this colloidal powder to the fulling liquid more rapid felting and less shrinkage result, together with a marked brightening of the material. An economy in soap and soda is also effected.—H. C. R.

Fire extinguishing and prevention of the ignition of combustible matter; Process for ——. A. Eichengrün. G.P. 355,107, 15.2.18.

Ammonium bromide is used in the solid state or in solution. It may be used in conjunction with other substances utilised for the prevention of burning. It is considerably more effective than ammonium chloride and other ammonium salts, and smaller quantities suffice for impregnating textile fabrics and paper.—H. C. R.

Vulcanised fibre; Preparation of ——. J. A. Sutcliffe. E.P. 183,497, 27.1.21.

Vulcanised fibre, prepared by the zinc chloride process, shows a tendency to absorb moisture owing to the presence of zinc chloride residues. This defect is remedied, and a product obtained more suitable for use in the manufacture of machinery parts, insulators, etc., by saturating the material immediately after the "washing off" process, or even after it has been dried, with strong ammonia solution. When completely saturated, the material is removed from the bath, washed, and dried.
—D. J. N.

Waterproofing vulcanised fibre; Method of —— J. McIntosh, Assr. to Diamond State Fibre Co. U.S.P. 1,425,878, 15.8.22. Appl., 27.4.20.

Wet vulcanised fibre is immersed in a waterproofing solution until thoroughly impregnated and then dried.—F. G. P. R.

Sulphite liquor; Process and apparatus for preparing ——. D. B. Davies and E. P. Strong. U.S.P. 1,424,883, 8.8.22. Appl., 1.6.20.

Liquor from a storage tank is continuously circulated through a pipe system, and sulphur dioxide is introduced into the stream. The liquor is subsequently returned to the storage tank at or near the bottom.—D. J. N.

Cellulose; Process for the extraction of —— from vegetable fibres. B. Cataldi, Assr. to A. Pomilio. U.S.P. 1,424,620, 1.8.22. Appl., 17.5.21.

Cellulosic material, such as straw, esparto grass, jute, cotton, and the like, or wood freed from bark, is leached in a digester with alkali solutions under heavy pressure, first hydraulic then steam pressure, and is then disintegrated, and transferred to an acid-resisting digester, where it is alternately chlorinated and washed with water (to cool the mass and remove hydrochloric acid). When further chlorination ceases to cause any rise in temperature, the material, after a final wash with water, is leached with alkali solution at atmospheric pressure. The resulting product consists of practically pure cellulose.—D. J. N.

[*Artificial silk*] *threads; Process of producing lustrous* ——. C. A. Huttinger, Assr. to The Acme Artificial Silk Co. U.S.P. 1,425,654, 15.8.22. Appl., 12.6.19.

Wood pulp is saturated with caustic soda solution of sp. gr. 1·17, pressed, and treated with carbon bisulphide; the resulting xanthate is dissolved in water, filtered, and spun into an aqueous solution of a bisulphate, containing no free acid, and maintained at a temperature of 70° F. (21° C.).
—D. J. N.

Cellulose butyrate; Process of preparing ——. A. D. Little, Inc., Assees. of G. J. Esselen, jun., and H. S. Mork. E.P. 167,143, 9.3.21. Conv., 26.7.20.

In the preparation of cellulose butyrate, cellulose, 100 pts., in any form such as yarn, linters, wood pulp, paper, etc., containing 3—8% of moisture, is soaked in 1500—1600 pts. of an acetic acid solution of sulphuric acid (the latter acting as a catalyst in the subsequent esterification), having the following approximate composition by weight, sulphuric acid (sp. gr. 1·84) 1—5%, water 5—8%, acetic acid 94—87%; the impregnated cellulose is then pressed until it contains 1¼ times its weight of solution, and is treated in a bath containing, for example, butyric acid 400 pts., butyric anhydride (90%) 465 pts. by weight, the reaction, which is accompanied by a rise in temperature, being allowed to proceed until a product of the desired solubility is obtained. When sulphuric acid is used in relatively small quantities it is advisable, when the product shows good solubility in chloroform, to accelerate the reaction by the addition of, *e.g.*, 5 pts. of sulphuric acid (sp. gr. 1·84) and 3—5% (by volume) of water on the volume of the butyrating mixture. The resulting product is soluble at room temperature in methyl or ethyl alcohol containing 50—90% by volume of benzol, and in many other solvents and solvent mixtures such as chloroform, acetone, 90% carbolic acid, hot denatured alcohol, hot solvent naphtha, hot benzol, etc.—D. J. N.

Cellulose derivatives [viscose]; Manufacture of ——. H. Dreyfus. E.P. 183,882, 9.2.21.

A high molecular viscose, which may be used in the manufacture of artificial filaments etc. without previous "ripening," is made by treating cellulose or a near conversion product (1 mol. $C_6H_{10}O_5$) with not more than 2 and preferably about 1 mol. of alkali at concentrations above 15%, preferably 20—50%, and kneading the alkali-cellulose thus obtained with not more than $\frac{1}{2}$ mol. ($\frac{1}{5}$—$\frac{1}{2}$ mol.) of carbon bisulphide per molecule of cellulose $C_6H_{10}O_5$, until all the carbon bisulphide has entered into combination. The carbon bisulphide may with advantage be dissolved in a suitable organic solvent, such as benzol, in amount equal to 3 or 4 times the weight of cellulose. The solvent is subsequently recovered by any suitable method. By thus obviating the usual "ripening" process, during which the cellulose aggregate is exposed to the degrading action of free alkali, a product is obtained, which is capable of giving stronger threads than can be obtained from viscose prepared by the usual methods. —D. J. N.

Cellulose compounds [ethers, esters, etc.]; Manufacture of ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 183,908, 28.4.21.

Cellulose derivatives are made by treating cellulose in a highly dispersed condition with the desired reaction components, with or without condensing agents. The cellulose is dispersed by intensive mechanical disintegration at high speeds until the particles are about 0·8 μ in diameter, *e.g.*, in the colloid mill (E.P. 179,124; J., 1922, 449 A). Cellulose phosphoric ester is made by treating 4 pts. of cotton dispersed in water as described above, with 2 pts. of orthophosphoric acid at a gradually increasing temperature (30°—50° C.), until esterification takes place, as shown by the appearance of foam. The reaction is preferably carried out *in vacuo*, and 0·1 pt. of concentrated sulphuric acid may be added as an accelerator. Cellulose acetate is obtained by heating 100 pts. of highly dispersed cellulose, pressed until it contains only 20—30% of water, with 30 pts. of acetic anhydride and 120 pts. of acetic acid, until esterification takes place with vigorous foaming. Cellulose sulphide may be prepared by heating a gel of highly dispersed cellulose with an equal weight of sulphur, preferably with addition of 1—5% of alkali or alkali carbonate, to 150° C. until evolution of hydrogen sulphide ceases, and a homogeneous mass is obtained. Cellulose sulphide is a yellow-grey to brown-grey mass, which evolves hydrogen sulphide on treatment with water. In the preparation of cellulose methyl ethers, 1 pt. of cellulose is dispersed in 8—15 pts. of water in a colloid mill, methyl alcohol (3 pts.) is added during the dispersion process, and etherification is effected by treatment with hydrogen chloride gas.—D. J. N.

Cellulose esters; Process for utilising [improving the dyeing properties of] ——. J. Duclaux. E.P. 184,197, 1.2.21.

Cellulose esters (other than the xanthate) are dissolved in volatile solvents, *e.g.*, formates or acetates of methyl, ethyl, butyl, amyl alcohol, etc., containing small quantities (1—5% on the weight of solvent) of organic substances such as acetamide and its homologues, chloral and chloral hydrate, which are non-volatile or but slightly volatile, are solvents for cellulose esters, and are soluble in water. Threads or films produced from these solutions by evaporation of the volatile solvent are washed with water to remove the non-volatile solvent. Non-granular, transparent products are obtained having dyeing properties closely resembling those of natural fibres. —D. J. N.

Cellulose derivative and process of preparing same. G. J. Esselen, jun., and H. S. Mork, Assrs. to A. D. Little, Inc. U.S.P. 1,425,580, 15.8.22. Appl., 10.4.20.

In the preparation of a cellulose butyrate soluble at normal temperatures in mixtures of benzol and alcohol, cellulose is subjected to a preliminary impregnating bath containing a solution of butyric acid and a catalyst.—H. H.

Cellulose ether solvent and composition. S. J. Carroll, Assr. to Eastman Kodak Co. U.S.P. 1,425,173, 8.8.22. Appl., 21.1.21.

An alkyl ether of cellulose is dissolved in a solvent containing 82—92 pts. of ethyl acetate, 7—12 pts. of ethyl alcohol, and 1—6 pts. of water by weight. —D. J. N.

Paper filler. W. Hoskins. U.S.P. 1,424,306, 1.8.22. Appl., 31.3.21.

Powdered calcium sulphate is superficially coated with an insoluble soap by washing it with soap solution. Other substances, which are slightly soluble in water, and are capable of forming an insoluble soap, may be similarly treated. The resulting products find application as fillers in the papermaking industry.—D. J. N.

Paper; Method for recovering [removing printer's ink from] waste ——. T. Jespersen, Assr. to Lincoln Trust Co. U.S.P. 1,424,411, 1.8.22. Appl., 15.12.16. Renewed 22.12.21.

Printer's ink containing a mineral oil vehicle is removed from waste paper by treating the paper stock with sodium silicate solution.—D. J. N.

Patterned textile fabrics; Process for producing —— and the resulting product. H. Giesler, Assr. to Heberlein u. Co., A.-G. U.S.P. 1,425,520, 15.8.22. Appl., 10.11.14.

See G.P. 282,351 of 1914; J., 1915, 713.

Artificial threads; Method of and apparatus for producing —— more particularly multiple filament threads from cellulose solution. E. Schülke. E.P. 163,312, 13.5.21. Conv., 17.5.20.

See G.P. 341,833 of 1920; J., 1922, 52 A.

Artificial silk; Manufacture of ——. E. Bronnert. U.S.P. 1,426,953, 22.8.22. Appl., 10.9.20.

See E.P. 172,038 of 1920; J., 1922, 52 A.

Molecular filters. G.P. 351,084. *See* I.

Alkali lyes contaminated with hemicellulose. G.P. 355,836. *See* VII.

Delinting cottonseed. U.S.P. 1,425,688. *See* XII.

Gas-impervious material. E.P. 184,012. *See* XV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Assistants used in printing and finishing textile fabrics; The colloidal nature and influence of ——. N. J. Planowsky. Ber. Polyt. Iwanowo-Wosniessensk, 1921, **4**, 129—137. Chem. Zentr., 1922, **93**, IV., 551—552.

The pseudo or colloidal solutions of starch, dextrin, British gum, etc. such as are used for printing textile fabrics, are heterogeneous, homogeneous, or micellar according to their degree of dispersion, but this division is not always possible, since the states of these substances when in solution frequently change. Starch forms a precipitate with tannic acid, so that in printing pastes containing basic dyestuffs, colour lakes are formed which adhere only to the surface of the printed fabric and therefore are not fast. Analogous precipitates are formed with British gum and Gommelin, which are usually mixed with starch. Of the substances examined, starch had the most and Gommelin the least peptising power. In the presence of starch or gum tragacanth, dyestuffs partially diffuse into the textile fibres immediately after printing and this diffusion is hastened by steaming. In the presence of homogeneous substances, however, this diffusion is very small and is not assisted by steaming, so that the shade of the fabric is pale and not fast to washing. Fabrics printed with Malachite Green and starch or gum tragacanth appeared deeper than those for which Gommelin or British gum was used. Diffusion experiments showed that gum tragacanth has the greatest and British gum the least power of diffusion.—A. J. H.

Calico-printing; The possibility of using phosphorescent substances in ——. S. G. Schimansky. Ber. Polyt. Iwanowo-Wosniessensk, 1921, **4**, 171—172. Chem. Zentr., 1922, **93**, IV., 318—319.

Mixtures containing phosphorescent sulphides have been used successfully, the fabric being printed with a paste containing the sulphide, ammonia, and albumin. During printing, the fabrics must be protected from light, since the small quantities of acetic acid formed cause decomposition of the sulphides. Unsatisfactory results were obtained with acid dyestuffs, *e.g.*, Eosin and Fluorescein. —A. J. H.

Azo dyes of the naphthalene series. Woroshtzow. *See* IV.

Patents.

Colour printing; Double tone ——. Chem. Fabr. Worms A.-G. G.P. 354,081, 8.12.17. Addn. to 347,902 (J., 1922, 382 A).

A colour base is warmed with montanic acid and printers' ink added to the solution. The printing colour thus obtained is ready for use. The colour salts of montanic acid yield in printing a colour which stands out in more distinct contrast than that produced by the corresponding fatty acid salts. —J. B. F.

Vat preparations; Stable, dry, and readily-soluble —— *and process of making same.* K. Thiess, F. Maennchen, A. Steindorff, and F. Giloy, Assrs. to Farbwerke vorm. Meister, Lucius, u. Brüning. U.S.P. 1,426,522, 22.8.22. Appl., 23.8.21.

See E.P. 171,078 of 1921; J., 1922, 705 A.

Printing fabrics; Rotary offset machines for ——. T. R. Johnston. E.P. 184,128, 18.3.22.

Cellulose esters. E.P. 184,197. *See* V.

Bleach solutions. U.S.P. 1,426,752. *See* VII.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Sulphuric acid from gypsum. W. Dominik. Przemysl Chem., 1921, **5**, 185—191. Chem. Zentr., 1922, **93**, IV., 308.

Gypsum may be converted into ammonium sulphate and the latter into sodium hydrogen sulphate, from which free sulphuric acid may be obtained by (1) reduction of the free acid to sulphur dioxide and re-oxidation, (2) distillation with ballast (*cf.* Moscicki and Dominik, J., 1920, 746 A), (3) crystallisation of hydrated sodium sulphate by cooling and concentration of the mother liquor. Sodium sulphate increases in solubility with addition of free sulphuric acid to a maximum above which the acid sulphate separates. The solubility also decreases rapidly with the temperature; at $-11°$ C. the maximum solubility corresponding to 32% free acid is only about 4% Na_2SO_4 by weight, so that at this temperature a fairly complete separation can be obtained in one operation. A calculation of the water required and fuel consumption necessary for the decomposition of the acid salt at a given temperature is added.—C. I.

Calcium sulphate [and magnesium sulphate]; Reduction of —— *by carbon monoxide [carbon and hydrogen sulphide].* J. Zawadzki, K. Kossak, and H. Narbut. Przemysl Chem., 1921, **5**, 225—236. Chem. Zentr., 1922, **93**, III., 329.

At temperatures below 900° C., calcium sulphate is reduced to calcium sulphide; the reaction is quantitative about 900° C.; the velocity of reaction is sufficient for technical purposes. The calcium sulphide yields hydrogen sulphide quantitatively on heating with magnesium chloride solution. Above 900° C. calcium oxide and sulphur dioxide are also produced in quantities increasing with rise of temperature. Magnesium sulphate on reduction with carbon monoxide is almost completely converted into magnesium oxide, sulphur dioxide, and free sulphur. Magnesium sulphate reduced with hydrogen sulphide above 700° C. yields magnesium oxide whilst calcium sulphate under similar conditions is converted into calcium sulphide. The products of the reduction of calcium sulphate and magnesium sulphate by carbon are dependent on the temperature and the ratio of carbon to sulphate; at lower temperatures and with excess of carbon, magnesium sulphate leaves a residue containing magnesium sulphide as well as oxide; in the case of calcium sulphate the residue is sulphide only. At higher temperatures and with less carbon the products are magnesium oxide, sulphur dioxide, and sulphur, and calcium oxide and sulphur dioxide respectively.—J. B. F.

Hypochlorous acid; Ionisation constant of ——. *Evidence for amphoteric ionisation.* W. A. Noyes and T. A. Wilson. J. Amer. Chem. Soc., 1922, **44**, 1630—1637.

The ionisation constant k_a, representing $HClO \rightleftarrows H^{\cdot}+ClO'$ is $6{\cdot}70\times10^{-10}$ at 25° C. whilst the constant,

k_b, is too small to affect the conductivity of 0·0001*N* nitric acid when hypochlorous acid is added to it. When a current of air is passed through a solution of hypochlorous acid chlorine monoxide and not the acid is lost. This indicates the presence of positive chlorine ions and confirms the amphoteric ionisation, *i.e.*, in addition to ionisation represented by the above equation, ionisation also occurs according to the equation $HClO \rightleftarrows Cl^{\cdot} + OH'$.—J. F. S.

Causticising in the presence of silicate. R. H. McKee and T. H. Chilton. Pulp and Paper Mag., 1922, **20**, 693—694.

Experiments are described showing that it is possible to obtain satisfactory causticisation of soda solutions containing silicate by allowing sufficient time (longer than with carbonate alone) for the completion of the reaction.—H. R. D.

Potassium hydroxide; Application of Scheele's reaction to preparation of ——. W. Dominik. Przemysl Chem., 1922, **6**, 25—36. Chem. Zentr., 1922, **93**, III., 237.

The reaction,

$$2KCl+4PbO+H_2O \rightleftarrows PbCl_2+3PbO+2KOH$$

was studied, using mixtures containing not more than 20 g. of lead oxide per 100 c.c. of potassium chloride solution, filtering when the reaction was complete, adding a further quantity of lead oxide to the filtered liquid, and repeating these operations until equilibrium was attained. It was found that to obtain 1 g. of caustic potash about 16 g. of lead oxide is necessary. At the ordinary temperature the equilibrium between caustic potash and potassium chloride may be expressed by the equation:—

$$K = \frac{KOH}{KCl} = \frac{1}{0{\cdot}422 + 0{\cdot}074[OH]} - 1,$$

and the maximum concentration attainable is 112 g. KOH per litre. Regeneration of lead oxide by treatment of the lead chloride formed with milk of lime or calcium bicarbonate is not practicable, but may be accomplished by treatment with ammonium carbonate in presence of excess of carbon dioxide, whereby ammonium chloride and lead carbonate are formed, and the latter can be converted into lead oxide by treatment with steam at 300° C. With this method of regeneration the process as a whole becomes technically sound. —H. R. D.

Chlorates; Rôle of chromate in the electrolytic preparation of ——. A. W. Pamfilow. Ber. Polytech. Iwanowo-Wosniessensk, 1921, **4**, 113. Chem. Zentr., 1922, **93**, III., 327.

The addition of chromate in the electrolytic preparation of chlorate not only prevents the decomposition of hypochlorite and corrosion of the electrode, but also produces the required adjustment of acidity. If the solution is simply made acid or alkaline in the absence of chromate there is no variation in the concentration of the hydrogen and hydroxyl ions. To produce merely a protective film a trace of chromate would suffice, whereas in practice larger quantities are used. The phosphates have similar properties but are less suitable, since only sodium dihydrogen phosphate has an acid reaction and copper electrodes cannot be used. —J. B. F.

Ammonia; Presence of acetone in commercial ——. J. Bougault and R. Gros. J. Pharm. Chim., 1922, **26**, 170—171.

Examination of samples of ammonia from different sources indicates the presence of acetone in quantities varying from 0·01 to 0·5 g. per litre. This may be a source of serious error in analytical work, especially in the use of ammonia for physiological tests.—H. J. E.

Lime; Fundamental physical and chemical properties of commercial ——. I. The available lime content. M. L. Holmes and G. J. Fink. Chem. and Met. Eng., 1922, **27**, 347—349.

The loss on ignition and available lime, calculated on a non-volatile basis, of a large number of American samples are tabulated. By available lime is understood the total CaO, which is easily soluble in water, and it is determined as follows: 1·4 g. of the material, ground to pass 100-mesh, is boiled for 3 min. with 200 c.c. of water, and the solution is titrated with *N*/1 hydrochloric acid and phenolphthalein until the pink colour disappears for 1—2 seconds. The experiment is repeated in a 1 litre graduated flask using a quantity of acid (A c.c.) 5 c.c. less than before. Any lumps that form are ground up, and the solution is diluted to 1 litre with recently boiled distilled water. 200 c.c. is pipetted off and titrated with *N*/2 hydrochloric acid until the solution remains colourless with phenolphthalein for 1 min. If B c.c. be used in the second titration then the percentage of available lime is 2A+5B.—A. R. P.

Copper hydroxide; Solubility of —— in caustic soda solution. G. S. Melbye. Medd. Kgl. Vetenskapsakad. Nobelinst., 1921, **4**, [8], 1—11. Chem. Zentr., 1922, **93**, III., 480.

Copper sulphate solution is run into caustic soda solution until the solution becomes turbid. The precipitate is filtered off through glass wool, the filtrate diluted with water, and the copper estimated iodometrically with thiosulphate. The solubility of the copper hydroxide varies with the conditions and method of experiment, *e.g.*, the results vary with the size of the drops of the copper sulphate solution. The solubility is a linear function of the concentration between 2·65 and 6·6*N* caustic soda, and is expressed by the equation: $[Cu(OH)_2] = 0{\cdot}045[NaOH] - 0{\cdot}095$.—J. B. F.

Manganese dioxide; Some properties of ——. A. de Hemptinne. Bull. Acad. roy. Belg., Classe des Sci., 1922, **8**, 71—75. Chem. Zentr., 1922, **93**, III., 478—479.

Manganese dioxide is reduced by hydrogen or a mixture of hydrogen and hydrogen sulphide at ordinary temperatures, and at atmospheric pressure. After 5 days a rapid and progressive reduction in pressure due to absorption of hydrogen was perceptible (phosphoric anhydride was used to absorb the water formed), and after 53 days about one-third of the hydrogen had been used up. The reduced product was rapidly re-oxidised on exposure to the air. When manganese dioxide was exposed, similarly, to a mixture containing 33% of hydrogen sulphide and 67% of hydrogen a considerable diminution in volume took place in 3 mins., the manganese dioxide being converted into a sulphur compound, from which hydrogen sulphide was evolved on treatment with sulphuric acid.—J. B. F.

Sulphur dioxide; Oxidising and reducing properties of ——. I. Mercury chlorides. L. M. Stewart and W. Wardlaw. Trans. Chem. Soc., 1922, **121**, 1481—1489.

The type of reaction which occurs when sulphur dioxide reacts at 95° C. with mercurous chloride in the presence of hydrochloric acid depends on the concentration of the acid. With high concentrations of acid (8—2*N*) sulphur dioxide acts as an oxidising agent, sulphur being precipitated and mercuric chloride formed. At acid concentrations between 2*N* and 0·16*N* decomposition to mercuric chloride and mercury occurs to an extent decreasing with decrease in acid concentration. An inert period, extending over the range of acid concentration 0·16*N* to 0·07*N*, during which calomel is unaffected, is followed, below a concentration of

0·07*N*, by reduction of the chloride to mercury, increasing with decreasing acid concentration. With a definite concentration of acid the amount of reduction of mercuric chloride to the mercurous state by sulphur dioxide at 95° C. is dependent on the initial concentration of the mercuric chloride. Quantitative reduction occurs when sulphur dioxide reacts for 12 hours at 95° C. with 2·6 g. of mercuric chloride in 120 c.c. of water. Above this concentration of mercuric chloride the reduction is incomplete. For complete reduction of either chloride a very low acid concentration is necessary. Incomplete reduction occurs if the concentration of acid exceeds 0·02*N*. The small degree of ionisation of mercuric chloride in aqueous solution, and the fact that it forms complexes with hydrochloric acid, have an important bearing on the above reaction.—P. V. M.

Oxides of lead; Physical chemistry of ——. IV. Red lead and lead sesquioxide. S. Glasstone. Trans. Chem. Soc., 1922, **121**, 1456—1469.

Red lead and hydrated lead sesquioxide are plumbous salts, giving plumbous ions in solution. The hypochlorite and plumbite-plumbate methods for the preparation of lead sesquioxide are uncertain; in no case was an anhydrous sesquioxide obtained. Fairly pure hydrated lead sesquioxide can be obtained by a method based on the solubility of this oxide in alkali. A 12% solution of sodium hydroxide (250 c.c.) saturated with lead monoxide is diluted to 500 c.c., and an equal quantity of saturated bromine water added. The mixture, after standing overnight, and washing free from hypobromite and alkali by decantation with water plus a little acetic acid, is added, as an aqueous paste, to 60 g. of sodium hydroxide in 300 c.c. of water at 50° C. The cold filtrate from this mixture is treated, with continuous stirring, with 40 g. of acetic acid in 150 c.c. of water, and the precipitate washed and filtered with the aid of the pump. The ratio of lead dioxide to monoxide in the product is determined by analysis at this stage, and the solution in alkali and precipitation with acid repeated if necessary. The various methods of preparation of the sesquioxide are in harmony with the view that in a solution of the sesquioxide in alkali there is equilibrium between plumbate, plumbite, and hydroxyl ions. At ordinary temperatures the normal plumbate-plumbite potential is 0·30 volt. Consideration of the $Pb^{\cdot\cdot}$-ion concentrations produced by dissolving lead monoxide, sesquioxide, and dioxide respectively in *N*/1 caustic soda indicate that in the presence of lead dioxide and monoxide there will be a tendency for lead monoxide and sesquioxide respectively to dissolve in alkali to form red lead. In agreement with this lead sesquioxide was converted completely into red lead when left in contact with a solution of lead monoxide in alkali for six weeks.—P. V. M.

Oxides of lead; Physical chemistry of ——. V. Electromotive behaviour of lead dioxide. S. Glasstone. Trans. Chem. Soc., 1922, **121**, 1469—1480.

The system lead—lead dioxide—alkali is unstable; lead and lead dioxide combine directly in the presence of alkali to form red lead. The value of the $Pt/(PbO,PbO_2)N/1NaOH$ electrode potential is of the order of 0·27 volt. The high initial potential value of electrolytically deposited lead dioxide (from acid lead nitrate solution) is probably due to the presence of traces of a higher metastable acid oxide, possibly PbO_3, not capable of detection by analysis. The decomposition of this oxide is accelerated by rise of temperature and by plumbite solutions. The existence of hydrated lead dioxide is doubtful. The normal plumbic-plumbous potential has been redetermined, and a maximum value of 1·75 volts at 25° C. is indicated.—P. V. M.

Water vapour; Catalytic formation of —— from hydrogen and oxygen in the presence of copper and copper oxide. R. N. Pease and H. S. Taylor. J. Amer. Chem. Soc., 1922, **44**, 1637—1647. (*Cf.* J., 1922, 98 A.)

The combination of hydrogen and oxygen is practically complete at 200° C. when mixtures containing up to 5% of oxygen are passed over copper, prepared by reducing copper oxide in hydrogen at 150°—200° C., but is only just measurable at 100° C. In nearly all cases copper oxide is produced simultaneously with water. If the oxygen is shut off and pure hydrogen passed over the catalyst, the oxide so produced is reduced at a greater rate than that of the formation of water whilst the oxygen is passing. Between 130° C. and 100° C. the rate of oxidation of the copper and the rate of the reduction of the oxide so formed, as well as the catalytic activity, suffer a marked reduction. At 130° C. with a supply of oxygen equivalent to 10 mg. of water in 5 mins., the rate of formation of water passes through a maximum to a steady minimum value. (*Cf.* J.C.S., Oct.)—J. F. S.

Hydrogen peroxide; Colorimetric determination of ——. M. L. Isaacs. J. Amer. Chem. Soc., 1922, **44**, 1662—1663.

Hydrogen peroxide may be estimated colorimetrically as follows: 1 c.c. of a 10% solution of ammonium molybdate is slowly added to a mixture of about 30 c.c. of water, 10 c.c. of a 5% solution of citric acid, and 1 c.c. of the hydrogen peroxide, water is added to make the volume 50 c.c. and the whole well shaken. A yellow colour develops immediately and the solution is then compared with a standard potassium chromate solution (0·4 g. per litre) in a Dubosq colorimeter. When the standard is set at 20 the amount of hydrogen peroxide is given by $x=0{\cdot}05467/y$, where y is the colorimeter reading and x the number of grams of peroxide in the 50 c.c. of solution. The results obtained by this method compare favourably with those obtained by direct titration with potassium permanganate solution.—J. F. S.

Selenium oxychloride. V. Lenher. J. Amer. Chem. Soc., 1922, **44**, 1664—1667.

Selenium oxychloride is extremely hygroscopic and the greatest precautions are necessary to obtain the anhydrous material. The presence of small quantities of water increases the electrical conductivity enormously and its reactivity towards carbonates is largely dependent on the amount of water present. To test for the presence of water in selenium oxychloride cobalt carbonate which has been dried at 300° C. for 3 hrs. is sealed up with a sample of the oxychloride; in the absence of water no reaction occurs, but if the merest trace of water is present the oxychloride becomes blue and a pressure of carbon dioxide is set up. The dry carbonates of calcium, strontium, copper, nickel, and ferrous iron are without action on the oxychloride, whilst carbonates of barium, lithium, and magnesium evolve carbon dioxide slowly and that of zinc much more rapidly. Fused carbonates of sodium and potassium react readily with anhydrous selenium oxychloride evolving a large amount of heat. Sulphur dioxide has no action on the boiling anhydrous oxychloride, but in the presence of water selenium is precipitated. Dry hydrogen sulphide produces a red-brown colour, after which hydrogen chloride is evolved and yellow selenium sulphide is produced; heat is evolved and this dissociates the sulphide into sulphur and red selenium. Carbon monoxide has no action on the oxychloride. Chlorine is evolved by iodic acid, iodates, bromates, and persulphates. Tungsten, tantalum, and titanium are only slightly attacked after long periods at elevated temperatures. Phosphorus reacts violently at 0° C., producing selenium monochloride and tetrachloride and phosphorus pentoxide. Carbon tetrachloride dissolves selenium oxychloride but after a time phosgene is evolved and selenium tetrachloride formed.—J. F. S.

Selenium oxybromide. V. Lenher. J. Amer. Chem. Soc., 1922, **44**, 1668—1673.

SELENIUM oxybromide is best prepared by adding to pure resublimed selenium dioxide the calculated quantity of fused selenium in a flask fitted with a rubber stopper through which passes a dropping funnel and a safety tube filled with fused calcium bromide. The flask is cooled to 0° C. and the amount of bromine necessary to convert the metal into tetrabromide is cautiously added in small quantities. The mixture is then warmed until the whole of the oxide has dissolved. Selenium oxybromide is a reddish-yellow solid melting at 41·5°—41·7° C., boiling at 217° C. under 740 mm. with considerable decomposition. Owing to its decomposition on heating it cannot be purified by distillation even under reduced pressure. It has a density of 3·38 at 50°. Water converts it into selenious and hydrobromic acids. It dissolves in carbon bisulphide, chloroform, benzene, toluene, and xylene and the fused material is miscible in all proportions with these solvents. Carbon tetrachloride dissolves it readily but the fused material mixes only to the extent of 6%, and on heating for several days the solution evolves phosgene. It is an extremely active chemical reagent, behaving as a brominating and oxidising agent, and it is a powerful solvent. (*Cf.* J.C.S., Oct.)—J. F. S.

Pure gases. Heirich. *See* I.

Iron oxides for gas purification. Gemmell. *See* IIA.

PATENTS.

Sulphuric and hydrochloric acids; Process of manufacture of ——. R. Stollé. G.P. 353,742, 14.6.14.

SULPHURIC and hydrochloric acids are prepared by the interaction of chlorine and sulphur dioxide in the presence of water at an elevated temperature.
—J. S. G. T.

Hydrochloric acid; Electrolytic method of manufacturing ——. T. Blasweiler. G.P. 355,387, 28.11.20.

SOLUTIONS of alkali chloride are electrolysed in cells in the anode chamber of which lignite or peat is suspended.—H. R. D.

Sulphurous acid; Process of producing —— *by heating sulphates.* M. Trautz. G.P. 356,414, 23.12.19.

SULPHATE, briquetted or mixed with charcoal or iron, is heated in the absence of hydrogen, in a stream of gas such as carbon dioxide, nitrogen, etc. which is not acted upon by sulphur dioxide, until all sulphur is expelled. Alternatively, the sulphate is initially heated in a stream of gases containing sulphur vapour and gases not acted upon by sulphur dioxide (carbon dioxide, sulphur dioxide, nitrogen, etc.) and then distilled in a stream of gas containing neither sulphur dioxide nor sulphur vapour.
—J. S. G. T.

Alkali lyes coloured and contaminated with hemicellulose; Process for purifying ——. F. Küttner Kunstseidespinnerei, and E. Profeld. G.P. 355,836, 22.2.21.

THE lye is treated in the cold with an oxidising agent such as hydrogen peroxide or ozone in the presence of metallic catalysts such as copper and lead. The oxidation may be carried out in vessels made of the metals which catalyse the reaction. The cellulose compounds in solution are precipitated on the surface of the metal and the solution is bleached. The purification is the more complete the greater the area of the metallic surface.—H. C. R.

Sodium carbonate, caustic soda and sulphur; Production of ——. Rhenania Verein Chem. Fabr. A.-G., and F. Projahn. G.P. 356,287, 16.2.16.

BARIUM sulphate is reduced to barium sulphide and then treated with water. The baryta is separated from the resulting liquor, which is treated with carbon dioxide to form barium carbonate and sulphur, the barium carbonate being afterwards treated with sodium sulphate, to form sodium carbonate and barium sulphate. The baryta is treated with sodium sulphate to form barium sulphate and sodium hydroxide, or it may be used to causticise the sodium carbonate previously obtained. The barium sulphate formed is again reduced to barium sulphide and the process repeated.—A. B. S.

Anhydrous chlorides of alkaline-earth metals; Process of manufacturing ——. Minami Manshu Tetsudo Kabushiki Kaishi. E.P. 163,304, 10.5.21. Conv., 15.5.20.

AN alkaline-earth carbonate, oxide, oxychloride, or hydroxide is heated with ammonium chloride in presence of a halide of a base electropositive to the alkaline-earth metal. For example, a mixture of 5 pts. of sodium chloride and 5 pts. of potassium chloride is maintained in a melted state at about 800° C., and a mixture of 30 pts. of ammonium chloride and 10 pts. of magnesium oxide is gradually added. The product consists of anhydrous magnesium chloride mixed with chlorides of sodium and potassium, and free from oxide; it is suitable for the electrolytic preparation of magnesium. The by-product ammonia and chlorine generated by electrolysis of anhydrous magnesium chloride are utilised to make the ammonium chloride for the process.
—H. R. D.

Barium chloride; Process for manufacture of pure —— *from barium carbonate and magnesium chloride lye.* Chem. Fabr. Coswig-Anhalt, and W. von Dietrich. G.P. 355,299, 3.11.20.

A FLUID mixture of barium carbonate and magnesium chloride lye is caused to set by addition of a dehydrating substance, *e.g.*, calcined barium chloride, and heated above the decomposition temperature of magnesium chloride. A portion of the calcined product may be used as dehydrating agent in the first stage of the process.—H. R. D.

Hyposulphites [hydrosulphites]; Process for the manufacture of ——. Farbenfabr. vorm. F. Bayer und Co. E.P. 176,344, 20.2.22. Conv., 3.3.21.

HYDROSULPHITES of high concentration are obtained by treating a bisulphite solution with an amalgam, preferably of an alkali metal obtained electrolytically, and a free acid (hydrochloric, sulphuric, sulphurous), which is present in quantity equivalent to the non-mercurial metal of the amalgam. The bisulphite solution is well cooled and stirred, whilst adding the amalgam and acid. The mercury formed is returned to the electrolytic cell for use in the production of a further quantity of amalgam.
—H. R. D.

Soluble phosphates; Process of manufacturing ——. J. G. Williams. E.P. 184,206, 10.11.21.

A WATER-SOLUBLE sulphate, such as sodium, potassium, or ammonium sulphate, is caused to react with calcium phosphate in the presence of water and sulphur dioxide. When mineral calcium phosphate and ammonium sulphate are used the reaction gives calcium sulphate, diammonium hydrogen phosphate, and ammonium sulphite. (Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 26,097 of 1912.)—H. R. D.

Dibasic calcium phosphate; Process of reducing the amount of acid necessary in the manufacture of ——. Bayerische A.-G. für chem. u. landwirtschaftl.-chem. Fabrikate, and H. Hackl. G.P. 354,784, 20.8.20. Addn. to 352,782 (J., 1922, 723 A).

The interaction between monobasic calcium phosphate and finely ground bone meal in accordance with the previous patent is effected under the influence of heat and of the pressure set up by the carbon dioxide evolved.—J. S. G. T.

Potassium bicarbonate; Electrolytic production of —— *from potassium chloride solutions.* Chem. Fabr. Griesheim-Elektron, and R. Suchy. E.P. 184,244, 2.5.21.

A cathode solution containing, *e.g.*, 240 g. of potassium chloride and 140 g. of potassium bicarbonate per litre, is electrolysed until the potassium carbonate content reaches about 200 g. per litre. The liquor is transferred to a carbonating apparatus, about 20 g. of potassium chloride per litre added, and carbon dioxide introduced, until complete saturation results. The product is filtered off and the mother liquor, which has the same composition as the original cathode solution, is used again.—H. R. D.

Potassium and sodium carbonates; Preparation of a non-hygroscopic mixture of ——. A. Welter. G.P. 354,575, 21.4.21.

Sodium hydrogen carbonate and potassium hydroxide are allowed to interact in the solid state or in concentrated solution. A spray of concentrated caustic potash is blown into a reaction vessel containing finely powdered sodium hydrogen carbonate and the whole contents of the vessel are agitated with a current of air which removes excess moisture.—C. I.

Sodium silicate and the like; Furnace for producing ——. W. H. Stanton. U.S.P. 1,425,551, 15.8.22. Appl., 9.8.20.

The furnace is composed of a covered horizontal hearth, beneath which is a pair of gas regenerator chambers extending the full length. Beneath each of these chambers is an air regenerator chamber. A flue leading from the outer extremity of each regenerator space leads into the space between the superimposed hearth and roof at a point near an outer extremity of the hearth. Separate air or gas passages communicate with the inner end of each of the chambers for introducing the gas or air, and removing spent gases.—H. R. D.

Antimony trichloride; Preparation of aqueous solutions of ——. G. E. Williams, Assr. to Hooker Electrochemical Co. U.S.P. 1,425,565, 15.8.22. Appl., 10.8.20.

Metallic antimony is heated with chlorine in presence of hydrochloric acid sufficiently concentrated to prevent separation of oxychloride.
—H. R. D.

Purified gas mixtures; Process of preparing ——. J. C. Clancy, Assr. to The Nitrogen Corp. U.S.P. 1,425,577, 15.8.22. Appl., 8.5.20.

A mixture containing hydrogen, nitrogen, and carbon dioxide is passed in contact with ammonia free from contaminating impurities in order to prepare a mixture consisting essentially of hydrogen and nitrogen.—H. H.

Hydrogen and hydrogen-nitrogen mixtures; Process of generating ——. J. C. Clancy, Assr. to The Nitrogen Corp. U.S.P. 1,425,579, 15.8.22. Appl., 25.5.20.

A mixture of hydrocarbon vapour, steam, and air is passed into contact with iron-chromium surfaces at a high temperature.—H. H.

Zinc oxide; Method and means for producing ——. J. Thomson. U.S.P. (A) 1,425,917 and (B) 1,425,918, 15.8.22. Appl., 16.3. and 5.5.21.

(A) "Zinc gas," produced by re-distillation of metallic zinc in an electric furnace, is passed between impinging streams of "partially depotentiated" oxygen. (B) Crystalline zinc oxide is produced by oxidising superheated "zinc gas" by preheated air.—H. R. D.

Zinc oxide; Process of treating by-product ——. J. E. Booge, Assr. to E. I. du Pont de Nemours and Co. U.S.P. 1,426,349, 22.8.22. Appl., 21.10.20.

The process consists in calcining by-product zinc oxide so as to form a product containing water-soluble compounds, which are removed by washing with water.—G. F. M.

Bleach [hypochlorite] solutions; Preparation of liquid ——. J. H. MacMahon, Assr. to The Mathieson Alkali Works, Inc. U.S.P. 1,426,752, 22.8.22. Appl., 4.3.22.

Liquid chlorine is vaporised by indirect contact with alkaline solutions, the heat of vaporisation of the chlorine being utilised to cool the alkaline solution, into which the gaseous chlorine is introduced.
—H. R. D.

Lead arsenate; Method of manufacturing ——. A. O. Allen, Assr. to J. Lucas and Co., Inc. U.S.P. 1,427,049, 22.8.22. Appl., 29.6.21.

Lead arsenate is precipitated from a basic solution of lead salts, obtained by mixing 70% acetic acid, 40° B. nitric acid, and litharge in the proportions by weight of 10:1:39 respectively by means of arsenic acid containing 58—63% As_2O_5.—H. R. D.

Potassium nitrate and ammonium sulphate; Process of manufacture of ——. Chem. Werke Lothringen, and T. W. Pfirrmann. G.P. 353,432, 4.1.21.

Potassium nitrate and ammonium sulphate or ammonium sulphate-nitrate are obtained by the double decomposition of potassium sulphate and ammonium nitrate in an acid solution preferably acidified with nitric acid.—J. S. G. T.

Nitrogen compounds, e.g., cyanides, cyanamides, nitrides, etc.; Process of producing —— *from metals, or metallic oxides or carbonates, and carbon and nitrogen.* Chem. Fabr. Griesheim-Elektron. G.P. (A) 305,612 and (B) 305,613, 14.3.14.

(A) The gases evolved in the process of manufacture are burned with so much air that essentially a mixture of nitrogen and carbon dioxide is produced, from which carbon dioxide is recovered as usual. (B) The reaction is carried out at a lower temperature, and is accelerated by the use of briquetted or powdered lignite or peat in place of coke or coal (anthracite).—J. S. G. T.

Ammonium salts; Process of manufacturing —— *from ammonia produced catalytically.* Badische Anilin u. Soda-Fabrik. G.P. 352,978, 24.4.21.

Ammonium salts, more especially ammonium sulphate and ammonium chloride, are produced by treating a solution or suspension of an appropriate salt (sulphate or chloride) with ammonia and subsequently or simultaneously with the mixture of carbon dioxide and hydrogen resulting from the catalytic interaction of water-gas and steam, the mixture of gases being if necessary freed from hydrogen sulphide. Carbonate formation is carried to completion by employing the carbon dioxide residue recovered from the gas by water under pressure and subsequent release of pressure.—J. S. G. T.

Ammonium salts containing tarry matter; Process of purifying ——. L. Singer. G.P. 353,744, 25.7.16.

A solution of the ammonium salt is treated with air, then slightly supersaturated with ammonia and filtered through sand or fuller's earth etc. Any residual tarry matter contained in the filtrate may, if necessary, be removed by treatment with steam. —J. S. G. T.

Sal-ammoniac waste; Process of working up ——. Metallbank u. Metallurgische Ges. A.-G., and W. Schopper. G.P. 353,636, 8.7.20. Addn. to 352,505.

The process described in the previous patent (*cf.* E.P. 145,085 of 1920; J., 1921, 734 A) is applied to the working up of other residues containing chlorides of heavy metals, and more especially to tin residues containing chloride. The material is mixed with an amount of dry slaked lime equivalent to its chlorine content, worked up with water to a crumbly mass, which is then treated with steam.—J. S. G. T.

Ammonium sulphate; Saturator for producing ——. Berlin-Anhaltische Maschinenbau-Akt.-Ges. G.P. 353,370, 17.10.20.

One or more sieves are inserted cross-wise in the gas distributor and acid is supplied from above. This arrangement produces a salt of exceptionally low acidity.—A. B. S.

Ammonium chloride; Production of ——. Holzverkohlungs-Industrie A.-G. G.P. 354,078, 10.10.17.

Ammonia and hydrochloric acid, both in gaseous form, and the latter in slight excess, are passed through methyl alcohol or other liquid in which both the gases are soluble, but ammonium chloride is insoluble. Pure ammonium chloride is thus obtained direct without evaporation.—A. B. S.

Hydrocyanic acid; Process of increasing the stability of ——. Deutsche Gold- u. Silberscheideanstalt vorm. Roessler. G.P. 352,979, 5.4.19.

The stability of hydrocyanic acid is increased by the addition of a little oxalic acid.—J. S. G. T.

Extraction process; Continuous ——, particularly for separating potassium chloride from crude potassium salts. Fellner und Ziegler, and M. König. G.P. 355,979, 25.7.19.

The solvent liquor at a low temperature is brought into contact with the salts in an extractor consisting of two chambers one above the other and connected so as to allow the salt to be separated from the liquor. Between these chambers is a preheating and settling chamber for treating the solvent liquor after it has been run off the salt.—A. B. S.

Sodium bisulphate; Separation of —— in the solid state from solutions. Spinnstoff-fabrik Zehlendorf G.m.b.H., and K. Leuchs. G.P. 356,103, 3.2.20.

The solution is treated with concentrated sulphuric acid.—A. B. S.

Aluminium sulphate; Process for preparing —— from aluminium hydroxide. Vereinigte Aluminiumwerke A.-G., and W. Fulda. G.P. 354,328, 15.3.21.

Aluminium hydroxide is heated with ammonium sulphate and the ammonia evolved re-converted into sulphate by means of gypsum.—C. I.

Aluminium oxide; Process for production of —— from bauxite. Schweizerische Sodafabrik. G.P. 355,301, 25.6.21.

Bauxite is emulsified with soda lye, without the use of pressure, in a homogenising apparatus provided with at least one turbine wheel.—H. R. D.

Aluminium oxide: Manufacture of —— from materials containing alumina and silica. Metallbank und Metallurgische Ges A.-G. G.P. 355,302, 12.5.16.

Furnace slags, especially blast-furnace slag, rich in alumina, either alone, or mixed with other substances rich in alumina, are treated by a process whereby soluble sodium aluminate and insoluble calcium silicate are formed.—H. R. D.

Aluminium compounds; Process for separation of —— from other substances, especially iron compounds. Rhenania Ver. Chem. Fab. A.-G. Zweigniederlassung Mannheim. G.P. 355,303, 24.9.18.

A solution (not too dilute) of the substances under treatment is mixed with a sodium salt and an alkali fluoride, avoiding excess of the latter, and the double fluoride which separates is washed with water or very dilute acid till free from foreign matter.—H. R. D.

Silver halides; Process for preparing solid, colloidally soluble ——. J. D. Riedel A.-G. G.P. 354,450, 14.5.19. Addn. to 350,097 (J., 1922, 392 A).

A colloidally soluble silver halide preparation is obtained by addition of water to the colloid solution prepared as in the chief patent.—C. I.

Magnesium chloride lyes; Treatment of ——. W. Esch. G.P. 355,300, 22.1.20. Addn. to 332,153 (J., 1921, 302 A).

About eight-ninths of the magnesium is separated as basic carbonate by treating the lye with magnesium hydroxide and secondary ammonium carbonate or its components (ammonia and carbon dioxide) in corresponding proportions. The mother liquor instead of being treated with lime, as in the chief patent, is boiled with excess of magnesium oxide or hydroxide, the liberated ammonia being recovered and used again in the process. The residue, consisting of magnesium chloride, together with the excess of magnesium oxide or hydroxide, is then heated to a higher temperature to obtain hydrochloric acid, and the residue from this operation, which consists chiefly of magnesia, is used again in the process, after being leached, if necessary, to recover potassium salts.—H. R. D.

Minerals or oxides; Process for decomposing or dissolving refractory ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 355,738, 12.7.19.

Refractory minerals or oxides may be dissolved after treatment with a mixture of alkali oxide and hydroxide.—A. R. P.

Hydrogen peroxide; Process for producing ——. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler. G.P. 355,866, 1.9.16.

Concentrated sulphuric acid is allowed to flow into a suspension of alkali perborate in water, the quantities of acid and perborate being so adjusted that a solution of hydrogen peroxide is obtained, having a concentration preferably of 20%, but in any case more than 10%.—A. R. P.

Metallic salts; Production of —— from ores, slags, residues, etc. J. Leibu. G.P. 356,293, 13.4.20.

Metals or metallic oxides in the form of vapour, or waste gases containing them, with either oxidising or reducing gas as may be required, are brought into contact with acids and the resulting salts are recovered by customary methods.—A. B. S.

Mercury; Electrolytic oxidation of —— in sodium carbonate solution. Consortium für Elektrochem. Ind., G.m.b.H. G.P. 356,507, 3.5.18.

The sodium carbonate solution should not contain less than 0·02% or more than 0·08% of halogen salts, preferably sodium chloride. The process is particularly applicable to re-oxidising the metallic mercury produced in the preparation of acetaldehyde from acetylene, so as to obtain a fresh supply of mercuric oxide used in this process.—A. B. S.

Iodine; Process for recovering ——. O. V. Faber. E.P. 168,324, 23.8.21. Conv., 28.8.20.

Carbon or carbonaceous material containing absorbed iodine (*e.g.*, from mineral water) is heated in presence of a medium (*e.g.*, a current of air or carbon dioxide) which will carry away the iodine as evolved.—H. R. D.

Inert gases, e.g., nitrogen and argon; Process of producing —— free from oxygen and hydrogen. Patent-Treuhand Ges. für elektrische Glühlampen m.b.H. G.P. 353,743, 9.4.20.

The inert gas is freed from oxygen by heating with an excess of hydrogen, which is subsequently removed from the perfectly dried gas by liquefaction. The last traces of hydrogen are removed from the liquefied mixture of gases by boiling.—J. S. G. T.

Gas [nitrogen and oxygen] mixtures; Process for separating ——. R. and R. Mewes. G.P. 354,217, 12.3.19.

The vapours of low oxygen content passing away from the oxygen condensing column are forced by means of a jet, along with cooled and purified air, into the nitrogen column, passing through the liquid flowing from it.—C. I.

Sulphur; Process of obtaining —— in a finely powdered form. F. Meyer. G.P. 356,047, 24.6.21.

Sulphur vapour is passed over or through liquids such as alcohol, acetone, benzene, carbon bisulphide, trichloroethylene, or mixtures thereof, which have the property of abstracting the finely divided sulphur present in the vapour without causing it to agglomerate. On removal of the liquid the sulphur is obtained in a finely divided form.—A. R. P.

Sulphuric acid chambers; Construction of ——. R. E. Dior. U.S.P. 1,426,261, 15.8.22. Appl., 25.3.21.

See E.P. 164,572 of 1920; J., 1921, 582 A.

Oxides of nitrogen; Process for the production of —— from ammonia by catalytic oxidation. C. Bosch, Assr. to Badische Anilin u. Soda Fabrik. U.S.P. 1,426,952, 22.8.22. Appl., 9.7.20.

See E.P. 145,059 of 1920; J., 1921, 811 A.

Metal oxides; Process for obtaining volatilisable ——. F. D. S. Robertson. U.S.P. 1,426,602, 22.8.22. Appl., 16.12.18.

See E.P. 147,470 of 1920; J., 1922, 99 A.

Hydrogen; Production of ——. G. Claude, Assr. to L'Air Liquide Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. U.S.P. 1,426,462, 22.8.22. Appl., 31.5.18.

See E.P. 131,091 of 1918; J., 1918, 765 A.

See also pages (A) 736, *Absorption tower for hydrochloric acid* (G.P. 383,553); *Drying substances containing free alkali* (G.P. 352,343). 737, *Catalyst* (U.S.P. 1,425,576). 738, *Acid-resisting linings* (G.P. 355,874). 740, *Sulphur from gas scrubbers* (G.P. 355,867). 741, *Aluminium chloride* (U.S.P. 1,426,081). 771, *Oxide of iron* (E.P. 183,323).

VIII.—GLASS; CERAMICS.

Gilding glazed clay vessels. P. P. Budnikow. Ber. Polyt. Iwanowo-Wosniessensk, 1922, **6**, 211—220. Chem. Zentr., 1922, **93**, IV., 235.

The author has examined various methods of gilding glazed clay ware. A suitable gilding solution is produced by precipitating gold from solution in *aqua regia* by hydrous ferrous sulphate. The precipitate is ground with 8—10% of a flux consisting of 6 pts. of basic bismuth nitrate and 0·5 pt. of anhydrous borax, mixed with oxidised turpentine and lavender oil, and applied to the wares. A bright gold film is produced after baking at 650°—900° C. Paler hues are obtained if about 30% by weight of silver chloride is mixed with the gold. "Sulphur balsam" may likewise be employed for gilding. 100 g. of dry French turpentine is mixed with 20 g. of sulphur and 20 g. of Venetian turpentine and boiled gently on an oil bath. Acids must be distilled off at intervals, and it is best to carry out the distillation in a stream of carbon dioxide, employing a long glass tube as a reflux condenser. To 8—9 pts. of the balsam so prepared, a solution of gold chloride containing 1 pt. of gold, 4 pts. of concentrated hydrochloric acid, and 4 pts. of nitric acid, diluted with water, is added, and the mixture heated on an oil bath until the gold dissolves. Water is removed, and 7—8% of lavender oil and 12% of French turpentine added, and the mixture heated until completely mixed. The resulting mass is dissolved in carbon bisulphide and filtered. The carbon bisulphide is evaporated off, and 5—8% of basic bismuth nitrate added, and the resulting mass applied to the wares, which are then carefully baked at 450°—600° C. The reactions occurring have been investigated by studying the interaction of sulphur and pinene. $C_{10}H_{16}S$ or $C_{10}H_{16}S_2$ is probably formed by reaction between pinene and sulphur. With gold chloride, the compound $C_{10}H_{16}S,AuCl_3$ is probably formed, and by baking, this is probably decomposed into $C_{10}H_{16}Cl_2$, Au and SCl_2. Gold sulphide gives only a matt film, under the conditions of the experiments. "Sulphur balsam" may be prepared by the interaction, at room temperature, of sulphur monochloride and turpentine, the evolution of hydrogen sulphide and hydrogen chloride being prevented by cooling. Used in conjunction with gold chloride this gives even better films than the first-mentioned balsam.
—J. S. G. T.

Quartz; Heat of crystallisation of ——. R. C. Ray. Proc. Roy. Soc., 1922, **A 101**, 509—516.

The heat of crystallisation of quartz has been determined from the respective values of the heat of solution in hydrofluoric acid of silver sand and silica glass, which were found to be 30·29 and 37·24 kg.-cals. per g.-mol. of silicon dioxide respectively, the difference, 6·95 kg.-cals. per g.-mol., representing the heat of crystallisation of quartz. The value is considerably higher than the values obtained by Wietzel (2·32) and by Mulert (2·21), and the discrepancy is attributed to the effect of prolonged grinding in reducing part of the substance to the vitreous condition. The calculated value of the heat of crystallisation at 900° C. is 6·50 kg.-cals. per g.-mol. At the melting point, the value is very nearly the same as that at air temperature. (*Cf.* J.C.S., Oct.)—J. S. G. T.

Patents.

Alkali metal silicates [for glass-making]; Process of producing —— in blast furnaces. S. Peacock, Assr. to C. W. Waggoner. U.S.P. 1,425,048, 8.8.22. Appl., 18.12.20.

A mixture of carbon, silica, and a colourless non-oxidising alkali metal compound is smelted in a blast furnace and the slag is tapped and utilised for glass-making purposes.—A. R. P.

Muffle-flattening oven and leer. E. E. Milner and W. J. Lytle, Assrs. to H. L. Dixon Co. U.S.P. 1,426,309, 15.8.22. Appl., 12.8.21.

A flattening oven comprises a chamber containing a flattening stone, a number of heating flues in the top walls of the chamber, an off-take at one end of each of the flues, another off-take between the ends of the flues, and means for regulating the flow of gases in the off-takes.—A. B. S.

Annealing lehr; Plate-glass ——. E. E. Milner and W. J. Lytle, Assrs. to H. L. Dixon Co. U.S.P. 1,426,310, 15.8.22. Appl., 16.8.21.

An annealing lehr for plate-glass comprises several muffle heating chambers arranged zigzag, a number of heating flues in the top wall of each chamber, with off-takes in each flue, means for producing combustion in these flues, and connecting flues common to all the chambers and to all the off-takes.—A. B. S.

Lamp-bulbs and other glass ware; Melting together of glass parts of —— by means of soluble fluxes. L. S. Vello. G.P. 355,883, 4.5.19. Conv., 22.1.19.

A flux composed of phosphoric acid and lime has the advantage of being more readily fusible and more free from colour than the lead fluxes generally used, and of having a coefficient of expansion similar to that of the glasses used for the purposes named.—A. B. S.

Silica; Production of dense, acid-resisting articles from ——. O. Bühring. G.P. (A) 353,912, 31.5.19, (B) 353,913, 27.5.22.

(A) Silica sand is mixed with plaster and moulded; the resulting articles are saturated with a solution of water-glass, fired, and then soaked in sulphuric acid or other acid. They are again treated with water-glass and afterwards with acid and again fired, these processes being repeated as often as is desired. (B) The firing of articles made as described is continued until the mass is vitrified.—A. B. S.

Mica sheets; Process of manufacturing refractory —— from mica waste. P. Kertész. G.P. 349,849, 6.11.20.

Mica waste is finely ground and worked up with silicic acid, with just sufficient alkali and lime to enable the silica to set. The mixture is formed into sheets and heated until the silicate melts. Alternatively an alkali silicate may be employed as binding medium and silicic acid added until no free alkali is present. The product is suitable for insulating heated conductors, *e.g.*, resistance wires, or for fixing them to supports.—J. S. G. T.

China clay or like clays; Treatment of ——. T. Rigby. E.P. 183,535, 16.4.21.

China clay or like clay suspended in water, is concentrated by settlement or by mechanical means, such as a rotary filter, until it contains only about 50% of water. The product is dried in a continuous manner, by spreading it as a film on a surface heated by steam, in an evaporating plant of the type specified in E.P. 180,963, 181,035, or 149,055 (J., 1920, 682 A; 1922, 573 A, 574 A), or in any other suitable plant, using steam at low pressure as the drying agent. The use of various known types of excavators in association with the evaporating plant is claimed.—A. B. S.

Clay; Treatment of ——. W. Feldenheimer and W. W. Plowman. E.P. 184,271, 9.5.21.

Clay is purified by suspending it in water, adding a solution containing 1—3 lb. of metaphosphoric acid (or the equivalent amount of sodium metaphosphate, or a mixture of sodium carbonate and metaphosphoric acid) to each ton of clay, allowing the coarser particles to settle, running off the supernatant liquid, and flocculating the clay therein by the addition of a solution of alum. (*Cf.* E.P. 121,191; J., 1919, 41 A.)—A. B. S.

Kaolin; Process of producing ——. R. Froelich. G.P. 350,918, 22.10.20.

Native felspathic kaolin rock, free from iron, lime, magnesia, and mica, is decomposed into clay, quartz, felspar, and other products by drying, disintegration, mechanical working, and winnowing.—J. S. G. T.

Tunnel ovens or kilns for firing pottery, tiles, and the like. C. F. Bailey. E.P. 183,708, 23.7.21.

A tunnel oven may be built shorter than usual if its ends are at a lower level than the middle where the heating zone is situated. The trucks are moved by means of an endless chain fitted with arms which connect it to the cars. The chain and arms may run in an air-cooled groove.—A. B. S.

[*Tunnel*] *kiln.* R. T. Kyle. U.S.P. 1,426,655, 22.8.22. Appl., 10.3.21.

A tunnel kiln has a series of heat inlets at horizontally spaced points along one vertical side and a single heat outlet at the opposite side to the heat inlets and in the same horizontal plane, so that the heat is forced to travel diagonally across the tunnel and through the ware before passing to the outlet. —A. B. S.

Tunnel-kiln for baking ceramic articles etc.; Gas-fired ——. A. Dahl. G.P. 350,143, 10.7.20.

Air for combustion is preheated in separately controlled channels in the roof of the kiln, and flows from these into a longitudinal channel arranged in the combustion arch of the kiln, whence the stream branches on both sides of the kiln walls and passes to common channels, arranged below the kiln on either side and communicating with the channel for supplying gas to the combustion chamber. The nostrils of the latter channel are situated behind the combustion arch and are longer and narrower in the front part of the kiln used for the preliminary slow firing than in that part in which the goods are subjected to a full heat.—J. S. G. T.

Kiln; Method for heating a periodic —— by producer gas. F. and K. Meiser. G.P. 352,224, 17.4.21.

Air is drawn in by the action of the producer gas, which is introduced under pressure, and is heated in the first place either by the flue gases or by passing through channels heated by the furnace wall and secondly in channels surrounding the producer shaft. The suction action produced by the inflowing gas under pressure allows much more gas to burn in a narrow space, and a stable flame and high temperature are quickly attained.—J. B. F.

Sagger furnace; Annular —— in which the saggers can be manipulated from above. F. and K. Meiser. G.P. 354,948, 5.12.20.

A burner is arranged at one external end and the chimney at the other end of heating passages built between the saggers, so that the direction of flow of the hot gases is reversed in the furnace. The furnace can be emptied from below, and hoods are provided for collecting gases and vapours. The furnace is suitable for baking electrodes, clay ware, etc.—J. S. G. T.

Enamel coating to metallic surfaces; Method of producing and applying ——. H. M Smith, Assr. to Stanley Insulating Co. U.S.P. 1,425,612, 15.8.22. Appl., 30.9.18.

The enamel mixture is distributed over the surface and an air blast applied during the fusion process. —D. F. T.

Ceramic products; Process of manufacturing porous ——. Soc. Anon. le Carbone. G.P. 351,790, 29.2.20.

A powdered mixture of clay, gypsum, and wood charcoal is mixed with water to a paste which is then moulded as desired and baked. Alternatively, a mixture of clay, grog, and calcium carbonate (powdered chalk or marble) is baked.—J. S. G. T.

Porcelain and the like; Firing ——. Siemens-Schuckertwerke G.m.b.H. G.P. 353,857, 27.5.22.

In a gas-fired kiln, the flames are made to resemble those from coal by the addition of other combustible matter. Very smoky flames are produced by means of turpentine, resin, etc. which are burned in a special furnace and then introduced into the gas flames, or the smoke-producing material may be introduced directly into the gas flames.—A. B. S.

Fluxes in ceramic masses; Process for thoroughly distributing ——. L. Wessel Akt.-Ges. für Porzellan u. Steingutfabr. G.P. 354,941, 17.6.22.

The flux is added to the ceramic mass in the form of a solution of a soluble salt and, after being thoroughly mixed, is precipitated by the addition of a suitable reagent.—A. B. S.

Carbon and articles containing carbon; Process for coating —— *with enamel, quartz, or glass.* N. Meurer. G.P. 355,467, 23.8.21.

The articles are first given a thin coating of copper, nickel, iron, silver, or the like by the spraying process and then a coating of enamel is applied by any suitable process. By this means any desired portion of a carbon article may be electrically insulated. —A. R. P.

Graphite; Manufacture of shaped pieces of pure ——. E. Trutzer. G.P. 355,484, 23.11.20.

Finely powdered graphite is intimately mixed with a colloidal solution of graphite, the mixture is moulded into the desired shape, and the dispersion medium removed by spontaneous evaporation, by heat, or by high pressure, or by a combination of these methods.—H. R. D.

IX.—BUILDING MATERIALS.

Concrete; Flexural strength of plain ——. D. A. Abrams. Amer. Conc. Inst., 1922, 18. Lewis Inst. Structural Materials Research Laboratory, Bull. 11.

Tests of the flexural strength (modulus of rupture) of 750 plain concrete beams (38 in. by 10 in. by 8 in.) were made by applying loads at the ⅓ points of a 36 in. span, a wide range of mixtures, consistencies, size and grading of aggregate and curing conditions being employed. It was found that there is no uniform relation between the modulus of rupture and the compressive strength, though for the usual concrete mixtures the modulus of rupture is about 22% of the compressive strength. An increase either in the proportion of cement or in the size of the aggregate increased both the flexural and compressive strengths of the concrete. An increase in the proportion of water reduced both the flexural and compressive strengths. The advantage of curing in a damp state was fully shown by the tests. Both the flexural and the compressive strengths after curing in a damp state were proportional to the logarithm of the age of the concrete. No serious discrepancy between the flexural and compressive strengths was caused by using pebbles, crushed slag, or crushed limestone as aggregate, but granite gave slightly lower values possibly because of its low absorption. There is a definite relation between the water-ratio (*i.e.*, volume of water to volume of cement in the batch) and the flexural strength, just as there is between the water-ratio and the compressive strength, but the curve representing the former is of an entirely different form from that representing the latter; with an increase in the water-ratio the compressive strength drops rapidly at first and then more slowly, whilst the flexural strength drops slowly at first and then rapidly. In most of the tests a variation in any one constituent or condition had a much smaller effect on the flexural than on the compressive strength, but on the whole the relations between the two strengths are consistent.—A. B. S.

Plaster; Setting and velocity of solution of ——. P. P. Budnikow and J. K. Syrkin. Ber. Polyt. Iwanowo-Wosniessensk, 1922, 6, 235—248. Chem. Zentr., 1922, 93, III., 476—477.

The velocity of solution of plaster prepared by calcining gypsum at various temperatures was determined by electrical conductivity measurements. Plaster prepared by calcining at 115°—125° C. dissolved rapidly at first and then more slowly; after 24 hrs. the solution was feebly supersaturated relative to $CaSO_4,2H_2O$. The results were similar for plaster prepared at temperatures up to 400° C. The solubility-temperature curve is regular. Plaster prepared at 500° C. and higher (up to 800° C.) forms no supersaturated solution; the amount passing rapidly into solution is very small. Within this range lies the formation of so-called dead-burnt plaster. Dead-burnt plaster even when produced at 800° C., contains a proportion of soluble anhydrite which passes into solution but is mechanically prevented from setting by the insoluble anhydrite, which prevents coalescence of the soluble crystalline modification. The addition of easily crystallisable substances, such as alum, accelerates the setting. The setting of the soluble component is invariably followed by a slow conversion of the insoluble anhydrite into the soluble modification. This also takes place, though slowly, even after prolonged calcining at 800° C.—J. B. F.

Patents.

Wood; Process of treating ——. H. F. Ammon. E.P. 165,784, 9.6.21. Conv., 1.7.20.

Wood, especially for the manufacture of pencils, is rendered more durable and easier to work, by being submitted to the action of air heated to 420°—480° C. until it has acquired a uniform brown colour without appreciable decomposition.—D. F. T.

Wood-preserving agent. Grubenholzimprägnierung G.m.b.H. G.P. 356,132, 14.12.21.

The agent contains soluble fluorine and arsenic compounds. For instance, arsenious oxide and sodium fluoride are dissolved in water, the solution is diluted and employed in the usual manner for impregnating wood, with or without the addition of other antiseptic salts, or salts reducing the combustibility of wood. The protective effect against fungi of arsenic and fluorine compounds used in conjunction is greater than the additive effects of the constituents.—H. C. R.

Cements; Production of aluminate ——. W. Mathesius. G.P. 307,169, 28.2.18.

Suitable mixtures of bauxite or bauxite residues and lime are heated to fusion under reducing conditions so as to separate the metallic iron produced, or they may be fused under oxidising conditions. The resulting slags should have one of the following percentage compositions:—(1) Al_2O_3 20, SiO_2 13, CaO 67%; (2) Al_2O_3 20, SiO_2 24, CaO 56%; (3) Al_2O_3 76, CaO 24%; (4) Al_2O_3 42, CaO 58%.—A. B. S.

Building material; Process of manufacturing ——. A. Savelsberg. G.P. 350,363, 23.5.20.

Combustible refuse and inferior fuels in general, are calcined together with binding media, *e.g.*, limestone, dolomite, gypsum, etc., in a converter supplied with a blast. The combustible materials serve to reduce the plasticity of the mass and supply the heat necessary for the calcining process. —J. S. G. T.

Building materials; Treatment of —— *made of unfired loam, water-glass, and sulphite waste.* Silonit Baugesellschaft m.b.H. G.P. 351,677, 16.7.20.

The exposed faces of blocks of artificial stone are coated with a mixture of magnesia and aluminium "fluate" so as to render them waterproof. —A. B. S.

Cement and concrete materials; Process of manufacturing ——. O. Roucka. G.P. 352,175, 18.6.21.

The raw materials are heated in a closed vessel in which the temperature rises at the rate of 1°—1·5° C. per minute until a temperature of 60°—80° C. is attained. Thereupon, by heating the vessel from beneath and simultaneously regulating the admission of steam, the pressure in the vessel is raised to about 8 atmospheres, to which the materials are subjected for about 8—10 hours. The crushing strength of cement manufactured in this way exceeds 600 kg. per sq. cm.—J. S. G. T.

[*Hydraulic*] *powder; Production of a rapidly hardening* —— *from cement and alkali carbonate.* B. Hövermann. G.P. 353,617, 7.4.21.

A mixture of 100 pts. of cement, 2—4·5 pts. of alkali carbonate, and 1—1·5 pts. of aluminium sulphate yields a product which is impermeable to water under either low or high pressure.—A. B. S.

Weather-proof stone; Production of ——. B. Riedel. G.P. 353,618, 17.11.20.

A dry mixture of granite, serpentine, and cement is sprayed with a solution of caustic soda; the product is thoroughly mixed and made into blocks of the desired shapes. The resulting stones are very durable and impermeable.—A. B. S.

Building materials; Production of unfired ——. Dr. Plönnis und Co. G.P. 354,069, 20.10.19. Addn. to G.P. 342,403 (J., 1922, 103 A).

Loam or clay and waste sulphite liquor are mixed with porous materials such as peat, turf, sea-wrack, leaves, pine needles, or fibrous material.—A. B. S.

Refractory concrete; Process for the manufacture of ——. C. Loeser. G.P. 355,372, 16.9.16.

The refractory consists of a mixture of cement and particles of grog coated with corundum or similar material.—A. R. P.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Cast iron and its chemical composition. O. Smalley. Brit. Foundrymen's Assoc., 1922. Engineering, 1922, 114, 277—281.

The remelting of chilled cast iron yields close-grained tough castings, and by the addition of 10—15% of mild steel, the grain may be refined still further. Dirty castings and blowholes cannot be attributed directly to the presence of oxygen, as even the cheapest grade of metal, whether melted with or without steel, will give a clean casting if correctly melted and poured at the proper temperature. The effect of deoxidisers, *e.g.*, cerium, uranium, calcium, vanadium, aluminium, magnesium, manganese, and zirconium, was tried on a working scale, and no benefit was obtained by using up to 0·2% of the alloying element, a quantity which should be sufficient to counteract the effect of incorrectly melted iron. Generally the degree of superheat in iron melted in cupolas may be taken as corresponding to 10% above the melting point of the particular mixture used, but other considerations of casting practice suggest that this should not be an arbitrary figure. Solidity of the casting should be controlled by the aid of the chemical composition, casting temperature, and the rate of solidification, as it is a direct function of the quantity and form of the graphite separated. The limitations of cast iron for use in internal combustion engine parts, or other plant working at high temperatures, are shown by experiments in which the tensile strength fell at 200°—500° F. (94°—260° C.), rose to a maximum between 800° and 900° F. (427°—482° C.), and then rapidly fell to less than 2·5 tons per sq. in. at 1530° F. (832° C.).—C. A. K.

Cast-iron; Occurrence of ferrite-graphite eutectic in certain kinds of ——. E. Schüz. Stahl u. Eisen, 1922, 42, 1135—1136.

A cast iron of the following composition: graphite 3·22%, combined carbon 0·38%, Si 3·31%, Mn 0·88%, P 0·89%, and S 0·104%, showed a large amount of graphite-ferrite eutectic surrounding well-defined ferrite polygons and pearlite crystals, while free graphite flakes were evenly distributed throughout the mass. The iron had a Brinell hardness number of 150 and good mechanical properties, and could be readily machined. The structure was probably produced in the following manner: on cooling from 1240° to 1152° C. mixed crystals are precipitated which become slowly enriched in carbon, viz., from 0·8 to 1·3%. At 1152° C. the ferrite-graphite eutectic with 4·5% C freezes out, while at the same time in the regions of pure pearlite the mass cools according to the metastable Fe—Fe_3C system in which between 1240° and 1145° C. mixed crystals with 0·8—1·7% C separate, followed by freezing of ledeburite at 1145° C. Eventually the latter decomposes between 1145° and 1090° C. into free graphite and pearlite.—A. R. P.

[*Steel.*] *Diminution of lag at Ar*1 *through deformation.* J. H. Whiteley. Iron and Steel Inst., Sept., 1922. [Advance proof.] 5 pages.

Pieces of mild steel plate which had been allowed to cool in the centre of a solidifying slag ball were heated to 900° C., allowed to cool to 695° C. in 10 mins., and after 15 mins. at this temperature, hammered to produce a comparatively small deformation, then quenched in water. Micro-examination showed that the pearlite transformation was nearly complete, while this transformation was found to take place very slowly in undisturbed specimens. In strips similarly heat treated but bent through 60° with light hammer blows pearlite was present at the bends, but where the metal had not been distorted the structure consisted of ferrite and martensite only. A similar but less pronounced effect was found at 700° C. Strips were also heated to 900° C., cooled a little below Ac3, and then bent, but the separation of free ferrite from solid solution was not accelerated.—T. H. Bu.

Iron and steel; Crystal structure of ——. A. Westgren and G. Phragmén. Z. physik. Chem., 1922, 102, 1—25.

Röntgen photographs of iron wire at 800°, 1100°, and 1425° C., show that iron within the so-called β- and δ-regions has a space-centred cubic lattice similar to that of α-iron, whilst iron in the γ-iron region has a face-centred cubic lattice. The transition which occurs at 900° C. (A3) is therefore reversed at 1400° C. (A4). The γ-iron lattice of austenitic steel is extended by the dissolved carbon. A steel containing 1·98% of carbon possesses a larger iron lattice when it is quenched at 1100° C. than when quenched at 1000° C., also the α-iron lattice in martensite appears to be somewhat extended by the carbon. The homogeneous lattice region within the α-iron range in martensite is extremely small. A steel containing 0·80% of carbon quenched at 760° C. is practically amorphous. Röntgen photographs of cementite and spiegeleisen are identical. Cementite crystals belong to the rhombic system and have an axial ratio 0·670:0·755:1. The elementary parallelepiped has dimensions 4·53, 5·11 and 6·77 AU and contains 4 molecules of Fe_3C, consequently the specific gravity of cementite is 7·62.—J. F. S.

Steel; Rapid determination of the elongation and resistance to shock of ——, by bending of a notched bar. L. Jannin. Bull. Soc. d'Encour., 1922, **124**, 646—656.

The test piece is in the form of a bar 10 mm. square and 50—60 mm. in length, in the middle of which a semicircular notch is cut having a radius of 5 mm. so that 5 mm. of metal is left. One end of the bar is fixed and the other is hammered by hand in the direction tending to open the notch. Bending of the bar is stopped at the first indication of a crack in the bottom of the notch. The angle of bending is a function of the elongation as determined by ordinary methods, as is also the width (l) of the metal at the bottom of the notch, considered in relation to the original length (L) of the notch (10 mm.). The value $(L-l)/L$ multiplied by a factor to give L=100, is in close agreement with that obtained by the standard method. The resistance of steel is nearly proportional to the Brinell hardness, and the author proposes to multiply the value for the Brinell hardness by the supplement of the angle of bending in the notched bar test, divide the result by 1000 and term the number obtained the "coefficient of shock" (*coefficient de choc*) which would indicate the resilience of the steel. The coefficient is of course an abstract number from its origin.—C. A. K.

Carbon steels; Effect of longitudinal stress on the electrical resistance of ——. S. Fukuta. Sci. Rep. Tohoku Imp. Univ., 1922, **11**, 131—137.

The increase in the resistance of carbon steel is almost proportional to the applied stress. With increase in the carbon content of the steel the magnitude of this effect diminishes. Thus, with iron the rate of increase in resistance is less than with steel.—W. E. G.

Boiler plate [steel]; Effect of rate of loading on tensile properties of ——. H. J. French. Chem. and Met. Eng., 1922, **27**, 309—310.

The tensile strength, elongation, and reduction in area of steel, such as is used in railway fireboxes, are independent of the rate of loading at temperatures up to and including the blue-heat range (295° C.), above which the tensile strength alone appears to increase slowly with the rate of loading while the other properties remain constant. By increasing the load extremely slowly the tensile strength is increased and the ductility decreased at 156° C., while the reverse holds good for temperatures above 295° C. Only very slight differences could be discerned in the fracture of specimens broken under different rates of loading.—A. R. P.

Steels; Flow of —— at a low red heat, and scaling of heated steels. J. H. S. Dickenson. Iron and Steel Inst., Sept., 1922. [Advance copy.] 38 pp.

The author carried out on a number of steels, including carbon, nickel-chromium, high nickel, high chromium, and high-speed steels, and on the nickel-chromium alloy (Vikro), prolonged tensile tests at constant load and temperature, commencing at approximately 525° C. and increasing by increments of 50° C., also tests at constant load and slow uniform rate of heating. As a general deduction, the temperature at which a given load can be supported is higher, the shorter the duration of loading. The reduction of area increases as the test pieces are more rapidly broken and is sometimes accompanied by increased elongation. If the temperature be plotted against the logarithm of the duration of loading for the various steels almost straight lines are obtained, and this suggests that the samples behaved in accordance with the law governing the change of viscosity with temperature. The lines for nickel-chromium alloy and nickel chromium steel are inclined to those of the other steels. The first-mentioned (Vikro) is much superior at high temperatures (950° C.) but at lower temperatures (500° C.) only shows equal endurance to high speed steel. The maximum temperatures up to which the metals will support a load of 8·5 tons applied rapidly or for a short period, and the corresponding temperatures when the metals are expected to endure for considerable periods without sensible deformation, are: 0·3% carbon steel, 775°, 500°; nickel-chromium steel, 805°, 450°; high chromium steel, 800°, 520°; high-speed steel, 955°, 575°; nickel-chromium alloy (Vikro), 965°, 600° C. Scaling tests were made on a similar series of steels up to 1125° C., the specimens being exposed for 18 periods of 5¼ hrs. each and being scraped after each exposure. With a scaling rate fixed at 0·005 g. per sq. in. per hr., carbon steel and nickel-chromium steel could be used only up to 620° C., high-speed steel up to 710° C., 14% chromium steel up to 840° C., and nickel-chromium alloy up to 1070° C. Plotting the temperature against the logarithm of the scaling rate gave approximately straight lines. Micro-examination was made of the specimens heated at 900° C. for 24 hrs. and then heavily copper plated to hold the scale in position before sectioning. In the case of 25% nickel steel the strongly adherent lower layer of scale characteristic of steels containing nickel (Stead, J., 1916, 1018) was particularly well defined, and this explains the stepped scaling curve of this steel. The scale on the high chromium steel was barely visible; that on the nickel-chromium alloy unrecognisable.—T. H. Bu.

Carbon steels; Preliminary magnetic study of some heat treated ——. E. D. Campbell and E. R. Johnson. Iron and Steel Inst., Sept., 1922. [Advance proof.] 22 pp.

A uniform method of magnetisation was obtained by supporting a steel bar, 15 cm. long, vertically in the axial centre of a magnetising coil consisting of 1004 turns of wire wound over a length of 25 cm. The force with which a disc of annealed electrolytic iron was attracted by one pole of the magnetised bar was measured by means of a special balance. Four straight carbon steels were used for experiments involving heat treatment, the constitution of the steel being expressed in the form of concentration of alloying elements in mg.-atoms per c.c., thus correlating the atomic relations between solute and solvent in the steels with that of solutes and solvents in ordinary solutions. The different physical properties associated with magnetic properties are tabulated. Specific resistance increased rapidly with the carbide concentration; the permanent north field increased to a maximum with increase in the carbon content of the steel, but then decreased in the case of two hypereutectoid steels. The current required to demagnetise the bars indicated that the force field of carbon ions resulting from ionic dissociation of dissolved carbides will produce not only electrical but also magnetic resistance. The attractive force of the induced fields

with electrolytic iron increased much more rapidly than the inducing current, approaching more nearly a linear function of the square of the current; in the case of the hypereutectoid hardened steel the increase is more nearly a linear function of the current. The authors formulate a hypothesis for the mechanism of permanent magnetism in steel.
—C. A. K.

Iron and steel; Nitrogenisation of —— by sodium nitrate. L. E. Benson. Iron and Steel Inst., Sept., 1922. [Advance proof.] 6 pp.

Evidence of the formation of nitride in iron and steel was observed repeatedly when the metals were annealed in a salt bath (sodium nitrate 85, potassium chloride 15%) at 500° C. Steels of different composition were annealed in a bath of sodium nitrate and the rate of penetration of nitrogen was determined. The penetration into Armco iron was 0·15 mm. in 1 hr., 0·30 in 5 hrs., 0·70 in 20 hrs., and 2·0 mm. in 80 hrs. The rate of penetration into steel in general was slower than in pure iron, and was retarded considerably by the presence of carbon (pearlite). Manganese appeared to exert even more influence in this direction than carbon. A nitrogenised specimen or Armco iron showed no sign of nitride structure after heating in a muffle at 700° C. for 90 mins., and the nitrogen content was found to be only 0·0025%, which confirms the instability of iron nitride as observed by Tschischewski (J., 1915, 1012).—C. A. K.

High-speed steel; Manufacture and treatment of ——. H. K. Ogilvie. Iron and Steel Inst., Sept., 1922. [Advance proof.] 11 pp.

Although equally good steel can be made in the crucible and in the electric furnace, the cost per ton of sound billets is less in the electric furnace. In the crucible method, if small particles of tungsten compounds are not completely melted, hard spots form which may destroy fine toothed cutters; it is preferable to introduce the tungsten as ferrotungsten or tungsten-chromium alloy, rather than as tungsten powder. In this country it is not commercially possible to make good high-speed steel from turnings alone, but heavy clean scrap is used. The length of each heat should be shortened as much as possible, not exceeding 4½ hrs. for a 3- or 4-ton furnace. Electrode coolers should fit closely and attention must be paid to the furnace bottom and banks after each heat. The author recommends that no aluminium or other deoxidising substances be added in the ladle or moulds. When heating the metal to the temperature necessary for tapping, the steel, especially in smaller furnaces, occasionally becomes "wild," and it is useless to attempt to deoxidise with additions of ferrosilicon etc. The author's method is to cool the steel without any addition until samples taken at regular intervals show the metal to be sound. The ingots should be top poured in octagon moulds, the ingots being of less than 8" diameter and 10 cwt. weight. They are transferred to the reheating furnace when cooled to 200°—300° C. Surface cracks and flaws should be removed from the billets by grinding. In correctly forged cutters the steel should be structureless. If towards the centre the structure becomes coarser, fracture is liable to take place. Heavy duty cutters should be made of the 18% tungsten type of steel, hardened at 1300° C., and tempered at 590°—610° C., as this tempering treatment increases the toughness 100—150% over that produced by tempering at 220° C. The length of time the steel remains at the hardening temperature is most important; a bar just raised to 1300° C. gave the best load and deflection in a bending test. In hardening screw dies with fine teeth very little scale is sufficient to clog the teeth; a gas-fired carborundum tube furnace with a slightly reducing atmosphere was found to give no scaling whatever.—T. H. Bu.

[Nickel chromium] steel; Change in volume of [air hardening] —— during heat treatment. L. Aitchison and G. R. Woodvine. Iron and Steel Inst., Sept., 1922. [Advance proof.] 16 pp.

Specimens of steel containing 4·64% Ni and 1·53% Cr, rolled to round bars, were heated in a dilatometer similar to that used by Andrew (*cf.* J., 1920, 452 A) and the change in volume noted. Following a gradual expansion, a marked contraction took place at 685°—745° C., the steel expanding again at higher temperatures. The steel contracted in a normal way during cooling from 850° to 285° C., but expanded in the interval 285°—150° C., contracting again whilst cooling to atmospheric temperature. The final volume showed, however, a definite increase over the initial volume, and a steel treated in this way formed the basis of subsequent experiments and was termed "semi-standard" steel. Repeated heating and cooling of the semi-standard steel showed that generally the first heating caused an expansion of the metal, followed by contractions in the later heatings, and 5—6 heatings at 200°—500° C. were necessary to secure a stable volume which was greater at 200°—300° C. than when the metal was heated to 400°—500° C. only once. Continuous heating at 200° C. or 100° C. for 6 days resulted in a contraction equal to that produced by repeated heatings at the higher temperatures.
—C. A. K.

Chromium steels and their recent applications. L. Guillet. Rev. Mét., 1922, 19, 499—504.

The heating curve of stainless steel containing 13% Cr shows two transformation points at 710° C. and at 780° C.; on cooling these transformations take place at 680° C. and 320° C. The material may be made sufficiently soft for working either by heating to 900° C. and cooling very slowly, or by annealing for a long time at 750° C. followed by either slow or rapid cooling. The best temperature for forging steel containing 13% Cr and 0·35% C is between 1000° and 1250° C. and preferably as near the upper limit as possible. The maximum tensile strength and elastic limit are obtained by quenching in oil from 900° C. Annealing at temperatures above 400° C. rapidly reduces the figures obtained for these properties and only slowly increases the elongation, but the higher the annealing temperature, especially if above 600° C., the greater the resistance to shock. 13% Cr steel retains its hardness up to about 500° C., except for a slight softening at 300° C., and offers the greatest resistance to corrosion after quenching in oil from 950°—1050° C., after which it has a hardness of 500—600.—A. R. P.

Steel plates containing zirconium and other elements; Manufacture and properties of ——. G. K. Burgess and R. W. Woodward. U.S. Bureau of Standards, Tech. Paper No. 207, 1922. 49 pp.

The authors have prepared and studied 193 heats of steel containing as principal variable elements, carbon, silicon, nickel, aluminium, titanium, zirconium, cerium, and tungsten. None of the steels presented any difficulty in rolling, except those containing boron, which forms a complex eutectic fusible at the ordinary rolling temperature. A type of steel recommended for structural work and having a tensile strength of about 300,000 lb. per sq. in., contains 0·4—0·5 C, 1—1·50% Si, 3—3·25% Ni, and 0·6—0·8 Mn. The metal should be deoxidised with a simple deoxidiser such as aluminium, but the addition of more costly alloying elements does not lead to any material advantage. Zirconium, like titanium and aluminium, acts as a scavenger and any excess remains in the metal in the form of square bright yellow inclusions which may be detrimental to the steel if segregation occurs. Most of the other alloying elements go into solution and produce a martensitic structure in the air-cooled specimens, a larger quantity of copper than of the other elements being required to produce the effect. Besides showing the martensitic structure when air-cooled, steels containing cerium and uranium exhibit characteristic inclusions.—C. A. K.

Corrosion of iron and steel. R. Hadfield. Proc. Roy. Soc., 1922, A **101**, 472—486.

Tests have been carried out to ascertain the effect of a small percentage of copper upon the resistance of steel to corrosion. It is shown that a small copper content, from 0·16 to 0·25%, is beneficial both in the case of bare metal and of metal coated with rolling scale exposed to atmospheric corrosion, especially in a sulphurous atmosphere. Steel with the scale removed is more resistant than steel with the scale on. When exposed to the action of sea-water, ordinary steel corrodes the more rapidly initially. Subsequently the rate of corrosion of both varieties of steel diminishes, indicating a certain degree of self-protective action which is rather more pronounced for the ordinary variety. At the end of 16 weeks, the total corrosion of copper steel containing 0·268% Cu was still less than that of ordinary steel. The comparative behaviour of the material with scale on and with scale removed resembled that found in the case of atmospheric corrosion There was little to choose between the two varieties in the matter of resistance to corrosion by tap-water. The specimens were tested with their rolling scale removed, and it was found that tap-water, though initially less corrosive than sea water, is more corrosive over a long period. Both varieties were initially rapidly attacked by 50% sulphuric acid solution, but after 3 weeks' exposure the copper steel was only very slowly corroded, while the rate of corrosion of the ordinary variety remained unaltered. Tests with 20% sulphuric acid solution confirmed the superiority of the copper steel. The results are in agreement with the conclusions of Buck (J., 1921, 262 A) and of Bauer (J., 1921, 393 A) as to the superior resistance to atmospheric corrosion of mild steel containing a small percentage of copper, the superiority amounting to about 10% in pure air and to about 25% in an industrial atmosphere. No superiority is shown by copper-steel when immersed in tap water, and it is possible that the initial superiority shown by this variety when exposed to sea water may be annulled and even reversed on long exposure.—J. S. G. T.

Brass and bronze; Development and manufacture of high tensile ——. O. Smalley. Inst. Brit. Foundrymen, 1922. Engineering, 1922, **114**, 187—189, 218—221.

The modifications of the mechanical and physical properties of a pure brass by the addition of other alloying elements has been studied in detail. The examination of brass containing 1·0—5·8% Al showed that the presence of 1% Al is equivalent to about 5·6% Zn in its effect on the general physical properties, so that a brass containing 70% Cu, 26·5% Zn, and 3·5% Al possesses the principal features of ordinary Muntz metal. Small proportions of aluminium increase remarkably the yield-point and strength of both 70/30 and 59/41 brass, with a corresponding loss in ductility. More than 3·5% Al causes the ductility of a 70% copper brass alloy to fall rapidly, and in the 59/41 series 1·35% Al appears to be the limiting amount of aluminium for rapid increase of strength, though the maximum strength is not reached until 3·0% Al had been added. All β-aluminium brasses, regardless of the chemical composition, suffer from heat fragility over a long interval, which extends from 315° to 455° C. for the Cu-Zn series, and from 226° to 558° C. for β-brasses of the Cu-Zn-Al series. β-Brasses of maximum tenacity are brittle alloys and slight overheating renders them unsafe in use owing to the abnormally rapid crystal growth at temperatures above 700° C. Manganese brass is prepared from cupro-manganese in preference to ferro-manganese, which is difficult to alloy completely. Considered as a zinc-replacing element 1% Mn is equivalent to 0·8% Zn. Manganese is of chief value as a deoxidiser and when added in excess of the amount required for deoxidation trouble is experienced and defective castings result from the tendency to oxidation. A better cohesion between adjacent grains is noticed, which suggests that manganese may be of value as a toughening agent. Tin improves the corrosion-resisting properties of brass; in complex brasses of high ductility 0·7% is the maximum amount which should be used. The quantity of tin which brass will take into solution was found to be determined by the zinc content, *i.e.*, in the α-series an 80/20 brass dissolves 5% and a 70/30 brass less than 1% Sn. The addition of 0·5% Sn increases the yield-point and maximum strength of cast brass 2·25 and 1·3 tons respectively without affecting the other mechanical properties. Further addition of tin hardens the alloy without increasing the strength and the alloy finally becomes brittle. There is no difficulty in forging tin brasses, but 1% Sn is the limit of practical utility.—C. A. K.

Red-brass; Volumetric determination of tin and antimony in ——. F. J. Mück. Chem.-Zeit., 1922, **46**, 790.

Two grams of the alloy is dissolved in 20 c.c. of nitric acid, the solution evaporated to 5 c.c., 100 c.c. of boiling water added, the liquid boiled for 5 min. and the precipitate of antimonic and stannic acids filtered off, washed with hot 5% nitric acid and dissolved in 15 c.c. of strong sulphuric acid and 10 c.c. of strong nitric acid. 2—3 g. of potassium sulphate and 0·5 g. of tartaric acid are added and the solution is evaporated to syrupy consistency. After cooling, 180 c.c. of water and 7 c.c. of hydrochloric acid are added and the solution is boiled for 5 mins., cooled, and titrated with permanganate for antimony. Another 30 c.c. of water and 60 c.c. of hydrochloric acid are added and the tin is reduced by boiling with 2—3 g. of antimony and titrated with iodine as usual.
—A. R. P.

Brass; Dezincification of —— [*by solution*]. R. B. Abrams. Trans. Amer. Electrochem. Soc., 1922. [Advance copy.] 12 pages.

The dezincification of brass takes place in two stages; in the first the brass as a whole is dissolved, in the second the copper in solution is re-deposited with solution of an equivalent amount of brass. The second stage does not take place unless there is a means of holding the copper solution in contact with the brass, such as the presence of a membrane or of a large excess of dissolved copper. Under natural conditions of weathering the membrane may be supplied by a layer of insoluble zinc or copper salt or by contact of the metal with a cover of wood or metal. Without this protection the soluble copper salt is washed away and the brass dissolves as a whole; with it the metal gradually turns into a mass of solid copper which is generally deposited in two layers.—A. R. P.

Aluminium-silicon alloys; "Modification" of ——. J. J. Curran. Chem. and Met. Eng., 1922, **27**, 360—361.

Aluminium-silicon alloys are "modified" by melting them under a layer of an alkali fluoride which according to Guillet simply fluxes off oxide inclusions and gives a more satisfactory structure. The author finds that a "normal" aluminium-silicon alloy shows a "modified" structure after melting with a little sodium, part of which remains in the final alloy, and suggests, therefore, that in the use of alkali fluorides part of the alkali metal is reduced by the silicon (which volatilises as fluoride) and its presence in the final alloy is the real cause of the "modified" structure.—A. R. P.

Tin alloys containing iron; Analysis of ——. N. Welwart. Chem.-Zeit., 1922, 46, 777.

A discussion of Meyer's paper (J., 1922, 256 A) pointing out a number of precautions that must be taken to ensure accurate results and suggesting certain minor modifications that shorten the time required for an analysis.—A. R. P.

Nickel, monel metal, stellite, stainless steel and aluminium; Thermal expansion of ——. W. H. Souder and P. Hidnert. U.S. Bureau Standards, Sci. Paper 426, 1922, 497—519.

The average coefficient of thermal expansion between 0° and 600° C. of commercial nickel was found to be 14·9—15·7×10^{-6}, of monel metal 15·9—16·7×10^{-6}, of stellite 13·6—17·1×10^{-6}, of stainless steel 11·2—12·1×10^{-6}, of aluminium 29·3—29·5×10^{-6}. The expansion curve of nickel is, with the exception of a small break at 350° C., quite regular, while that of stellite shows irregularities between 300° and 500° C. The curve of monel metal is regular up to 600° C., as is that of stainless steel up to the critical region (825°—850° C.). The aluminium curve may be expressed by the empirical equation: $L_t = L_0\,[1+(21{\cdot}90t+0{\cdot}012t^2)10^{-6}]$.—A. R. P

Uranium; Glacial acetic acid method for determining —— *in carnotite.* W. W. Scott. J. Ind. Eng. Chem., 1922, 14, 531—532.

About 0·5 g. of the ore is boiled with 40 c.c. of dilute nitric acid (1:1) until decomposed completely, the solution evaporated to dryness, the residue baked for a few mins., and then boiled for 5 mins. with 25 c.c. of a mixture of glacial acetic acid and nitric acid (100:5). The solution is filtered, the insoluble portion washed with the acid mixture, the filtrate, which contains all the uranium, is evaporated to dryness, the residue heated over a burner until it turns black, and the extraction with the acid mixture repeated. The filtrate thus obtained is evaporated, the residue heated, dissolved in 10 c.c. of nitric acid and 40 c.c. of water, the solution partly neutralised with ammonia, and solid ammonium carbonate added until the uranium carbonate first precipitated is re-dissolved. After the addition of a further 3 g. of ammonium carbonate and 5 c.c. of ammonia the solution is filtered, the residue washed with hot water, the filtrate acidified with nitric acid and boiled to expel carbon dioxide. Excess of ammonia is then added and the solution boiled until all the uranium is precipitated, as is shown by the yellow-coloured solution becoming colourless. The precipitate is collected, washed with a small quantity of 2% ammonium nitrate solution, ignited and weighed as U_3O_8.—W. P. S.

Metals; Beilby's theory of the amorphous state of ——. C. Benedicks. Rev. Mét., 1922, 19, 505—513.

The author reviews critically the facts on which Beilby's theory of the amorphous state of metals is based. Several of the results obtained by Beilby may be satisfactorily explained without assuming the presence of a thin, mobile, transparent, amorphous film of metal. Thus, the surfaces of polished specimens of antimony and copper often show spots of considerably less reflecting power than, or of a different colour to, the rest of the metal, which Beilby assumes to be due to cavities covered with a thin film of amorphous metal, whereas the author has found that these effects are produced by inclusions of antimony trioxide or cuprous oxide. With regard to the increase of hardness of the polished surface it has been shown by Osmond that this is probably due to particles of the polishing medium becoming embedded in the metal. While it is fair to assume that, if the amorphous phase exists on the surface of a metal, it can also exist in the interior, the assumption that its presence there, after subjecting the metal to a hammer-hardening process, is the cause of the increased hardness observed does not accord with past experience. The following theory is advanced to explain the increase of hardness of metals on hammering: After deformation, an originally plane surface may exhibit a "parallel translation," in which each particle slides over the next in a manner similar to a pile of books that has been pushed sideways, or it may undergo a "proportional translation," in which the lamellæ have a macled aspect, *i.e.*, they do not really slide but a rotation of the crystal element takes place. In the former case, the amount of deformation possible is unlimited, the lamellæ simply sliding over one another, and there is no increase in hardness. In the second case, however, the amount of deformation possible is strictly limited by the characteristic angle of the macles and each deformation the metal undergoes increases the resistance to further deformation, *i.e.*, increases the hardness by making the lamellæ grow into each other, an operation that becomes more difficult to perform the further it is carried out.
—A. R. P.

Hardness of metals; An accurate method of determining the —— *with particular reference to those of a high degree of hardness.* R. L. Smith and G. E. Sandland. Proc. Inst. Mech. Eng., 1922, 1, 623—641.

By a suitable modification of the Brinell formula it is possible to obtain truly relative hardness figures from which may be calculated the load required to give a constant impression. The modified hardness numeral suggested is calculated from the expression: Brinell hardness number at 1000 kg. ×$(0{\cdot}9+0{\cdot}4/d^2)$, where d is the diameter of the impression in mm. The figure arrived at is not strictly accurate where the hardness exceeds 525 Brinell, owing to the deformation of the ball, and the authors have calibrated natural pyramidal diamonds to replace the steel ball and so obtain substantially correct values for hardness for the higher ranges. The diamonds have to be calibrated individually owing to the difficulty in grinding true hemispherical surfaces. The load applied with the diamond test is light and the impression shallow, and the test is very sensitive therefore to the surface hardness of the material. A more accurate estimate of the maximum stress is possible with the modified hardness numbers, as they lie on a straight line which passes through the origin, and only one conversion factor (0·23) is required over the range 30—90 tons for plain carbon steels.—C. A. K.

Brinell machine attachment for use with small specimens. E. D. Campbell. Iron and Steel Inst., Sep., 1922. [Advance proof.] 8 pp.

The large regular balance corresponding to a pressure of 500 kg. on the ball of a Brinell machine was replaced by a light balance constructed of brass tubing, using also separate holders for balls of 5 and 2 mm. diam. The light balance was adjusted so that the impression produced when viewed through a 16-mm. objective would appear of the same size as an impression made with a 10-mm. ball under a 3000 kg. load viewed through the standard 48-mm. objective. The final weight of the balance was adjusted by experimental comparative calibration.

The instrument was adapted to the use of softer metals by calibrating similarly a 5-mm. ball and observing the impression through a 32-mm. objective. Certain precautions are necessary in the determination of hardness by means of small impressions. The metal must be polished almost to the same degree as for metallographic work and a film of oil applied to lessen friction during the test. The application of the load should be gradual and the full load should be maintained at least 1¼ min.
—C. A. K.

Metals; Tearing tests on ——. H. L. Heathcote and C. G. Whinfrey. Chem. and Met. Eng., 1922, **27**, 310—311.

Structural metals which have been tested to withstand certain definite stresses may fail under apparently smaller stresses owing to the concentration of the stress overstraining the piece at the surface where the section changes, and thereby causing the metal to tear. The resistance to tearing of a metal may be found by cutting a thin sheet in two places and bending the tongue of metal thus formed at right angles to the sheet and the two wings, which should be of equal size, into alinement with the tongue in the opposite direction. The specimen is then gripped in a delicate testing machine by the tongue and wings and load is gradually applied until the metal tears as viewed by a "strong" glass. The average of 5—6 tests gives the pull required to tear the metal in two places and bend and unbend a width equal to that of the specimen. By carrying out tests on specimens of width x in. and y in., and assuming that P and p are the pulls required to tear, bend and unbend material which is t in. thick, then the actual tearing force F per linear inch is given by the equation: $F=(px-Py)/2t(x-y)$. The results obtained agree more closely with those given by the notched bar impact test than with those obtained in the ordinary tension test.—A. R. P.

Moulding sands [for iron foundries]; Factors influencing the grain and bond in ——. C. W. H. Holmes. Iron and Steel Inst., Sept., 1922. [Advance proof.] 22 pages.

In judging the value of sands for grey-iron founding, the mechanical and physical properties are of equal importance to the chemical analysis. The most successful moulding sands contain both mobile or hydrated bonding material capable of transference from grain to grain and static bonding material firmly attached to the surface of the grains. The bond absorption value obtained on raw sand is greatly modified by mechanical treatment. Appreciable degradation of the sand grains occurs during the usual mechanical preparation, and in view of the fact that the degradation may be excessive, the bond distribution factor is a very important characteristic of sands. No single test is sufficient to judge the practical value of moulding sands.—T. H. Bu.

Thermal conductivity. Jakob. *See* I.

Granulated nickel for electric heating. Dony-Hénault. *See* XI.

Isotopes of lead. Dillon and others. *See* XXIII.

Patents.

Iron and steel; Process for the direct manufacture of ——. L. P. Basset. E.P. 159,475, 24.2.21. Conv., 24.2.20.

Fuel in an extremely divided condition, *e.g.*, finely pulverised coal or hydrocarbon, and superheated air in suitable proportions to produce only carbon monoxide, are injected into the lower end of an inclined rotary furnace. The ore is mixed with a quantity of carbon insufficient to reduce the whole of it, and with basic fluxes, and the mixture is fed into the upper end of the furnace. The fraction of the ore escaping reduction serves, with the help of the basic slag, to prevent the reduction of the calcium phosphates, silicates, etc. in the ore and thus avoid phosphorisation of the metal.
—T. H. Bu.

Iron and steel; Process of desulphurising ——. H. Koppers. E.P. 162,618, 28.4.21. Conv., 28.4.20.

After treatment of the molten iron in the usual manner for the removal of phosphorus, manganese, silicon, and the like, the slag is removed and a highly basic slag put on, in which are immersed blocks of dense carbon of about the same sp. gr. as the slag, whereby calcium is liberated and combines with the sulphur in the iron. The dense carbon may consist of coke overheated in the carbonisation process, or of perforated or unperforated blocks of finely ground coke briquetted under high pressure with tar as a binder. The slag layer is revivified by passing a current of air through or over it.—T. H. Bu.

Silicon steel and other metals and alloys; Methods of refining ——. British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 183,217, 15.4.21.

The molten metal is subjected to a periodically varying magnetic field so as electromagnetically to expel occluded slag particles, which are caused to rise to the surface. The metal is then mechanically separated from the supernatant slag. Silicon steel refined in this way and with the sulphur not greater than 0·10% shows on the average a reduction of 12% in hysteresis losses.—T. H. Bu.

Iron and steel; Apparatus for the determination of the percentage of carbon in ——. C. J. G. Malmberg and J. G. Holström. E.P. 184,215, 11.3.21.

A specimen of iron or steel is subjected to repeated magnetisation and demagnetisation between two chosen values of the magnetising force. The difference between the two magnetic fluxes through the specimen is taken as an indication of the carbon content, and is measured by the induction in a wire wound round the specimen or on any part of the circuit of which the specimen forms a part.—C. A. K.

Steel alloy; Non-corrosive ——. W. Belleville. U.S.P. 1,424,612, 1.8.22. Appl., 16.6.21.

A steel alloy contains approximately Ni 15·5%, C less than 1%, Si 0·3%, Mn 0·5%, Cr, S, P each less than 0·1%.—C. A. K.

Alloy for forging steel and method of producing same from nickel ore. L. P. Burrows; L. B. Archer executrix. U.S.P. 1,424,710, 1.8.22. Appl., 20.1.20.

Crushed nickel ore is subjected to the action of reducing gas in a closed chamber until the oxygen content of the ore is removed. The refined ore is smelted, and the metallic product broken up and disintegrated by exposing it to the atmosphere. The disintegrated material is then subjected to a low red heat without oxidation until its weight is reduced about 20%.—T. H. Bu.

[Iron] alloy. W. H. Smith, Assr. to The Cleveland Brass Mfg. Co. U.S.P. 1,424,782, 8.8.22. Appl., 23.3.18.

The alloy contains 50—85% Fe, 1—10% Ni, 1—3% Si, and the remainder, chromium.—A. R. P.

Iron ores, iron and steel, and coke used in the metallurgy of iron; Process of desulphurising ——. W. I. Estabrooke and D. D. Jackson, Assrs. to J. T. Pratt, D. D. Jackson, and J. D. Sears. U.S.P. 1,426,054, 15.8.22. Appl., 13.7.20.

A halogen (chlorine) is introduced into the molten or heated material, whereby a volatile sulphur halide is formed.—C. A. K.

Electrolytic iron; [Bath for the] production of ——. M. Schlötter. G.P. 310,043, 13.12.17.

Alcohols, such as glycerol or glycol, are added to the ordinary bath for the deposition of electrolytic iron, which is then obtained so soft that it may be cut with a knife. For example, the bath may consist of a solution of 280 g. of ferrous chloride and 2 g. of hydrogen chloride in a litre of water to which 400 c.c. of pure glycerol has been added. —A. R. P.

Iron and steel; Process for covering —— with a rust-resisting coating. W. Schmidding. G.P. 310,756, 11.7.18.

The iron or steel articles are dipped in a solution containing phosphoric acid, zinc, and calcium, together with an oxidising substance which yields oxygen in the nascent state or which, in the presence of acids, yields hydrogen peroxide. The evolved oxygen prevents the formation of slime, shortens the time required and hastens the chemical reaction.—A. R. P.

Iron and iron ores; Removal of sulphur from ——. O. Baumann. G.P. 356,039, 13.3.19.

The ores are fused with barium sulphate, and the product is used in the ordinary smelting operations for removing sulphur. Barium has a greater affinity than calcium for sulphur, and so carries the sulphur into the slag.—A. B. S.

Shaft furnaces and the like. E. F. Chaudière. E.P. 161,971, 19.4.21. Addn. to 137,168 (J., 1920, 179 A).

A central core consisting of concentric iron columns protected by a refractory material is fitted vertically in a shaft furnace in line with the chimney. Suitable openings into the iron column allow a proportion of the air which has passed through the calcined material to be admitted direct to the chimney to assist the draught, or the heated gases above the combustion zone may be withdrawn for the purpose of recuperation of heat. The direction and volume of flow in the core is regulated by a reversible fan and by dampers.—C. A. K.

Furnaces; Open hearth ——. G. L. Danforth, jun. E.P. 183,247, 20.4.21.

The ports of an open-hearth furnace are arranged so that the air and gas from separate ports meet in a combustion chamber of diminishing sectional area towards the inlet to the furnace. In the furnace the cross-sectional area is gradually enlarged, thus allowing the gases to expand. The effect is that of a Venturi tube, and the minimum area of the port entering the furnace may be less than the combined areas of the gas and air ports opening into the combustion chamber.—C. A. K.

Crucible furnaces; Gas heated ——. T. Teisen. E.P. 183,394, 16.11.21.

In a crucible furnace of the type in which gas is admitted through a vertical burner passage, air is directed into this passage at right angles, either tangentially, or otherwise, so as to cause the air to swirl around the gas stream and so protect the lining from excessive heating.—C. A. K.

Furnace; Hearth smelting or heating ——. Façoneisen-Walzwerk L. Mannstaedt und Co. Akt.-Ges., and H. Bansen. E.P. 184,252, 4.5.21.

The furnace is heated by twin burners on either side of the furnace, and extending the full length of the furnace chamber. After passing partially across the furnace the gases travel longitudinally and pass out of the furnace through recuperators. Each pair of burners is provided with a regenerator, and at any one time one burner acts normally whilst the second is used as a flue for part of the furnace gases through the regenerator. The burners situated opposite to one another are directed in slightly different directions in the vertical plane. The combustion chamber may be constructed with circular cross-section so that the gas and air from the burners enter the combustion chamber tangentially.—C. A. K.

Cupola and blast furnaces; Process for improving the operation of ——. Vulkan-Werk Rheinshagen und Co. G.P. 354,469, 15.8.20.

Water, in a liquid form, is introduced into the furnace by the blast, whereby an economy is effected in the fuel consumption, the iron is improved in quality, and the lining of the furnace is protected.—A. R. P.

Tungsten wires; Manufacture of drawn ——. Patent-Treuhand-Ges. für Elektrische Glühlampen, m.b.H. E.P. 163,014, 6.5.21. Conv., 7.5.20.

Drawn tungsten wires are produced from pressed or sintered rods which contain in their cross-sections zones which differ from the main body and if necessary from one another in their chemical or physical properties, or in the composition, nature, or relative proportions of the constituents, all cross-sections throughout the length being in general alike. Thus filaments may be produced from tungsten with various sizes of grain, or from tungsten with various additions of thorium dioxide, or from tungsten containing molybdenum, uranium, thorium, tantalum, vanadium, chromium, carbon, phosphorus, etc. or mixtures thereof. Drawn tungsten wires of definite structure can be methodically produced from such material. —J. S. G. T.

Precious metals [e.g., gold]; Process for the metallurgical treatment of ores containing —— [and a volatile metal, e.g., antimony]. Blei- und Silberhütte Braubach A.-G. E.P. 167,741, 28.4.21. Conv., 12.8.20.

Ores containing gold or other precious metal, together with large amounts of volatile metals, such as antimony, arsenic, zinc, and lead, are smelted, in shaft furnaces of the type used in the production of pig-iron, with suitable additions to give a slag of a higher melting-point than the volatilisation-point of the one constituent (*e.g.*, antimony oxide), and a suitable concentration metal (*e.g.*, copper or pig-iron) in which to collect the precious metal. —A. R. P.

Gold; Recovering —— and apparatus therefor. O. C. Knipe. U.S.P. 1,426,746, 22.8.22. Appl., 31.10.21.

The interior of an open hollow drum is lined with a porous fabric coated with grease, which retains the particles of gold when a liquid containing gold in suspension is rotated rapidly within the drum. —C. A. K.

Noble metals; Recovery in a pure state of the ——, particularly gold and platinum, by chlorination. C. Bennejeant. G.P. 355,886, 14.1.21.

Alloys or ores of the noble metals are strongly heated with chlorine compounds so as to volatilise the chlorides of commoner metals whilst the chlorides of nobler metals remain in the residue. —A. B. S.

Precious and other metals; Joining together [welding or soldering] of ——. J. Maurer. E.P. 183,188, 18.3.21.

A SOLDERING paste for use in joining metals consists of a mixture of finely divided metals identical with the metals to be welded, the oxides of the same metals, a reducing agent, a flux, and a binding medium, the latter being preferably vaseline. Powdered carbon is a suitable reducing agent. —C. A. K.

Copper; Process for the autogenous [electric] welding of ——. H. Cauzler. G.P. 355,906, 7.10.20.

THE electrode consists of a copper rod containing gold, or gold and silver, together with phosphorus, manganese, silicon, or boron. The welds obtained have a high tensile strength, are readily machinable, and have a great resistance to attack by acids. —A. R. P.

Copper; Process for the extraction of —— from its ores. P. W. Nevill and H. Soanes. E.P. 172,926, 20.7.21. Conv., 13.12.20.

FINELY crushed copper ore, containing the bulk of the copper in an oxidised form, is treated with water and ferrous sulphate, either with or without the addition of sodium chloride, or with dilute sulphuric acid, and the resulting pulp is heated for a short time by means of steam while finely divided metallic iron is added to reduce all the copper compounds to a metallic sponge, which is then separated from the gangue by elutriation, flotation, or other means.—A. R. P.

Nickel ores; Process of treating —— and product resulting therefrom. L. P. Burrows: L. B. Archer executrix. U.S.P. 1,424,711, 1.8.22. Appl., 4.5.20.

STEAM is suddenly expanded, and without condensation, any water vapour held in suspension is separated. The resulting gaseous product is heated and crushed nickel ore is subjected to its action at red heat in a closed chamber for about 5 hours. —T. H. Bu.

Nickel or nickel-rich alloys; Process for the preparation of —— from low-grade nickel-iron alloys. M. Stern. G.P. 354,219, 23.3.18.

IRON-NICKEL alloys containing a low percentage of nickel are subjected in the form of turnings to oxidation, either by moistening them with a rust-producing substance, such as magnesium chloride solution, and heating the mass in the air, or by passing air or oxygen over the heated metal, so that the heat of oxidation of the iron raises the temperature to such an extent that the mass melts, the greater part of the iron being oxidised and slagged off while the nickel is recovered in nearly pure form or as a high-grade ferro-nickel alloy. —A. R. P.

Nickel; Process for the preparation of agglomerates of pure —— from crude nickel oxide. Soc. Anon. "Le Nickel." G.P. 355,887, 8.6.21. Conv., 21.4.21.

CRUDE nickel oxide is heated in a closed vessel with solid, liquid, or gaseous reducing agents to such a temperature and for such a time that it is reduced to metal except for a small quantity. The charge is powdered and washed with dilute hydrofluoric acid, then dried, and pressed into the desired shape. The shapes are heated in a closed vessel first alone, then with the successive addition of powdered carbon and lime.—A. R. P.

Zinc-smelting furnace; Vertical retort ——. A. Jones. U.S.P. 1,424,825, 8.8.22. Appl., 19.2.21.

THE furnace consists of a chamber containing a number of vertical retorts arranged in rows; a fixed condenser placed between each pair of rows communicates with each retort in these rows.—A. R. P.

Zinc and other volatile metals or metalloids; Process for the distillation of —— from ores. W. Troeller. G.P. 353,797, 10.10.13.

THE ore mass is mixed with a solid fuel and the mixture charged into a discontinuously working converter of the Huntington-Heberlein type, provided with either artificial external cooling appliances or extra thick walls. The furnace is fired with gaseous or liquid fuel or with coal dust, which is burnt in such a manner that the flame envelopes the ore mixture and the reducing gases permeate the porous mass and thus effect more complete reduction. The gases may also be burnt inside the ore mass after the manner of flameless combustion. From time to time the air supply is interrupted, so that the unburnt gases permeate the mass, thus effecting still more efficient reduction, while part of the metal is simultaneously recovered in liquid form.—A. R. P.

Zinc oxide and similar material containing lead; Process for removing lead from ——. H. Pape. G.P. 354,096, 16.1.17.

THE finely ground oxide is mixed with quicklime or slaked lime and water to a thick slime, which is stirred into a large bulk of water and the insoluble zinciferous material separated by filtration. The solution is treated with just sufficient of a compound of sulphuric, carbonic, or chromic acid to precipitate the lead, and the clear liquor is used instead of water for the first part of the process, while the precipitate is treated in the usual manner for the recovery of its lead content. Coarse material, such as roasted or sintered ore, is mixed with lime and water before grinding, and the mixture is then ground wet and treated as before. —A. R. P.

Zinc dust; Process of manufacturing ——. T. Kato. U.S.P. 1,425,661, 15.8.22. Appl., 26.11.19.

METALLIC zinc is volatilised in a retort from which air is excluded, and the zinc vapours are diluted with a non-oxidising gas and cooled quickly. —D. F. T.

Separating process. [Concentration of ores.] R. Ellis. U.S.P. (A) 1,425,185, (B) 1,425,186, and (C) 1,425,187, 8.8.22. Appl., (A) 15.4.18, (B) 2.4.19, (C) 20.8.15. (C) Renewed 25.4.21.

(A) The comminuted ore is mixed with water and an oily liquid, and then with a material which will give anions having a greater valency than two. The mixture is aerated and the froth separated. (B) After the addition of oil and before aeration a material capable of making the contact potential of the oil more negative is added. (C) A process for the concentration of mixed ores includes the use of a solution having a selective action for the oxidised portion of the ore and of a solution containing anions having a valency greater than two and cations having a valency greater than one. —C. A. K.

Flotation process. R. Luckenbach, Assr. to Luckenbach Processes, Inc. U.S.P. 1,425,327, 8.8.22. Appl., 9.2.20.

THE tar product from the distillation of "greasewood" is added to the pulp, which is then aerated, and the froth separated.—C. A. K.

Flotation process for dressing mineral mixtures. Maschinenbau-Anstalt Humboldt. G.P. 353,726, 17.8.20.

THE mixture before passing into the flotation vessel is treated with a mixture of vaporised or gaseous wetting media, such as oils, hydrocarbons, etc., and vaporised or gaseous media affecting the capacity for adsorption and suspension of the constituents of the mineral mixture. If desired the mineral mixture may be separately submitted to the action of the two kinds of media. The consumption of reagent for increasing the adsorption coefficient is in this manner reduced.—J. S. G. T.

Magnetic separator. W. E. F. Bradley. U.S.P. 1,425,235, 8.8.22. Appl., 21.9.18.

A STREAM of material to be treated is subjected to the action of a series of electro-magnets arranged in sequence with the pole faces directed downwards. The magnets are energised in groups of "relatively displaced cyclic current phases, the algebraic sum of the currents of a group alternating cyclically from a positive value to a negative value and back to positive."—C. A. K.

Alloy. S. Mayer and W. James, Assrs. to Magno Storage Battery Corp. U.S.P. 1,425,330, 8.8.22. Appl., 23.6.21.

AN alloy of Sn 50, Pb 25, Zn 17, and Sb 8%.
—C. A. K.

Ores; Method of reducing ——. E. C. King. U.S.P. 1,425,386, 8.8.22. Appl., 23.10.20.

A CARBONACEOUS material and an oxidising agent are introduced below the surface of a bath of molten metal produced from the ore, and further quantities of the ore are concurrently fed on to the surface of the bath.—A. R. P.

Zirconium alloy and process of making same. F. M. Becket, Assr. to Electro Metallurgical Co. U.S.P. 1,425,572, 15.8.22. Appl., 1.10.20.

A LOW-CARBON ferro-alloy consisting essentially of iron, silicon, and zirconium is made by smelting in the electric furnace a charge comprising silica, a zirconium ore, a carbonaceous reducing agent, and a source of iron. The charge is proportioned to yield an alloy containing silicon in at least as high proportion as the zirconium, thus preventing the formation of zirconium carbide in interfering quantities.—H. H.

Metals from ores; Process of extracting ——. S. McKirahan, Assr. to F. A. Fuller. U.S.P. 1,425,667, 15.8.22. Appl., 14.2.18.

FINELY comminuted, oxidised ore is mixed with sodium chloride and heated to a temperature above 1000° C. The metal in the ore sublimes as chloride.
—D. F. T.

Phosphor metals; Method of producing ——. S. L. Nicholson, Assr. to Westinghouse Electric and Manuf. Co. U.S.P. 1,425,679, 15.8.22. Appl., 29.11.20.

PHOSPHORUS vapour is brought into contact with a metal heated to a temperature below its melting point. The metal is melted subsequently and cast into ingots.—C. A. K.

Metals; Process of freeing —— from copper. M. O. Sem, Assr. to Det Norske Aktieselskab for Elektrokemisk Industri. U.S.P. 1,425,701, 15.8.22. Appl., 4.4.19.

METAL containing copper is melted and treated with a sulphide of the same metal, and the copper sulphide is separated from the purified metal.
—C. A. K.

Electroplating; Process and apparatus for ——. W. E. Belke. U.S.P. 1,426,141, 15.8.22. Appl., 15.3.22.

A BATH for carrying out electroplating operations is provided with an arrangement of pipes and valves at the bottom whereby the electrolyte may be withdrawn in part to a filtering apparatus situated above the tank, and means are provided to discharge the filtered liquid on to the surface of the bath.
—A. R. P.

Tin and lead; Electrolytic production of adherent deposits of ——. M. Schlötter. G.P. 299,791, 17.2.17.

THE articles to be plated are first coated in an alkaline bath, the chief part of the deposit being afterwards made in an acid bath. This double treatment avoids the drawbacks of either an acid or alkaline bath, when used alone.—A. B. S.

Tin; [Electrolytic] process of depositing —— free from pores. M. Schlötter. G.P. 299,794, 8.3.17.

TIN free from pores is deposited by the electrolysis of alkaline stannate solutions free from acid radicles and made up principally or entirely with caustic potash.—J. S. G. T.

Tin; Process for recovering —— [from concentrates]. H. H. Alexander, Assr. to American Smelting and Refining Co. U.S.P. 1,426,341, 22.8.22. Appl., 26.5.17. Renewed 17.11.21.

TIN concentrates are mixed with carbonaceous matter and the mixture is sintered until approximately 70% of the sulphur contained in the mixture has been removed. The resulting mass is broken up into suitable-sized lumps which are mixed with carbonaceous material and smelted in a blast furnace to obtain metallic tin.—A. R. P.

Smelting and electrolysing process. R. Rodrian, Assr. to Rodrian Electro-Metallurgical Co., Inc. U.S.P. 1,426,507, 22.8.22. Appl., 3.3.22.

A CHARGE of metalliferous material is melted above a bath of molten metal and an electric current is passed through the mass, the molten metal acting as cathode and a carbon rod as anode.—A. R. P.

Brass; Method of making ——. W. R. Webster. U.S.P. 1,426,623, 22.8.22. Appl., 31.3.20.

A CURVE is constructed showing the variation in the value of a physical characteristic of brass with differing proportions of zinc and copper. The composition of a mixture of scrap brass that is being melted is then determined by determining the value of the same characteristic on a test drawn from the furnace and reading the corresponding copper content on the curve. Sufficient copper or zinc may then be added to the furnace charge to bring the mixture to any desired composition.—A. R. P.

Metals [e.g. aluminium]; Recovery of —— from silicates. F. M. McClenahan. U.S.P. 1,426,890—1, 22.8.22. Appl., (A) 22.12.20, (B) 7.12.21.

(A) As a step in the recovery of metals from silicates the latter are decomposed by an excess of ammonium fluoride solution. (B) Aluminium hydroxide is recovered from a mixture of aluminium and ammonium fluorides by heating in the presence of water and removing the evolved vapours.
—A. R. P.

Metals and alloys; Process for briquetting turnings and scrap of ——. R. Walter. G.P. 352,684, 5.12.20. Addn. to 337,296 (J., 1921, 582 A).

IN the process described in the chief patent reducing substances are added to the scrap or briquettes when they contain metallic oxides, so that it is possible to employ oxidised scrap which could otherwise not be used.—A. J. H.

Ores; Process for the treatment of —— previous to blast sintering. Metallbank und Metallurgische Ges. A.-G. G.P. 353,867, 12.2.14. Addn. to 340,583 (J., 1922, 20 A).

The ore is treated with a fine spray of water in the form of a mist instead of with steam, so as to reduce the cost of the process.—A. R. P.

Magnesium and its alloys; Process for colouring ——. Chem. Fabr. Griesheim-Elektron. G.P. 354,281, 30.8.19.

The metal is treated with a solution of chromic acid containing salts of the heavy metals and small quantities of other acids. To obtain stable colours the articles, after removal from the pickling bath, are washed in boiling water and then heated in an air-bath to 100°—150° C. The shade of colour obtained depends on the nature of the heavy metal (copper, manganese, zinc, chromium, iron or cobalt) in the pickling bath. Black tones are obtained by using a larger amount of acid and no heavy metal salt. —A. R. P.

Metallic articles; Process for coating —— with a chemically inactive [acid-resisting] substance. W. Roth. G.P. 354,693, 1.11.21.

The articles are coated with molten silver bromide. A second layer may be provided if desired. The process is suitable for coating metallic articles which are to be used for electrochemical purposes in acid media.—A. R. P.

Antimony-lead alloys [; Process for the preparation of hard acid-resisting ——]. Soc. Thoumyre Fils. G.P. 354,978, 19.6.21.

Antimony is heated with a ferro-alloy, such as ferro-manganese, ferro-aluminium, ferro-nickel, ferro-vanadium, or ferro-tungsten in a finely divided form until the mass melts, whereupon the requisite quantity of molten lead is added. The resulting alloys are as hard as iron and very resistant to acids; they are suitable for the manufacture of cocks, pumps, vessels, and the like for acid liquids.—A. R. P.

Zirconium and similar metals, e.g., titanium, cerium, thorium, and the like; Process for treatment of materials containing ——. G. Siebert, Platin-Affinerie und Schmelze, and E. Korten. G.P. 355,485, 14.12.20.

The material is treated with halogens at a high temperature in presence of reducing agents, *e.g.*, carbon. A vertical electric furnace is used, having a funnel-shaped lower portion through which one of the electrodes is introduced. The walls of the furnace are protected by a stamped lining of the reaction mixture. At the beginning the reaction is effected under the influence of an arc struck between the electrodes, but subsequently the ends of the electrodes are pushed down into the reaction mixture or covered with a further quantity of the latter so that the charge acts as a resistance heater. Gaseous reacting substances are introduced into the furnace through one or more of the electrodes. —H. R. D.

Phosphate slags; Utilisation of basic ——. H. Nagell. G.P. 356,225, 14.5.18.

Vanadium compounds may be recovered from basic phosphate slags by heating a slightly acid solution of the slags.—A. B. S.

Manganese steel; Method of recovering ——. W. G. Nichols, Assr. to American Manganese Steel Co. Reissue 15,434, 22.8.22, of U.S.P. 1,291,656, 14.1.19. Appl., 17.12.21.

See J., 1919, 261 A.

Metal constituents of metalliferous materials; Process for dissolving out or recovering the ——. H. Bardt. E.P. 184,402, 10.10.21.

See U.S.P. 1,423,069 of 1922; J., 1922, 716 A.

Tin deposits; Process of producing dense and firmly-adhering ——. M. Schlötter. U.S.P. 1,426,678, 22.8.22. Appl., 21.1.20.

See E.P. 148,334 of 1920; J., 1921, 853 A.

Coating metal objects with a layer of another metal; Process for ——. O. Stalhane and O. O. Kring. U.S.P. 1,426,683, 22.8.22. Appl., 29.4.20.

See E.P. 167,262 of 1920; J., 1921, 703 A.

Ores containing zinc, cadmium, and copper; Electrolytic treatment of ——. D. Avery, R. H. Stevens, and R. T. D. Williams, Assrs. to Electrolytic Zinc Co. of Australasia Proprietary, Ltd. U.S.P. 1,426,703, 22.8.22. Appl., 16.3.20.

See E.P. 141,688 of 1920; J., 1921, 589 A.

Roasting zinc blende. G.P. 352,657. *See* I.

Electric lamps. E.P. 184,291. *See* IIb.

XI.—ELECTRO-CHEMISTRY.

Carbon-electrode industry; The technology of the ——. V. Baking and baking furnaces. C. L. Mantell. Chem. and Met. Eng., 1922, 27, 312—318. (*Cf.* J., 1922, 718 A.)

Furnaces for baking "green" carbon electrodes may be either electrically heated, the electrodes themselves acting as resistors, or gas-fired. In the electric furnaces the electrodes are packed in between two permanent end walls connected to the electric supply, and side walls of loose bricks are built up and strengthened with tie rods. The space between the electrodes is filled with crushed petroleum coke, and two cores are provided to start the process. Current is supplied at 30—60 volts, 25 cycles, and as the cores heat up, the volatile matter in the carbons is gradually distilled off until eventually they become sufficiently conducting to carry the bulk of the current. The baking process occupies 12—20 days, and a further period of 20 days is required for cooling; the maximum temperature attained varies from 1100° to 1300° C., those portions nearest the cores being at the highest temperature. Graphitising furnaces are constructed in a similar manner, but are operated at much higher temperatures (2000° C.), and the baking takes only 3—6 days. Gas-fired baking furnaces generally consist of rectangular pits for the carbon surrounded on both sides and at the bottom by heating flues; the pits form a rectangular "ring" round a central gas main, and the waste gas flues are disposed round the outside of the furnace. Each furnace is divided into a number of sections, each of which is independent of the others, so that part of the furnace is being loaded while other parts are heating or cooling. Each section is first heated with waste flue gases to about 500° C. (120 hrs.), then with fresh gas to about 1050° C. (75 hrs.), after which it is allowed to cool. All operations are controlled by thermocouple observations. At the present time gas-fired furnaces are gradually replacing electric ones, as the former are not only cheaper to run but are far more easy to control, and also allow of the recovery of the volatile by-products evolved by the binder on coking. The heat economy of the gas-fired furnace is much greater than that of the electric furnace owing to regenerative working, but the life of the latter is four times that of the former. The electrodes from the electric furnace are more difficult to clean, and the packing dust is more difficult to grind for re-use.—A. R. P.

Carbon-electrode industry; Technology of the ——. VI. Cleaning, testing, machinery and shipping. C. L. Mantell. Chem. and Met. Eng., 1922, **27**, 353—359.

Carbon electrodes, after baking, are cleaned either by tumbling in steel tumbling barrels or by brushing, followed, if necessary, by grinding on emery wheels; they are then tested for resistivity by means of a suitable ohmmeter, and for apparent specific gravity by weighing and measuring. The resistivity is directly proportional to the proportion of volatile matter and inversely proportional to the real density between 1·98 and 1·88. The cleaned carbons are inspected for faults, and all cracked and blistered rods are returned to the grinding process. A good electrode should have an apparent density above 1·54, not more than 2·5% of ash, a high electrical conductivity, slow rate of oxidation, and great mechanical strength, combined with a good shape, accurate dimensions, and low heat conductivity. The physical properties of various electrodes are compared, and a complete flow-sheet of the process of manufacture is given.—A. R. P.

Nickel; Use of granulated —— for electric heating. O. Dony-Hénault. Bull. Acad. roy. Belg., 1922, **8**, 67—70. Chem. Zentr., 1922, **93**, IV., 418.

"Mond" nickel is suitable for use in place of steel in the construction of resistances used in electric furnaces. The thin black layer of oxide with which the nickel becomes coated when heated is a conductor when cold. The following results give the respective percentage increases of weight due to oxidation when steel and "Mond" nickel spheres of the same size were maintained for long periods at a red or white heat. Percentage increase of weight after 20 hours at 600°—700° C., steel 2·77%, nickel 0·113%; after a further 17 hours at 1000° C., steel 9·40%, nickel 0·73%.—J. S. G. T.

Thermal conductivity. Jakob. *See* I.

Chlorates. Pamfilow. *See* VII.

Electromotive behaviour of lead dioxide. Glasstone. *See* VII.

Patents.

Electric battery. R. C. Benner and H. F. French, Assrs. to National Carbon Co. U.S.P. 1,425,573, 15.8.22. Appl., 16.1.19.

Mercury and lead material are associated with the active surface of a negative zinc electrode.—H. H.

Electrolytic cell. A. V. Davis. U.S.P. 1,425,752, 15.8.22. Appl., 7.6.21.

An anode and a cathode are spaced to provide between them an anode chamber opening freely into the cell at its upper and lower ends. Means are provided for supplying an electrolyte solution to the cell and for automatically maintaining its level above the upper end of the chamber as electrolytic action takes place, thus producing a thermosiphonic circulation of the electrolyte upwards in the chamber and downwards in the cell.—H. H.

Electric arc furnaces; Apparatus for the treatment of gases in ——. P. Real. G.P. 354,527, 16.7.20.

In a furnace with electrodes in the form of rotating discs, the latter are fitted with wings which communicate the rotary motion to the entering gases. The rapid burning away of the electrodes is thus avoided.—C. I.

Gases; Process of treating —— in the electric flame arc. P. Real. G.P. 356,413, 15.1.21.

Rotating disc-electrodes provided with wind vanes are arranged in star formation in vertical planes disposed radially about a common axis coinciding with the direction in which the gas to be treated is fed to the arc.—J. S. G. T.

Carbon electrodes; Process of increasing the durability and conductivity of ——. A. Bergström. G.P. 354,773, 30.4.19.

Carbon electrodes are impregnated with a mixture of solutions of a metallic salt and of carbon compounds and then heated to a high temperature. In this manner the reduction of the metallic salt to metal is not effected at the expense of the electrode.—J. S. G. T.

Electrolytic tanks with diaphragm cells; Arrangement in ——. G. Haglund. U.S.P. 1,426,071, 15.8.22. Appl., 10.9.20.

See E.P. 151,260 of 1920; J., 1921, 121 A.

See also pages (A) 737, *Discharge electrode* (U.S.P. 1,425,637); *Electrical precipitation* (G.P. 349,737, 352,901, and 354,783). 741, *Transformer oil* (U.S.P. 1,425,645). 752, *Hydrochloric acid* (G.P. 355,387). 753, *Potassium bicarbonate* (E.P. 184,244). 754, *Mercury* (G.P. 356,507). 764, *Electrolytic iron* (G.P. 310,043). 766, *Smelting and electrolysing* (U.S.P. 1,426,507). *Electroplating* (U.S.P. 1,426,141); *Tin* (G.P. 299,791 and 299,794) 767, *Coating metallic articles* (G.P. 354,693). 770, *Soap* (G.P. 354,234).

XII.—FATS; OILS; WAXES.

Oil seeds; Certain tropical ——. E. R. Bolton and D. G. Hewer. Analyst, 1922, **47**, 282—284.

The following seeds are described and the percentage of shell, kernel, and of oil in the kernel are given, together with full analytical characters of the oils obtained from them:—Bacury (*Platonia insignis*) kernels, Andirobinha or Mapia seeds, Bey beans (*Baillonella sp.*), Parinarium seeds, and the seeds of *Theobroma grandifolia* and *bicolor*.—H. C. R.

Soya bean oil; Composition of ——. W. B. Smith. J. Ind. Eng. Chem., 1922, **14**, 530—531.

The composition of the acids of soya bean oil having an iodine value of 134 (calculated as percentages of the original oil) is approximately as follows:—Linolenic acid, 2—3; linolic acid, 55—57; oleic acid, 26—27; saturated fatty acids, 9—10%.—W. P. S.

Beef bone fat and neat's foot oil. H. Eckart. Z. Unters. Nahr. Genussm., 1922, **44**, 1—29.

The bones are first boiled in open kettles, whereby the adhering flesh is removed and the best quality fat is obtained, but the cartilage is practically unchanged. The bones are then transferred to digesters and treated with hot water and steam at 0·5—1·5 atm. pressure for 4—6 hrs. The fat thus obtained from fresh bones is of a light yellow colour and faint aromatic odour and can be used without refining as an edible fat, the free fatty acids not amounting to more than 1·5% (as oleic acid). Details of the yields obtained in practice are given, the average yield of fat from bones being 12·6% and that of oil from the hoofs being 9·3%. A table of analytical characters of bone fats, marrow fats, kidney fats, and neat's foot oils as obtained by the author from a well-nourished animal and as found in commerce is given. The rate of increase in free fatty acids shown by bone fat and neat's foot oil on storage depends on the conditions of storage and is much more rapid if the sample is exposed to the action of light and air than if it is stored in the dark and sealed up. In the case of the solid fat exposed to light and air an autocatalytic hydrolysis appears to take place, while in the case of the oil the hydrolysis appears to be a monomolecular reaction. Measurement of the surface tension of neat's foot oils by the drop-pipette method gave values varying from 26·7 to 29·7 dynes per sq. cm. at 50° C. The mixed ethyl esters of the fatty acids from bone fat were prepared and their analytical constants recorded. The compositions of beef bone fat and neat's foot oil are as follows:—Stearic acid 19—21%, 2—3%; palmitic acid, 20—21%, 17—18%; oleic acid, 53—59%, 74·5—76·5%; glycerol, 5—10% in both ases; unsaponifiable matter, about 0·5% and 0·1—5% respectively. The presence of cholesterol in he unsaponifiable matter in each case was conrmed. Tristearin was definitely identified as a onstituent of beef bone fat.—H. C. R.

Hardened fats; Ability of —— to hold water in suspension. K. Brauer. Chem.-Zeit., 1922, **46**, 793—794.

AMPLES of hardened and other fats used in the manufacture of margarine were melted and agiated with water and the percentage of water in he emulsion determined both before and after the emoval of as much as possible by pressing. The folowing figures were obtained: Hardened whale oil, 9%, 23%; hardened soya bean oil, 25%, 7%; hardned herring oil, 18·6%, 9·9%; hardened linseed oil, 6%, 5·8%; coconut oil, 6·4%, 3·6%; tallow, 15%, 0·8%. The striking ability of hardened whale oil o take up water and retain it even after pressing s suggested as a means of distinguishing between t and other hard fats.—H. C. R.

Twitchell's reagent; Constitution of ——. A. E. Sandelin. Annal. Acad. Scient. Fennicae, 1922, [A] **19.** (19 pages.) Chem. Zentr., 1922, **93**, IV., 508—509.

HYDROXYSTEARIC acid, hydroxystearosulphuric acid, and α- and β-naphthalenesulphonic acids possess no fat-hydrolysing properties, but a compound with feeble fat-hydrolysing properties is obtained when a mixture of hydroxystearosulphuric acid or hydroxystearic acid and α-naphthalenesulphonic acid is treated with sulphuric acid. By oxidising Twitchell's reagent with alkaline potassium permanganate, an acid was obtained the lead salt of which had the empirical formula, $C_{18}H_6O_{12}Pb_3$. Analysis indicated a tricarboxybenzene. The free acid consisted of prisms of m.p. 189°—190° C., soluble in ether, alcohol, and acetone, but only slightly soluble in light petroleum spirit, carbon tetrachloride, and chloroform. The sodium and potassium salts are easily soluble, the barium salt slightly soluble in water. The silver salt is soluble in hot water. Analysis of the free acid gave the formula $C_9H_6O_6$, and it is in all probability hemimellitic acid. The difficultly soluble barium salt of another acid, benzene-1.2-dicarboxy-4-sulphonic acid, was also isolated. The formation of these two acids leads to the conclusion that Twitchell's reagent is formed by combination of the naphthalene with the double bond of the oleic acid and sulphonation of the addition product, and that it has the constitution $C_{18}H_{35}O_2C_{10}H_6SO_3H$. In all probability fat-hydrolysing agents prepared from naphthalene and ricinoleic acid, castor oil or their hydrogenation products are of analogous constitution. The "Kontakt" fat-hydrolyser is, on the other hand, of different constitution, for here the sulphonic acid of high molecular weight contains no carboxyl groups.—H. C. R.

Fat-hydrolysing catalysts. A. E. Sandelin. Annal. Acad. Scient. Fennicae, 1922, [A] **19.** (13 pages.) Chem. Zentr., 1922, **93**, IV., 509.

THE reagents prepared from petroleum (Happach) and naphtha contain no carboxyl groups. All these reagents have the following properties in common. They are of high molecular weight, are sulphonic acids, easily soluble in water and can be precipitated by the addition of acids or sodium chloride solution; they are easily soluble in alcohol and slightly soluble in ether. Their aqueous solutions foam strongly, as also do solutions of their alkali salts, which are soluble in alcohol. Their alkaline-earth and metallic salts are amorphous and insoluble in water, but are often soluble in alcohol. Their action in the hydrolysis of fats is due first to their action as emulsifiers of fat with water and secondly to the fact that they are strong acids and as such accelerate the hydrolysis. Their action is intensified by the addition of sulphuric acid. Many sulphonic acids of high molecular weight have been prepared, such as those from oleic acid with toluene, cymene, terpenes, alcohols, and benzene, thymol, or naphthalene, and their fat-hydrolysing action has been tested. All had considerable effect as fat-hydrolysers, with the exception of those prepared from oleic acid and toluene or cymene. The failure of those is no doubt due to the decomposition of the sulphonic acids by boiling water.—H. C. R.

Unsaponified fat in soap; Determination of ——. O. Hagen. Seifensieder-Zeit., 1922, 49, 359—361. Chem. Zentr., 1922, **93**, IV., 330.

IF petroleum spirit is used in this determination very troublesome emulsions are usually met with, while with ether, although with care emulsions can be avoided, considerable amounts of soap are dissolved. The following method is suggested as overcoming the difficulties. The soap is cut into shavings and completely dried at 100° C. It is then mixed with about 5 times its weight of sand and extracted with petroleum spirit (b.p. below 60° C.) in a Dittmar and Vierth's rapid extractor. The extraction is complete in 1½—2 hrs. and the extract is evaporated to dryness. The determination can be completed in a day.—H. C. R.

PATENTS.

Oils and fats; Process for purification of ——. N. Goslings. E.P. 167,462–3, 22.6.21. Conv., 3.8.20.

THE free fatty acids are neutralised with alkaline-earth or metallic hydroxides and other bases which form insoluble soaps with the fatty acids, a soluble salt being added to the bases in such quantity as is necessary nearly to saturate the water used for dissolving or suspending the bases. The quantity of neutral fat carried down with the soap is by this means reduced to 5—12%. In the case of liquid fats and oils the soap produced is hardened by the incorporation of a small quantity of solid fatty acids with the oil before neutralising it.—H. C. R.

Cottonseed; Method of delinting ——. L. G. Polhamus. U.S.P. 1,425,688, 15.8.22. Appl., 19.4.22.

THE cotton seed is exposed to the action of gaseous hydrochloric acid for about one hour to render the lint extremely brittle, and is then agitated to remove the lint. The seed is subsequently exposed to the action of gaseous ammonia.—H. C. R.

Fish oil and the like; Apparatus for treating —— with ozone. J. C. W. Stanley, Assr. to The Title Guarantee and Trust Co. U.S.P. 1,425,803, 15.8.22. Appl. 21.3.21.

THE apparatus comprises a chamber containing in its upper portion an oil receiver with a perforated bottom. A reservoir is provided for receiving the oil discharged from a chamber and is connected with it by a pipe; a pump is arranged to circulate oil through the chamber. There are also means for passing air through an ozoniser and then through the chamber, and for passing heated air through the chamber.—H. C. R.

Catalysts; Non-pyrophoric —— and process for effecting reactions [hydrogenation] therewith. N. Sulzberger. U.S.P. 1,426,517, 22.8.22. Appl., 11.9.16.

The catalyst comprises a black, non-pyrophoric, magnetic, catalytically active reduction product of a reducible nickel compound, reduced by a wet process and in the presence of a metal of the platinum group. The product contains nickel and the metal of the platinum group in an intimate state of combination.—H. C. R.

Hydrogenation; Catalyst for —— and the preparation thereof. C. Ellis. U.S.P. 1,426,629, 22.8.22. Appl., 23.12.13.

A nickel compound capable of being converted into a catalyst and an insoluble sulphate capable of acting as an accelerator are precipitated together. —H. C. R.

Hydrogenating catalyst. G. Teichner. U.S.P. 1,427,037, 22.8.22. Appl., 29.9.20.

A precipitated non-coherent, loose, amorphous compound of nickel is reduced in a dry state at such a low temperature that cohesion or slagging of the particles is avoided, while the interior of each particle is left unreduced.—H. C. R.

Catalyst [for hydrogenation]; Process of manufacturing ——. A. W. Arldt. G.P. 356,614, 23.4.16.

The metals or reducible metallic compounds employed to produce the catalyst are impregnated with a substance such as sugar or fatty oil, which is then carbonised by means of concentrated sulphuric acid at ordinary temperature. A similar treatment with sulphuric acid may be employed for the revivification of spent catalysts poisoned with organic residues, *e.g.*, oil.—J. S. G. T.

Oils and fats; Method of and apparatus for crystallising ——. H. H. Doering. U.S.P. 1,426,555, 22.8.22. Appl., 16.2.20.

A stream of hot oil is introduced at the bottom of a body of cold water and a jet of compressed air discharged adjacent to the point at which the oil is introduced, so that the oil is broken up into small particles prior to solidifying into crystals.—H. C. R.

Soaps; Process for the electrolytic production of ——. A. Sandreczki. G.P. 354,234, 3.2.20.

The electrolyte is a mixture of fat and salt solution. It is caused to stream past the cathode by heating it or by other means. The two electrodes are in the form of hollow cylinders with a common axis and separated by a diaphragm. Within the inner cylinder is a stirring device which causes the liquid inside this electrode to be projected over the edge into the annular space between the two electrodes, from which space it passes under the inner electrode and is again carried up by the stirring device, so that it is kept in circulation during the electrolysis.—H. C. R.

Detergent with disinfecting properties. E. Chamberlin. E.P. 184,248, 3.5.21.

A detergent and disinfectant solution is prepared by boiling together a mixture in water of sodium carbonate and potassium permanganate with animal charcoal and filtering the mixture. —H. C. R.

Lime sludge; Process for completely removing the soap from ——. P. Krebitz. G.P. 355,492, 22.4.20.

Before treating the lime-sludge with water in the usual manner, coconut or palm-kernel oil soap is added to the extent of at least 25% of the total soap content of the sludge. Alternatively resin soap may be added to the lime-sludge to the extent of at least 20% of its total soap content. If the original mixture of fats consists only of animal fats, hardened oils, olive or palm oils, or any fats or oils of which the alkali soaps are strongly hydrolysed on dilution with water, it is very difficult to remove the soap from the lime-sludge, which can neither be filtered nor centrifuged. By following this process any mixture of fats can be treated according to Krebitz's process (J., 1904, 490; 1906, 188, 434).—H. C. R.

Sulphurised oils. G.P. 354,172. *See* XIV.

Converting organic acids into esters. E.P. 183,897. *See* XX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Carbon black—its manufacture, properties and uses. R. O. Neal and G. St. J. Perrott. U.S. Bureau of Mines, Bull. 192, 1922. 95 pp.

Carbon black, in contradistinction to lampblack, vegetable black, etc., is obtained by direct contact of a flame of natural gas upon a depositing surface under conditions of incomplete combustion. Attempts to obtain carbon black by thermal decomposition or cracking processes have hitherto not been commercially successful on account of the relative inferiority of the products obtained, whilst processes purporting to increase the yield of carbon by effecting combustion in the presence of chlorine have been found to occasion undue depreciation of the apparatus involved. The production of carbon black from coal gas or other artificially made combustible gas, although claimed to yield a finer and blacker product, has not been undertaken commercially owing to the prohibitive price of the raw material in comparison with natural gas, which latter yields a handsome profit in spite of the low efficiency of the present combustion processes, viz., 2·5% recovery. The methods of manufacture of carbon black from natural gas differ mainly in the size and shape of the surface upon which the carbon is collected and the rate of travel of the moving parts of the apparatus. Generally speaking, the combustion plant consists essentially of a combustion building furnished with means for regulating air supply and ventilation at both inlet and outlet, and provided with burners adapted to play their flames upon collecting surfaces. The latter vary in design as the names of the several processes denote, and in decreasing order of output comprise (1) the channel process, (2) the small rotating disc process, (3) the large plate process, and (4) the roller process. In the channel process the flames from a number of fishtail-mouthed steatite-tipped burners are caused to impinge on to the under surface of travelling iron channel girders arranged horizontally side by side along the length of the combustion chambers, the deposited carbon being detached by stationary scrapers. A typical combustion building would contain about 38,400 burners. In the small disc process, the collecting surfaces consist of rotating discs of cast iron 36—42 in. in diameter, on the under side of which the flames impinge. The plates used in the large plate or Cabot process have a diameter of 24 ft., the plates being made of 48 segments. The plates are fitted with ventilator holes to allow the products of combustion to escape and maintain a draught. The rotating plates are furnished with scrapers and the operation is somewhat similar to that of the other processes, but owing to relative lightness of the supporting construction and slow movement of rotation of the plates, very little power is consumed in operation. In the roller or rotating cylinder process the flames from round burners impinge on horizontally supported rollers or cylinders 3—8 ft. in length and 8¼ in. outside diameter, disposed transversely to the length of the building. The scrapers are in contact with the roller at or near the top, whence the deposited carbon falls into a trough-shaped hopper in the bottom of the combustion chamber. A typical building contains 10,000 burners and 196 to 288 rollers. The temperature of combustion and the careful regulation of the air supply play an important part in determining the yield and nature of the black obtained, an insufficiency of air furnishing a carbon black containing absorbed intermediate products of incomplete combustion appearing as "volatile matter" on analysis. Such a product yields a "longer" black of lower fixed carbon content, a property in particular demand for certain purposes. The paper concludes with analyses of typical blacks of proprietary makes and specifications of material suitable for use in the several industries of printing ink, rubber, etc., together with a bibliography of the patent and technical literature relating to carbon black manufacture.—A. de W.

Shellac; Solubility of —— in alkalis or alkaline salts. H. Wolff. Farben-Zeit., 1922, **27**, 3130—3131.

THE solution of shellac in solutions of sodium carbonate, borax, etc., is not due to chemical combination of the base with the free aleuritic acid or the neutral saponifiable compound present in the shellac in amount corresponding to its ester value, since the resin dissolves in slightly warm sodium carbonate solution without a corresponding evolution of carbon dioxide. Furthermore, when shellac dissolved in just a sufficient amount of sodium carbonate solution is completely dried, the residue is no longer soluble in water but merely swells, the degree of swelling diminishing with each successive drying operation, as with a typical colloid. The solution process is therefore in the nature of a peptisation. The author claims to have obtained a water-peptisable residue by evaporation of the sol obtained by pouring an alcoholic solution of shellac into water; the residue, however, proved to be insoluble in alcohol until its solubility in water was lost by ageing. The loss of alcohol-solubility in bleached shellac is attributed to the coagulating effect of hydrogen-ions from the precipitation by acid, the maintenance of solubility by storage under water being in consequence due to a diminution of hydrogen-ion concentration.—A. de W.

Resins; Relation between the constitution of chemical compounds and their capacity to form ——. II. New method for production of synthetic resins. W. Herzog and J. Kreidl. Z. angew. Chem., 1922, **35**, 465—466. (*Cf.* J., 1921, 478 A.)

WHEN heated at 180° C. in a stream of carbon dioxide dibenzylideneacetone is gradually converted into a polymeric resinous compound, which melts between 85° and 95° C. and is soluble in ether, benzene, and turpentine. Analogous compounds, *e.g.*, dianisylideneacetone, dicinnamylideneacetone, benzylidenecinnamylideneacetone, difurylideneacetone and dipiperonylideneacetone give similar products. The capacity to polymerise in this way with formation of resins is attributed to the CH:CH·CO grouping, which is regarded as "resinophoric"; the additional presence of ethylenic linkages is favourable to the change. The grouping N:C:N has previously been shown to possess resinophoric character.—D. F. T.

Red lead and lead sesquioxide. Glasstone. *See* VII.

PATENTS.

Red oxide of iron; Manufacture of ——. D. Tyrer. E.P. 183,323, 8.6.21.

FERRIC oxide of good red colour can be obtained by exposing dry granular ferrous chloride (*e.g.*, from galvaniser's waste) in thin layers to the action of a mixture of steam and air heated to 250°—300° C.; the best mixture is obtained by passing air at ordinary temperature through water at 60° C. The condensed liquid obtained by cooling the mixture of air and excess steam should not attain a greater concentration than 30 g. of hydrochloric acid per 100 c.c. The action may be accelerated and the colour of the product enhanced by the addition to the ferrous chloride of a considerable proportion of ferric hydroxide or ferrous carbonate or of 0·1—1% of salts of copper, magnesium, tin, sodium or potassium.—D. F. T.

Inks and other pigmenting and like compositions. A de Waele. E.P. 183,513, 19.3.21.

THE vehicle for the colouring matter consists of an emulsion or emulsoid of which the component materials, *e.g.*, Yorkshire grease (from the waste liquor of wool washing) and water, possess "yield values" (*cf.* Bingham and Green, J., 1920, 495 A) materially lower than the yield value of the vehicle as a whole. The oily material normally forming the more viscous constituent may be mixed with a mineral oil or other organic solvent. With a vehicle of Yorkshire grease and water the latter may amount to 50—250% of the former, and the pigment may be a water-soluble dyestuff, such as Nigrosine.—D. F. T.

Pigments; Process of preparing —— from titanium compounds contaminated with sulphuric acid. G. Carteret and M. Devaux. E.P. 184,132, 27.7.21.

TITANIC oxide which has been washed with sulphuric acid, or other titanium compound contaminated with sulphuric acid is treated with an alkaline-earth chloride in solution, the free hydrochloric acid formed being eliminated by washing with milk of lime or milk of baryta and the titanic oxide finally dried.—A. de W.

Pigment and method of producing same. P. Fireman, Assr. to Magnetic Pigment Co. U.S.P. 1,424,635, 1.8.22. Appl., 31.5.19.

PRECIPITATED ferrous hydroxide is oxidised whilst suspended in its mother liquor, the oxidation being controlled by limiting the temperature during the early stages of oxidation to a point below that at which black oxides form.—D. F. T.

Pigment and pigment composition. K. B. Lamb, Assr. to The American Cotton Oil Co. U.S.P. 1,424,729, 1.8.22. Appl., 27.4.21.

AN intensely black pigment is produced by heating spent fuller's earth, with stirring, until the oil present is ignited and is finally consumed.
—D. F. T.

Paint composition. K. B. Lamb, Assr. to The American Cotton Oil Co. U.S.P. 1,424,414, 1.8.22. Appl., 2.2.22.

THE black pigment obtained by carbonising spent fuller's earth under suitable conditions is mixed with other black pigments and a drier and incorporated with a paint vehicle.—D. J. N.

Condensation products from phenols and aldehydes; Manufacture of ——, Bakelite-Ges. m.b.H., and R. Hessen. E.P. 159,461, 15.2.21. Conv. 1.3.20.

BY treating the primary product obtained by the condensation of formaldehyde and a phenol in the presence of a basic condensation agent, with sufficient acid or acid-forming substance approximately to neutralise the base, it is possible to produce "resoles," *i.e.*, resins which form infusible masses ("resites") when heated. Using a higher proportion of acid, albeit insufficient to effect direct conversion into "resites," a "novolak," *i.e.*, a resin which cannot be converted into an infusible mass by heat, is obtainable.—D. F. T.

Oil and varnish colours miscible with water. F. Günter. E.P. 183,177, 7.3.21.

A watery paste of the colouring material is emulsified together with binding agents (*e.g.*, drying oils) insoluble in water, in the presence of volatile stabilising agents, such as alcohol, pyridine, acetone, or naphthenic acid, and which are soluble both in water and in the binding agent. As an alternative, alkali salts of the fatty acids and of resin acids may be employed as stabilisers, in which case an element such as sulphur, phosphorus, or selenium, capable of forming an acid by slow oxidation, is added to the emulsion.—D. F. T.

Resins; Preparation of synthetic ——. D. G. Anderson and R. Maclaurin. E.P. 183,629, 17.5.21.

Synthetic resins are produced by the condensation of formaldehyde with the monohydric phenolic substances, boiling between 230° and 320° C., present in tars obtained by the low temperature distillation of coal.—D. F. T.

Rosin; Means for extracting crude spirits and —— from yellow and green pine stumps. J. M. Jordon. U.S.P. 1,424,248, 1.8.22. Appl., 10.1.21.

The wood is supported inside a vertical cylindrical chamber which is surrounded by a steam and water space. The water in the annular jacket is heated by means of a fire-box constructed inside the jacket. The extracted turpentine collects in the funnel-shaped bottom, which is provided with an outlet pipe.—D. F. T.

Resinous condensation products of aldehydes and phenols; Preparation of ——. A. Koch. G.P. 354,697, 13.4.20.

The condensation product of a phenol and an aldehyde is treated, during or after its formation, with hydrogen, preferably at elevated temperatures and under pressure, in the presence of any of the usual metallic catalysts, *e.g.*, reduced nickel or colloidal nickel, platinum, or palladium, in the presence of a protective colloid. For example, hydrogen is passed at 80° C. and under 3 atm. pressure through the anhydrous liquid condensation product obtained from phenol and a 40% aqueous solution of formaldehyde, in the presence of ammonia, until no further absorption of gas occurs, finely divided nickel being used as a catalyst. The product is filtered, washed, and concentrated. On heating it becomes hard, and is then soluble in alcohol, acetone, and caustic soda. It is odourless and has a higher melting point than that of the resin obtained under the same conditions without hydrogenation. Similar products may be obtained by passing hydrogen through a solution of resins (obtained from aldehydes and phenols) in suitable organic solvents not containing double linkings, *e.g.*, alcohol, in the presence of finely divided nickel.—A. R. P.

Resinous products from phenols methylated in the nucleus; Process for preparing ——. Chem. Fabr. vorm. Weiler-ter Meer. G.P. 355,173, 3.2.20, and 355,174, 24.8.20.

Cresol, chlorocresol, or higher homologues are treated with chlorine at temperatures above 100° C. until nearly free from substances volatile in steam, and the residue, on cooling, solidifies to a hard amorphous mass. Alternatively the cresol or the like may be saturated with chlorine at ordinary or slightly higher temperatures, and the resulting product heated above 100° C., under reduced pressure if necessary. The products, according to the chlorine content, are soluble in alcohol, acetone, ether, and alkalis. When the chlorine content is high the products are soluble only in benzene hydrocarbons. They can be used for the preparation of dark or black varnishes and have a strong bactericidal action.—J. B. F.

Resinous condensation products of phenols; Preparation of ——. Dynamit A.-G. vorm. A. Nobel und Co. G.P. 355,389, 4.1.20.

Halogenated aromatic hydrocarbons of the type $R.CHX_2$ are heated with phenols in the presence of a small quantity of a metal halide. Thus, benzal chloride is heated with either phenol, in the presence of zinc chloride at 50°—100° C., or with *m*-cresol, in the presence of aluminium chloride at 70° C., until hydrogen chloride is no longer evolved, and the excess phenol or cresol is removed by steam distillation. An odourless, light-coloured resin, which is soluble in caustic alkalis, methyl alcohol, ethyl alcohol, benzene, and chloroform, is thus obtained. Similar products are obtained from homologues of benzal chloride or from derivatives containing halogen atoms in the nucleus.—A. R. P.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

[Rubber] latex; Application of hydrogen sulphide and sulphur dioxide gases direct to ——. H. P. Stevens. Bull. Rubber Growers' Assoc, 1922, 4, 386—387.

It is not possible to vulcanise the rubber globules of latex with hydrogen sulphide and sulphur dioxide. The gases under these conditions merely dissolve in the aqueous serum, and there react, producing molecular sulphur.—D. F. T.

Patents.

Vulcanisation of rubber and apparatus for use therein. B. Lambert. E.P. 183,590, 27.4.21.

Vulcanisation is effected in a medium consisting of the eutectic alloy of tin (25 pts.), lead (16 pts.), and cadmium (9 pts.), which melts at 145° C. A sufficient proportion of the alloy to maintain the temperature during the required period of solidification is melted by an immersed, insulated, electrically heated wire. In order to shorten the time of vulcanisation, an alloy containing the metals in the proportions 57:21:22 may be employed, having a solidification range of 153°—145° C.—D. F. T.

Caoutchouc and caoutchouc-like substances and compounds thereof or compositions comprising same; Fireproofing natural and artificial ——. H. Frood and H. P. Alger. E.P. 183,922, 30.4.21.

Rubber materials, particularly floor coverings containing rubber, together with inorganic or organic fibrous fillers (the latter themselves also preferably being treated with fireproofing agents), are rendered less inflammable by the incorporation of casein and hydrated aluminium oxide, together with a small proportion of antimony trichloride.
—D. F. T.

Rubber; Process of reclaiming ——. J. O. Navone. U.S.P. 1,424,668, 1.8.22. Appl., 24.1.20.

The rubber is dissolved from a rubber product in a hydrocarbon, the latter being subsequently removed by evaporation and the rubber precipitated in heated water.—D. F. T.

Plastic mass especially suited for use as a tyre-filler; Process for producing and using a ——. R. Gollert. G.P. (A) 303,924, 15.8.16, (B) 305,197, 30.1.17.

(A) Starch powder is mixed with "perglycerin" or "perkaglycerin" (*cf.* Neuberg and Reinfurth, J., 1920, 801 A) to a homogeneous paste, and if necessary with the aid of heat. The mixture is introduced into the tyre whilst fluid, and then submitted to further heating, *e.g.*, at 60° C. (B) A non-fluid mass, produced by mixing the preceding product with more starch, may be first introduced into the tyre, followed by a more fluid mass. After a suitable maturing period the filling material is subjected to heat.—D. F. T.

Sulphurised oils, particularly factice; Manufacture of ——. F. Balla, and Farbenfabr. vorm. F. Bayer und Co. G.P. 354,172, 10.12.20.

By treating oils with sulphur in the presence of a vulcanisation accelerator, products are obtained of increased hardness and free from residual sulphur. —D. F. T.

XV.—LEATHER; BONE; HORN; GLUE.

Hide curing; Science of ——. G. D. McLaughlin and E. R. Theis. J. Amer. Leather Chem. Assoc., 1922, **17**, 376—399.

Hides are dehydrated by salting or immersion in a 25% brine solution. Of the three layers the adipose tissue is most dehydrated. The salt is absorbed by the hide during the process, and the greater the dehydration the greater the amount of absorbed salt. The epidermis does not absorb salt very readily, so that only the flesh side should be salted. If salting is delayed after the animal has been killed, the rate of diffusion of the salt into the hide is greatly reduced. The salt content of a hide containing blood which has been allowed to remain some time before curing is less than that of a similar hide from which the blood has been removed. The longer the delay between slaughtering and curing the greater the difference between the two. The diffusion of the salt is affected by the presence and condition of blood, by post-mortem changes, and by the composition of the salt. Hides should be washed and brined as soon as possible after flaying to secure a maximum absorption of salt in a minimum of time, to eliminate salt and iron stains, and to minimise the effect of post-mortem changes.—D. W.

Hide curing; Practice of heavy ——. G. D. McLaughlin and E. R. Theis. J. Amer. Leather Chem. Assoc., 1922, **17**, 399—404.

The authors have compared curing by "salting" and by "brining." When properly brined and tanned, the hides produce more leather, which is thicker, firmer, and has fewer salt and iron stains, than when the hides are salted. Brined stock requires special beam-house treatment, especially the use of "sharp" limes.—D. W.

Tannins and tanning extracts; Differentiation of ——. T. Körner and J. A. Bosshard. Ledertechn. Runds., 1922, **14**, 57—60, 65—66, 75—77. Chem. Zentr., 1922, **93**, IV., 289—290.

Quebracho tannin shows a higher carbon content than any other tanning material except cutch and gambier. Quebracho can be detected by dissolving a quantity of tanning extract in 10 parts of water, treating the solution with one-tenth of its weight of sodium chloride, filtering, extracting the filtrate with ethyl acetate, fractionally precipitating the ethyl acetate solution with alcohol, drying and analysing the last fraction. Pure quebracho extract in this way gives a carbon content of 60%, whilst with adulterated extracts lower values are obtained. Tannins can be separated and detected by fractional precipitation of the acetone solution of the acetylated tannin with alcohol. The acetylated tannins and the products obtained by their saponification lend themselves to differentiation. The acetylated tannins may be hydrolysed with 5 c.c. of hydrochloric acid (sp. gr. 1·19), cooled, treated with 25 c.c. of Wijs iodine solution, allowed to stand for 1 hour, diluted to 1 litre, and titrated with $N/10$ thiosulphate solution. The iodine absorbed by different tannins varies, but there is little variation for one and the same tannin.—D. W.

Tannin analysis; Contributions to —— *with special reference to gambier.* L. Pollak. Collegium, 1922, 125—133.

Various samples of Asahan gambier were analysed by the official shake method, by modifications of this method, using double and treble detannisations, a longer period of shaking, and a larger amount of hide powder, and by the filter bell method. The shake method with two and three detannisations gave a higher percentage of tans than the official shake method. There was no need to detannise three times. Pieces of sheep pelt were coloured in a known quantity of pine bark extract, and finished in a known amount of gambier liquor. The liquors were analysed by both filter bell and shake methods, before and after use, and the dry leather analysed. The discrepancies between the calculated amount of tannin in the leather and that actually found show that the official shake method gives less than the true tannin content and the filter bell method more.—D. W.

Tannin analysis. II. V. Kubelka and F. Berka. Collegium, 1922, 85—95, 143—155.

Results are given of numerous analyses of different extracts and tanning materials made by the official shake method, by detannising twice, and by the official shake method substituting dry chromed Freiburg hide powder for wet hide powder. The dry chromed powder has a higher absorptive power for materials which are not absorbed by the freshly chromed hide powder. The dry powder is used in the filter bell method, and that method yields better results than the shake method owing to the better absorptive power of the powder. The authors advocate the adoption of the filter bell method.—D. W.

Leather; Researches on ——. L. Jablonski. Collegium, 1922, 53—56, 96—97.

Portions from different parts of hides tanned with vegetable tanning materials in pits, partly in pits and partly in drums, and wholly in drums, and weighted, have been analysed for hide substance, specific gravity, water-soluble matter and fibrous structure. The results are shown graphically. Photomicrographs prove that the fibre bundles in the butt portions are thick and interwoven, whilst in the belly the bundles are very thin, and in some cases only separate fibres are present. No portion of a side is an average of the whole.—D. W.

Sole leather filled with sulphite-cellulose extract; Durability of ——. R. C. Bowker. U.S. Bureau of Standards, Tech. Paper No. 215. J. Franklin Inst., 1922, **194**, 241.

Sole leather filled with sulphite-cellulose extract is as durable as leather filled with chestnut wood and quebracho extracts.—D. W.

Keratin. I. A. Heiduschka and E. Komm. Z. physiol. Chem., 1922, **121**, 221—230.

Horn clippings were heated under a variety of conditions, for example, at atmospheric pressure, in a vacuum, in sealed vessels, and with water or ammonia in a vacuum. The temperature of incipient degradation varies with the time of heating and the conditions. Among the volatile products are ammonia, hydrogen sulphide, and other sulphur compounds.—H. K.

Ion concentration measurements. Keeler. *See* XXIII.

Patents.

Tanning hides; Process for ——. Chem. Fabr. Worms A.-G. E.P. 156,670, 6.1.21. Conv., 23.9.16.

Hides are tanned with the substances prepared according to E.P. 156,254 (J., 1922, 602 A), but treated with compounds (other than permanganates) of heavy metals, instead of with compounds of aluminium or chromium.—D. W.

Leathers; Treating and finishing ——. C. R. Reubig. E.P. 157,864, 10.1.21. Conv., 25.7.16.

Dressed or undressed leathers are treated for two hours with a solution of 8% of sodium thiosulphate and 5% of sodium sulphide to which has been added a caustic alkali, then with acids, and washed with water.—D. W.

Condensation products [tanning agents]; Method for the production of sulphonated ——. Elektrochem. Werke, H. Bosshard, and D. Strauss. E.P. 158,521, 10.1.21. Conv., 9.8.18.

Naphthalene or other polycyclic aromatic hydrocarbon, or carbazole, and sulphuric acid, or a sulphonic acid of the hydrocarbon or of carbazole, is condensed with glycollic acid by heating in the air or *in vacuo*.—D. W.

Hides and skins; Tanning arrangement for ——. M. Beretta. E.P. 159,215, 21.2.21. Conv., 20.2.20.

Hides and skins are tanned in an apparatus comprising one or more vessels divided longitudinally into two tanks, each vessel having at one end of the partition a port communicating with the two tanks, and provided with a sliding door, a filter chamber situated at the other end, and a propeller for circulating the liquor so that it can pass through the filter chamber if desired. The filter chamber may be provided with a sump to collect the solid matter. —D. W.

Tanning agents; Manufacture of ——. R. B. Croad, G. E. Knowles, and H. M. McArthur and Co., Ltd. E.P. 182,823, 3.1.21.

At least 2 mols. of an aromatic hydroxy compound is condensed in the open or under pressure with 1 mol. of formaldehyde, or an equivalent proportion of a compound yielding formaldehyde, in presence of an oxide, hydroxide, carbonate, or bicarbonate of an alkali or alkaline-earth metal, ammonia, or a salt of a strong base with a weak acid. The product is rendered soluble by sulphonation and partially neutralised.—D. W.

Tanning agents; Manufacture of ——. R. B. Croad, and H. M. McArthur and Co., Ltd. E.P. 182,824, 3.1.21.

At least 2 mols. of an aromatic hydroxy compound is condensed with 1 mol. of formaldehyde, or the equivalent proportion of a compound yielding formaldehyde, in presence of alkali or an alkaline salt, and the product is rendered soluble by sulphonating and further condensed with a suphonated aromatic compound and an aldehydic compound, or an aldehydic compound alone. The final product is partially neutralised.—D. W.

Tanning agent for the chrome tannage or dyeing of leather; Preparation of a ——. D. Burton and A. Glover. E.P. 184,360, 26.7.21.

A solution of sodium or potassium bichromate in water, after treatment with sulphuric or hydrochloric acid, is heated and then reduced by the addition of tea dust. Previous removal of the caffeine has little or no effect on the efficiency of the tea dust for this purpose.—D. F. T.

Chrome leather; Method for the neutralisation of ——. O. Röhm. G.P. 353,130, 2.12.19. Addn. to 352,285 (J., 1922, 722 A).

The leather is neutralised with sodium carbonate or other alkali or alkaline-earth carbonate, with the addition of formaldehyde or a formate, acetate, or lactate of an alkali or alkaline-earth metal; sulphites, thiosulphates, phosphites, arsenites, and arsenates of the alkali or alkaline-earth metals show a similar action to the salts of organic acids. For example, chrome-tanned pelts may be washed with water, allowed to stand in a bath containing a solution of sodium sulphite and calcium carbonate, until neutralised, then washed several times with water. —J. B. F.

Mineral tanned leather; Method for the neutralisation of ——. O. Röhm. G.P. 353,131, 2.12.19. Addn. to 352,285 (J., 1922, 722 A).

Iron- or aluminium-tanned leather is neutralised with alkali or alkaline-earth carbonates, together with formaldehyde or salts of lower fatty or hydroxy-fatty acids or of such weak inorganic acids, as carbonic acid. Thus an iron-tanned leather may be neutralised with calcium carbonate and sodium acetate, or sodium carbonate and sodium acetate, or an aluminium-tanned leather with sodium sulphite and sodium carbonate.—J. B. F.

Gas-impervious material [from animal membranes]; Method of making ——. The British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 184,012, 30.6.21.

A material impervious to gas and capable of retaining its flexibility when dry and at low temperatures is obtained by treating animal membrane, preferably the lining of the throat or bladder, with a hardening agent, such as Nigrosine, and a hygroscopic material having a freezing point below −50° F. (−46° C.), such as glycerin or ethyleneglycol. The membranes are first washed with dilute ammonia or similar detergent, dried while inflated, and preferably soaked for about 4 hrs. in a dilute (1%) solution of tannic or gallic acid; they are then agitated in a solution containing, for example, 30 pts. of glycerin, 5·5 pts. of ethyleneglycol, 2 pts. of Nigrosine, 70 pts. of water (by weight in each case), and, after removal of superfluous solution, are dried, preferably while mechanically working to increase their flexibility.—D. J. N.

Leather; Process for rendering —— *gas-tight.* A. Geiger and E. Brauer. G.P. 353,444, 14.2.18.

Leather is impregnated with halogenated aliphatic hydrocarbons of medium viscosity, and substances of high viscosity which will not crystallise out at low temperatures, *e.g.*, with a mixture of 70% of polymerised chlorinated spindle oil and 30% of coumarone resin.—D. W.

Tanning oils and fat-liquoring agents; Manufacture of —— *from hydroxy-fatty acids and phenol.* Gerb- u. Farbstoffwerke H. Renner und Co. A.-G. G.P. 354,165, 26.8.19.

The resins obtained by distilling hydroxy-fatty acids, *e.g.*, glycollic, lactic, or ricinoleic acid, or castor oil under ordinary or reduced pressure are mixed with phenols and diluted with mineral oil or other desired hydrocarbon. The insoluble resins yield with the phenol a colloidal solution which is absorbed by the animal hide and can serve as a substitute for the materials used in chamoising and oil tanning. Mixed with mineral oils these colloidal solutions yield emulsions which can be employed in stuffing or fat-liquoring vegetable-tanned leather. —D. W.

Plastic material made from casein. R. H. Abrey. E.P. 183,972, 30.5.21.

Casein is soaked in water, dissolved in an alkaline solution, and precipitated with a mixture of zinc sulphite, potassium or sodium metabisulphite, glacial acetic acid, and alcohol, which has been treated with zinc and milk of lime. The precipitate is worked into a tough mass, treated with formaldehyde, and dried.—H. C. R.

Albuminous matter; Process for separating —— from glue solutions prepared from bones. Plauson's Forschungsinstitut. G.P. 355,879, 13.9.19.

The glue solution is treated with ether or mixtures of ether with alcohol, acetone, etc. The extracted albuminous matter has a high food value, and the adhesive power of the glue is improved by its removal.—H. C. R.

[Waste tanning] liquors; Selective removal of organic matter from ——. C. L. Peck, Assr. to The Dow Co. U.S.P. 1,426,596, 22.8.22. Appl., 1.7.19.

Tannery liquors are subjected to a flotation process by which hair is selectively removed from fleshings etc.—A. G. P.

Leather; Process for the treatment of —— with indiarubber. A. McLennan. U.S.P. 1,425,530, 15.8.22. Appl., 21.1.22.

See E.P. 179,969 of 1920; J., 1922, 560 A.

XVI.—SOILS; FERTILISERS.

Selenium; Action of —— on the metabolism of plants in presence of the radioactivity of the air and soil. J. Stoklasa, P. Kricka, J. Penkava, J. Zelenka, J. Chmelar, and V. Jansky. Biochem. Zeits., 1922, **130**, 604—643.

The authors have examined the action of ions containing selenium in the presence of and absence of radium emanations on the growth of azotobacter, the germination of seeds, and the development of plants. Sodium selenite inhibits the growth of *Azotobacter chroococcus*, but the inhibition is overcome by radioactivity. Both selenite and selenate are detrimental to the germination of seeds, the selenite being the more powerful. Radioactive air accelerates the germination of seeds and inhibits the toxic action of selenites and selenates on the growth of plants. In water culture media very minute quantities of selenates can accelerate the growth of plants, but minute quantities of selenites and larger quantities of selenates inhibit. Radioactive water of weak activity stimulates the growth of plants, and may completely inhibit the toxic action of selenite ions.—H. K.

Patents.

Phosphatic fertiliser material and process of making the same. L. R. Coates. U.S.P. 1,425,747, 15.8.22. Appl., 1.9.21.

Material containing superphosphate is mixed with a material containing an alkaline calcium compound. The mixture is wetted and converted into a condition into which it can be strewn as fertiliser. —H. H.

Fertilisers; Process of preventing disintegration of ——, more especially of calcium cyanamide. W. Schwarzenauer. G.P. 306,237, 4.4.16. Addn. to 304,965.

Other oils, or fats, are used in place of the distillate derived from bituminous shale referred to in the previous patent (J., 1921, 314 A).—J. S. G. T.

Seed corn; Fungicide for treating ——. Farbw. vorm. Meister, Lucius, u Brüning. G.P. 353,014, 31.7.20.

Acetaldehyde is employed, either alone or in conjunction with other fungicides and substances, such as water or infusorial earth, reducing the risk of fire. The germinating power of the seeds is much less affected than is the case when formaldehyde is used.—J. S. G. T.

Fertiliser; Process of manufacturing a dustless, non-corrosive ——. W. Schrauth. G.P. 353,493, 22.1.20.

Calcium cyanamide is treated with naphthenic acids, if necessary mixed with neutral oils such as phenol-free tar oil or petroleum distillates. —J. S. G. T.

XVII.—SUGARS; STARCHES; GUMS.

White sugar; Deterioration of Mauritius —— during storage. H. A. Tempany and D. D'Emmerez de Charmoy. Bulletin 24 (General Series), Dept. Agric., Mauritius, 1922.

Moulds, bacteria, and torulæ are all concerned in the deterioration of white sugar (containing about 99% of sucrose and 0·15—0·30% of moisture), the most destructive of the three being the last mentioned, the forms of which encountered by the authors differ from those described by other investigators. Mauritius white sugars have a ratio of moisture to non-sugar well below the figure generally regarded as safe, and primarily the cause of their deterioration is the absorption of moisture from the atmosphere under unsuitable conditions of storage. Individual samples exhibited considerable differences in their liability to deteriorate, the reason for which may be the variation in the size of grain. Deterioration in Mauritius warehouses was noticed to be mostly confined to the layers of bags in contact with the floor, which effect appears to be due to the greater fluctuations of temperature and corresponding increases in the relative humidity of the air at these places, and it was observed that where non-conducting floors existed deterioration was practically absent. Therefore, the authors advise that warehouses for the storage of sugar should be solidly constructed, fitted with doors and windows capable of being tightly closed, and especially they should be provided with floors of non-conducting materials. They should be opened as infrequently as possible, and if possible provided with some means of drying the air, in which latter connexion it may be possible to utilise the hygroscopic property of jute, which was observed to be capable of absorbing 35% of its weight of moisture from the air in 10 days. Another practice counteracting the tendency to absorption of moisture is to use crinkled paper linings for the jute bags, direct contact with the air being lessened in this way. (*Cf.* J., 1918, 275 A; 1919, 549 A; 1920, 583 A.)—J. P. O.

Beet juice; Liming raw —— and the separation of the resulting precipitate by subsiding. V. Skola. Z. Zuckerind. Czecho-slov., 1922, **46**, 601—611, 625—629.

Experiments carried out with the object of effecting a preliminary separation of the albuminoids from beet juice by the addition of lime and subsiding, showed that the rate at which the precipitate settled out was not dependent solely on the amount of lime, but largely upon the manner in which the addition was made. Generally the best results in respect of rapidity of subsiding were obtained by running the diffusion juice into milk of lime while constantly stirring; under these conditions when using 1% CaO about 0·2% CaO was retained in the sediment. A less favourable result was obtained when about 0·2% CaO in the form of milk of lime was added to the juice and the mixture heated to about 80° C.—J. P. O.

Beet juice; Rate of decomposition of some nitrogenous constituents of —— by lime. J. Vondrák. Z. Zuckerind. Czecho-slov., 1922, **46**, 483—490, 533—539, 589—597.

Laboratory experiments carried out with aqueous solutions of various amides in the presence of lime, under conditions resembling those prevailing in the factory during defecation, showed glutamine to be very readily decomposed, asparagine more slowly, and choline and allantoin only inappreciably. A more rapid decomposition of asparagine resulted when the lime was added in the cold and the solution subsequently heated, than when the addition was made at a high temperature, and it is therefore suggested that in the factory defecation should be carried out in the cold. As a means of preventing the retrogression of the alkalinity during evaporation and boiling, it is advisable that lime should be added in the second carbonatation, the saturation at this stage being carried out with carbon dioxide at 100° C.—J. P. O.

Cane juice; Influence of the amino-acids of —— in inhibiting inversion. J. W. L. van Ligten. Archief Suikerind. Nederl.-Indië, 1922, **30**, 216—221. Int. Sugar J., 1922, **24**, 439.

Experiments are described demonstrating that the impurities which are present in cane juice (presumably principally the amino-acids) are capable to a marked extent of inhibiting the inversion of sucrose by hydrogen-ions at high as well as at low temperatures.—J. P. O.

Molasses; Exhaustibility of (Java) cane —— in connexion with its composition. H. Kalshoven. Int. Sugar J., 1922, **24**, 416—419.

In order to obtain a nearer insight into the influence which the composition of a molasses may have upon its exhaustibility, determinations of sucrose, reducing sugars, ash, and gum were made on a large number of samples of this product, which had attained equilibrium at room temperature, further crystallisation not being possible. These results showed that a high dry substance content causes a low purity under otherwise like conditions; that a high content of reducing sugars gives *ceteris paribus* a low purity; that the percentage of gums usually occuring exerts no appreciable influence on the purity; and lastly that the non-sugars present (especially the salts) may either increase or diminish the purity.—J. P. O.

Fructose [lævulose]; Preparation of ——. T. S. Harding. J. Amer. Chem. Soc., 1922, **44**, 1765—1768.

A solution of sucrose (2000 g.) in water (6000 c.c.) is acidified with glacial acetic acid (2 c.c.) and treated with such a quantity of invertase that hydrolysis is complete in about 18 hrs. at 20°—30° C. A few grams of active decolorising carbon is added and the solution is filtered. The clear, colourless filtrate is immediately concentrated to a syrup of about 90—95% total solids in a vacuum at as low a temperature as is possible by the use of a good water pump. The thick syrup is mixed with 2 vols. of hot glacial acetic acid, cooled, seeded with dextrose, and allowed to crystallise at 15°—20° C. during 3—4 days. The dextrose is removed and washed thoroughly with glacial acetic acid; its weight should be 36—37·5% of that of the sucrose taken. The filtrate is diluted with 2 vols. of distilled water and concentrated to a thin syrup in a vacuum at a low temperature. The resulting thin syrup is again diluted with water and subsequently concentrated at a low temperature until it contains about 90—95% of total solids. The final syrup is mixed with an equal volume of hot glacial acetic acid, the mixture is cooled somewhat, seeded with lævulose and allowed to remain at 15°—20° C., crystallisation being usually complete in 2—3 days. The crystals are removed and washed with glacial acetic acid. The yield of crude lævulose is 23·5—28% of the weight of sucrose taken. Further purification is effected by dissolving the crude product (400 g.) in boiling ethyl alcohol (75%, 200 c.c.), adding absolute ethyl alcohol (300 c.c.) and decolorising with active carbon. The filtered solution is diluted further with ethyl alcohol (100 c.c.), seeded with lævulose and allowed to crystallise in a desiccator at the atmospheric temperature. The yield is 75—80% of the weight of crude lævulose taken. Generally a second crystallisation by the same method is necessary to obtain a pure product.—H. W.

Maltose; Action of ozone on pure solutions of ——. C. W. Schonebaum. Rec. Trav. Chim., 1922, **41**, 501—502.

Treatment of 5% solutions of maltose with ozone for 3 hrs. at ordinary temperatures and at 70° C. effects no decomposition if the solution is neutral. In $N/10$ acid solution no decomposition occurs in the cold, but rapid inversion takes place at the higher temperature. In $N/10$ alkaline solution 35% of the sugar is decomposed in the cold; in heated solution it is rapidly destroyed. Formic acid is a primary product; water and carbonic acid are the final products.—H. J. E.

Dextrose, lævulose, sucrose, lactose and maltose; Action of hydrogen peroxide on pure solutions of ——. C. W. Schonebaum. Rec. Trav. Chim., 1922, **41**, 503—508.

The object of the investigations was to ascertain whether hydrogen peroxide could be used industrially for purifying sugar solutions. The method used was to add 4 c.c. of a 3% neutral solution of hydrogen peroxide to 4 g. of sugar dissolved in 80 c.c. of solvent; after 3 hrs. the solution was diluted to 100 c.c. and analysed. The solvents used for the sugar were water, $N/10$ sulphuric acid, and $N/10$ caustic soda; in each case two determinations were made, at ordinary temperature and at 70° C. Control experiments were also carried out. In general under these conditions no decomposition of the sugar occurred except in the case of sucrose, which was inverted in neutral solution to the extent of about 10%. The general conclusion is drawn that thin syrups may be purified with hydrogen peroxide of the strength indicated, provided that the solution is feebly alkaline. With increased concentration of the peroxide, a proportion of the sugar is decomposed.—H. J. E.

Invert sugar; Relative sweetness of ——. J. W. Sale and W. W. Skinner. J. Ind. Eng. Chem., 1922, **14**, 522—525.

If sucrose is assigned a sweetening value of 100, the sweetening value of invert sugar is only 85; since, however, 100 units of sucrose when inverted become 105 units of invert sugar, the net loss of sweetening value by the inversion of 100 units of sucrose is about 11 units. Invert sugar syrup prepared with invertase and concentrated by boiling under reduced pressure is superior to syrups prepared with acid, being free from "harsh" taste though having a slight "candy" flavour.
—W. P. S.

Maize starch syrup [glucose]; Researches on ——. E. Parow. Z. Spiritusind., 1922, **45**, 229.

Chemical examination reveals but little difference between syrups prepared from maize starch and potato starch, but the latter are usually more satisfactory when subjected to the "confectioner's test" (*i.e.*, little or no discoloration on heating to 145° C.). Complete analyses of a number of starches and syrups indicated that the discoloration on heating was influenced by the fat and protein contents of the syrups. The addition of fat to a syrup increased the discoloration. A syrup with 0·06% fat and 0·09% protein showed little alteration on heating to 145° C.; but others having 0·14—0·19% fat and 0·19—0·39% protein were badly discoloured. High fat content may frequently be avoided by limiting the amount of oil added to prevent frothing in the vacuum apparatus during the manufacture of glucose.—A. G. P.

Starch; Combination of —— *with iodine.* H. v. Euler and S. Bergman. Kolloid-Zeits., 1922, **31**, 81—89.

Aqueous solutions of soluble starch dissolve more iodine than pure water and the solubility of iodine in soluble starch solutions containing potassium iodide is greater than the sum of the solubilities in solutions of the two constituents separately. The power of starch to take up iodine is therefore increased by the presence of potassium iodide. (*Cf.* J.C.S., Oct.)—J. F. S.

Starch; Combination of —— *with iodine.* H. v. Euler and S. Landergren. Kolloid-Zeits., 1922, **31**, 89—90.

The amount of iodine extracted from toluene solutions of iodine by soluble starch solutions containing a constant quantity of potassium iodide does not increase with increasing concentration of starch.
—J. F. S.

Polysaccharides; Constitution of ——. *I. Xylan and its acetyl derivatives. I.* S. Komatsu and K. Kashima. Mem. Coll. Sci. Kyoto, 1922, **5**, 307—314.

Xylan was prepared from maize cobs by extraction with caustic soda and repeated precipitation with alcohol. Unlike xylan from wheat straw, acetylation of the product was difficult. The monoacetyl derivative was prepared by heating with acetyl chloride under pressure or by the action of acetic anhydride in acetic acid solution with chlorine and sulphur dioxide as catalysts (J., 1921, 8 T). The diacetyl derivative resulted from treatment of xylan with acetyl chloride using pyridine or zinc chloride as a catalyst, and from further acetylation of the monoacetyl compound in the presence of chlorine and sulphur dioxide. Xylan is rapidly hydrolysed by dilute hydrochloric or sulphuric acid, yielding *l*-xylose. The velocity constants of the hydrolysis of xylose and its acetyl derivatives have been worked out.—A. G. P.

Glucosides. Indican. Macbeth and Pryde. *See* IV.

Glucose from cellulose. Irvine and Hirst. *See* V.

Saccharification of cellulose. Budnikow and Solotarew. *See* V.

Ion concentration measurements. Keeler. *See* XXIII.

Patents.

Diffusion apparatus for the extraction of sugar from the beet. A. Rak. E.P. 166,527, 5.7.21. Conv., 13.7.20.

The apparatus comprises a continuous battery of units, each consisting of an open-topped diffuser, arranged vertically and enlarged towards the bottom, and a slice-press of the spiral type, the bottom of the diffuser communicating with the bottom of the slice-press by a conduit enlarged towards the slice-press end, and blade and shovel mechanism for feeding the slices through the conduit, the diffusion of the material taking place successively in several stages according to the number of units employed. In order to compensate for the diminution of the volume of the slices at the preliminary stage, two units may be provided for the first stage communicating with a single series of units for the subsequent stages.—J. P. O.

Sugar juice; Treatment of ——. W. Mauss. E.P. 182,855, 8.3.21.

The mechanical impurities (cane chips, particles of gum, wax, etc.) are removed from the juice, preferably by centrifuging, the residue being washed with water while in the machine, discharged, mixed with more water, again centrifuged, and finally discharged, while the water finally separated is used for maceration during milling. The juice is then treated for the separation of its chemical impurities, *e.g.*, by the sulphitation process, the precipitate resulting being removed, preferably by filtration, and washed with water, these wash-waters being also used for maceration during milling.—J. P. O.

[Sugar] centrifugals; Method of and means for washing ——. R. A. Steps, Assr. to Sugar Machinery Co. U.S.P. 1,423,583, 25.7.22. Appl., 7.1.20.

A vertically thin, elongated spray of wash-water is made to sweep substantially from the top to the bottom and from the bottom to the top of the centrifugal, a nozzle and means to oscillate it at speeds varying at different levels in proportion to the thickness of the mass of sugar being provided.
—J. P. O.

Refined massecuite; Process for the manufacture of ——. A. Hinze. G.P. 353,194, 1.4.21.

A small part of the sugar to be worked up is dissolved in water at 60°—80° C. to give a saturated solution, in which the remainder of the sugar in a finely-divided form is stirred and the mixture is then boiled for a short time. The sugar does not become yellow in the process and less heat is required than in the older methods.—A. R. P.

Lactose; Process for purifying ——. E. Trutzer. G.P. 355,020, 28.11.20.

Solutions of crude milk-sugar are treated with calcium aluminate to adsorb or precipitate non-sugars, thus avoiding any excess of free calcium hydroxide and ensuring a good yield of lactose.
—A. R. P.

Starch; Manufacture of —— *[from wheaten flour].* F. H. Campbell. E.P. 182,829, 11.1.21.

In the manufacture of starch, wheaten flour is subjected to the action of a single proteolytic enzyme, *e.g.*, pepsin or trypsin, whereby the nitrogenous constituents are converted into water-soluble substances, without the starch or its envelope being affected. In an experiment 0·04% of pepsin (on the weight of flour) was heated in slightly acidified water to 40°—50° C., the flour added, and the temperature maintained while constantly mixing for 1½—2½ hours, after which the starchy matter was separated in a centrifuge and washed with water till free from acid.—J. P. O.

Starch; Method and apparatus for separating gluten from ——. Corn Products Refining Co., Assees. of R. G. Brindle. E.P. 159,838, 3.3.21. Conv., 8.3.20.

Starch containing gluten is aerated to produce a froth which is maintained in a substantially stable and quiescent condition so as to keep the bubbles of the froth from breaking until the starch liquor has drained therefrom, after which it may be subjected to a further aeration until it has reached a condition at which a stable froth cannot be obtained. It is then run into a vessel in which it separates by stratification into a lower layer of refined starch, an upper of nearly clear water, and an intermediate stratum of mixed starch, gluten, and water. The intermediate layer is withdrawn from the vessel, and subjected to further aeration.—J. P. O.

Dextrin; Apparatus for manufacturing ——. J. J. Merrill, Assr. to Corn Products Refining Co. U.S.P. 1,425,497, 8.8.22. Appl., 2.11.17.

The reaction vessel contains a rotary agitator provided with a number of blades. The upper and lower end portions of each blade stand at an angle to each other and the corresponding end portions of the blades are substantially parallel one with another.—J. R.

XVIII.—FERMENTATION INDUSTRIES.

Yeast; Fat-coloration in —— *as a criterion of age, quality, and degeneration.* Bernfeld. Woch. Brau., 1922, **39**, 195.

The presence of fat in yeast cells may be rendered evident by staining with either alkanna or Soudan III. An aqueous suspension of the yeast similar in consistency to that leaving the separators is stirred with alcoholic solution of Soudan III., saturated in the cold, this being added drop by drop until an orange-red coloration is obtained; the action of the colouring matter is continued for 30—80 minutes. The extent to which the colour is taken up increases with the number of generations; thus, if the time during which the dye acts is constant, cells of the first generation may show no colour, whilst those of the third generation exhibit small, slightly tinted points and those of the fourth larger and distinctly coloured fat drops. Small cells are usually richer in fat than older ones. The results obtained may be vitiated if the staining is prolonged, owing to the toxic action of the alcohol or dye coming into play. If 0·005% of Methylene Blue is mixed with the Soudan III., dead cells may be detected at the same time.—T. H. P.

Yeast fermentation; Simple contrivance for the automatic registration of ——. E. Sieburg. Biochem. Zeits., 1922, **130**, 459—462.

The evolution of carbon dioxide from a sugar solution and yeast is recorded on a kymograph by arranging that the fermenting solution is contained in the closed limb of a U-tube with a lower layer of mercury, on the surface of which there is a float carrying a pointer. By arranging a series of such U-tubes comparative measurements of various yeasts on the same substrate, and of the same yeast on various substrates, and the influence of accelerators can be recorded continuously by the tracings.—H. K.

Fermentation; Accelerators of ——. H. v. Euler and S. Karlsson. Biochem. Zeits., 1922, **130**, 550—555.

Washed dry yeasts, free from co-enzyme, are not activated by juices and extracts containing much vitamin-B, but there is marked acceleration of fermentation by washed dry yeast on addition of the co-enzyme.—H. K.

Invertase; Inactivation of —— *by small quantities of silver salts.* H. v. Euler and K. Myrbäck. Z. physiol. Chem., 1922, **121**, 177—182.

Euler and Svanberg had previously shown (*cf.* J., 1920, 795 A) that whilst invertase was inhibited by silver salts proportional to their concentration, mercuric salts behaved differently, the results falling on a curve. A re-examination of the effect of silver salts shows, however, a parallelism with the mercuric salt curves, the previous results being due to the fact that the inhibitive power depends on the concentration of the enzyme.—H. K.

Invertase preparations; Analytical investigation of ——. H. v. Euler and K. Josephson. Svensk Kem. Tidskr., 1922, **34**, 74—81. Chem. Zentr., 1922, **93**, III., 383.

The authors have estimated the ash, carbohydrates (by Molisch's colorimetric method), nitrogen, and phosphorus in a number of invertase preparations of known inverting powers. The poisoning of invertase by silver nitrate observed by Myrbäck is discussed, and the conclusion is drawn that 0·1% of the dry matter of yeast consists of pure invertase, about 0·3 g. of the latter occurring in 1 kg. of pressed yeast.—T. H. P.

Carbohydrates; Acetone and butyl alcohol fermentation of various ——. G. C. Robinson. J. Biol. Chem., 1922, **53**, 125—154.

The fermentative ability of an organism of the *Granulobacter* type, isolated from a sample of fresh barley, towards various carbohydrates was studied. The course of fermentation was followed by making periodic estimations of the titratable acidity of the media and of the amount and, where possible, the composition of the carbohydrates present. The carbohydrates studied fell into two groups according to the type of fermentation which occurred. In the first group, which consisted of dextrose, lævulose, mannose, sucrose, lactose, and starch, the acidity of the media, after reaching a maximum, showed a decided fall, whilst the carbohydrate was completely consumed. The second group comprised galactose, xylose, arabinose, raffinose, melezitose, inulin, and mannitol. In these cases the high acidity persisted and the consumption was incomplete. Dextrin fell into the first or second group according as it was prepared by the hydrolysis of starch with malt amylase or with acid. Trehalose, rhamnose, melibiose, and glycerol were not fermented. With mixtures containing dextrose and either sucrose or lactose, dextrose was preferentially consumed. Maltose, however, was fermented concurrently with dextrose, lævulose, or mannose. Galactose was more completely consumed in the presence than in the absence of dextrose. From the experimental data it is concluded that the organism secretes the enzymes amylase, inulinase, and maltase, but not invertase, lactase, or raffinase. Raffinose is hydrolysed to melibiose and lævulose by sucrase within the cell.—E. S.

Hexoses and related compounds; Fermentation of —— *by certain pentose-fermenting bacteria.* W. H. Peterson, E. B. Fred, and J. A. Anderson. J. Biol. Chem., 1922, **53**, 111—123.

The action on various sugars of four cultures of the group of pentose-fermenting organisms previously described (J., 1922, 72 A) has been examined. Dextrose, lævulose, lactose, raffinose, and melezitose were converted almost quantitatively into lactic acid, small quantities of carbon dioxide, which is regarded as a product of cell respiration, also being produced. With the last three sugars the action was slow, and, when the cultures became old, a secondary fermentation began with the production of volatile acids. Mannitol was fermented differently from the sugars, thus showing the influence of the terminal alcohol group. With one exception, in which no volatile acids were formed, the products from this substance were lactic acid, ethyl alcohol, formic acid, and acetic acid. The action of the pentose-fermenting bacteria resembles that of *Streptococcus lactis*. The lactic acid produced by the former, however, is always optically inactive whereas that produced by the latter is active.—E. S.

Action of quinine etc. on yeast etc. Rona and others. *See* XIXb.

Action of poisons on yeast. Traube and Klein. *See* XIXb.

Emulsin. Willstätter and Oppenheimer. *See* XX.

Chymosin and pepsin. Hammarsten. *See* XX.

Patents.

Drying yeast; Apparatus for ——. E. Klein. E.P. 176,340, 10.2.22. Conv., 3.3.21.

The apparatus comprises a rotating tank with air inlets and outlets and an intermediate floor permeable to air and provided with oblique air conduits the direction of which substantially coincides with that of the movement of the material on the bottom. The floor is composed of two superposed plates provided with bevelled portions arranged to form nozzle-like air passage spaces which extend obliquely to the plane of the plate. The tank is provided with a stationary cover which carries a stirring or disintegrating device. When the yeast reaches a certain degree of fineness it is separated and carried by air currents into a series of collecting tanks where the drying is completed. The escaping air containing yeast particles meets numerous baffle plates and with the repeated change in the direction of the air the yeast particles are separated.—J. R.

Yeast; Growing of ——. B. A. Stagner, Assr. to National Retarder Co. U.S.P. 1,425,065, 8.8.22. Appl., 6.7.18.

Suitable carbohydrate material and the products of hydrolysis of keratin or material containing keratin are supplied to the seed yeast in order to assist in its growth and to supply nitrogenous material. The resulting yeast is of good colour, odour, and keeping quality, and is suitable for use in the manufacture of leavened bread.—J. R.

Malt preparation; Process for producing a —— *for brewing purposes.* F. Vydra. E.P. 184,381, 19.8.21.

Bruised or ground malt is mashed with water, partly or completely saccharified, and kiln-dried at 110° C. The product is used in small amounts in brewing beer.—A. G. P.

Diastatic preparations; Process for making stable, dry ——. Diamalt A.-G. G.P. 354,944, 8.7.16.

Highly diastatic malt extract is incorporated with inorganic colloidal matter which binds the diastase colloidally; the dry product forms a colloidal solution with water. In order to re-activate the adsorbed diastase, alkali hydroxide is added either to the dry product or to its solution in water. Colloidal silica is specially suited for use as the inorganic colloid. The product is very stable to dry heat, easily analysed, keeps well, and forms solutions of high diastatic power.—H. C. R.

Alcohol; Dehydration of ——. J. Van Ruymbeke. E.P. (a) 184,036, 15.7.21, and (b) 184,129, 22.3.22.

(a) Alcohol of 92—93% concentration as obtained in the usual rectifying process is heated and the vapours are brought in contact with glycerin in a rectifying column through which a counter current of glycerin flows. By suitably regulating the rates of flow of the glycerin and alcohol vapour, the vapour leaving the column when condensed in the usual manner gives an alcohol of 98—99% concentration. The glycerin which flows to the bottom of the column carries away both alcohol and water. This alcohol may be recovered in a second rectifying column by injecting steam and passing the recovered alcohol to the primary rectifying apparatus. The aqueous glycerin is then concentrated and used to dehydrate further amounts of 92—93% alcohol. (b) Instead of glycerin alone, a solution containing glycerin and an anhydrous salt or salts of a hygroscopic nature such as calcium chloride, zinc chloride, or potassium carbonate, may be employed with increased efficiency. By the use of such a mixture in the rectifying column an alcohol of 99·8% concentration or even higher may be obtained. After use the mixture of glycerin and salt is distilled in a current of steam to recover the alcohol and the residue concentrated by heating *in vacuo* at 160° C.—J. R.

Dealcoholising beverages. H. Heuser. U.S.P. 1,426,066, 15.8.22. Appl., 4.6.19.

Beverages are heated under reduced pressure and the vapours evolved carried away to a cooled receptacle.—A. G. P.

Distillery waste; Process of recovering volatile organic acids from ——. L. M. Burghart, Assr. to U.S. Industrial Alcohol Co. U.S.P. 1,426,457, 22.8.22. Appl., 24.6.18.

The sugary material is mixed with a soluble caustic alkali and heated in a furnace. The clinker containing soluble oxalates and salts of other acids, is extracted with acidified water. Lime is added to precipitate calcium oxalate, after the removal of which the liquor is evaporated, treated with a non-volatile mineral acid and alcohol, and the esters formed collected.—A. G. P.

Glycerin; Production of —— *by fermentation.* A. T. Cocking and C. H. Lilly. U.S.P. 1,425,838, 15.8.22. Appl., 23.8.20.

See E.P. 164,034 of 1919; J., 1921, 557 a.

XIXa.—FOODS.

Self-raising flour; Determination of carbon dioxide in ——. B. R. Jacobs. J. Ind. Eng. Chem., 1922, 14, 419—420.

Five grams of the flour is placed in a flask connected with an absorption vessel containing a definite volume of standardised barium hydroxide solution, 100 c.c. of 0·1% diastase solution is added to the flask, and a current of air free from carbon dioxide is passed through the apparatus while the flask and its contents are heated, first at 70° C. for 10 mins. and then at 100° C. for 25 mins. The mixture is finally boiled for a few seconds, the absorption vessel then disconnected, and the excess of barium hydroxide titrated, using phenolphthalein as indicator. If it is desired to determine the residual carbon dioxide, the operation is continued after the addition of hydrochloric acid to the contents of the flask.—W. P. S.

Urea; Value of —— *for increasing the production of milk from cows.* W. Völtz, W. Dietrich, and H. Jantzon. Biochem. Zeits., 1922, **130**, 323—431.

A detailed description is given of a large number of experiments on the value of urea, alone, and mixed with feeding materials such as potatoes or beet poor in protein, in comparison with earth-nut cakes. The minimum maintenance demand of digestible protein was 0·33 kg. per 1000 kg. of cow per diem. The yields of milk and of the constituents of milk were invariably increased by administration of urea; not more than 150 grams per day per cow must be given.—H. K.

Casein; Products of prolonged tryptic digestion of ——. S. Fränkel and P. Jellinek. Biochem. Zeits., 1922, **130**, 592—603.

When casein is digested with trypsin until the bromine reaction for tryptophan is negative, the filtrate after precipitation with Hopkins' reagent gives on removal of mercury and addition of alcohol, racemic hydroxyproline in 0·8% yield. From the filtrate mercuric chloride precipitates histidine anhydride dihydrochloride, m.p. 285°, in small quantity. The mercuric chloride precipitate in alkaline solution contained ammonium and methylammonium chlorides.—H. K.

Proteins and their derivatives; New combined fractionation method for separating ——. M. A. Rakusin. Biochem. Zeits., 1922, **130**, 432—441.

The filtrates from 95% alcoholic extracts of a large number of animal and vegetable proteins and of enzymes, were tested qualitatively by various colour reactions and found to contain carbohydrate and nitrogenous substances in most cases. Pepsin-fibrin peptone can be fractionated by extraction with 95% alcohol and subsequent successive treatment of the filtrates with a 10% suspension of aluminium hydroxide for periods of 24 hours each, into a number of fractions which differ from one another in their colour reactions to various protein and carbohydrate reagents.—H. K.

Proteins; Kinetics of the coagulation of —— *by heat.* H. Lüers and M. Landauer. Z. angew. Chem., 1922, **35**, 469—471.

The coagulation of proteins by heat is considered as occurring in two stages, viz., a chemical process of denaturation, and the subsequent physical flocculation of the denatured particles. The initial process in the case of the plant albumin, leucosine (obtained from barley or malt extract) was found to be a reaction of the first order. Working at $p_H=6{\cdot}09$ and temperatures between 52·9° and 57·05° C., the temperature coefficient was 1·47 per degree. —A. G. P.

Proteins; Proteolysis in material containing ——. G. Chabot. Bull. Soc. Chim. Belg., 1922, **31**, 193—204.

Experiments on proteolysis were made with the aid of green malt such as is used in the manufacture of yeast by the aeration method, this material being rich in proteolytic enzymes and containing sufficient protein to allow the course of proteolysis to be easily followed. The malt was used at a concentration of 20%, and changes due to the action of micro-organisms were excluded by the addition of sodium fluoride solution. The extent of peptonisation was measured by determinations of amino-acid nitrogen by Sörensen's method before and after proteolysis. Sodium fluoride had no appreciable effect on the percentage of protein decomposed at 17° C.; at 35° C. it appeared to exert a slight inhibiting action, whilst at 50° C. it facilitated decomposition to a small extent. The optimum temperature for peptonisation over a period of 4 hrs. was about 45° C., and 25·17% of the total nitrogen was found as amino-acids capable of titration with formaldehyde. In absence of sodium fluoride, the optimum temperature was 35° C. Determinations of the optimum time at 45° C. in presence of sodium fluoride showed that continuance of the action from 15 hrs. to 24 or even 36 hrs. gave but a small increase in % of nitrogen as amino-acid. Investigation of the optimum reaction of the medium carried out by addition of different amounts of $N/10$ sulphuric acid and $N/10$ caustic soda showed that the addition of 0·2 g. of sulphuric acid per 100 g. of malt gave the greatest yield of amino-acid; this addition corresponds to the neutralisation of about three-fourths of the natural alkalinity of the malt. Hydroxyl ions, even in small quantity, exert an inhibiting action, which increases with the concentration. The author discusses briefly the part played in peptonisation by hydrogen ions.—H. J. E.

Eggs; Methods of minimising shrinkage during the storage of ——. L. H. Almy, H. I. Macomber and J. S. Hepburn. J. Ind. Eng. Chem., 1922, **14**, 525—537.

Loss on weight during storage of eggs is mainly due to the escape of moisture through the shells, and is not prevented by preliminary treatment with hot air for 5 mins., or to any appreciable extent by treating the eggs with cold or hot solutions of mineral or organic acids, mineral salts, or soap. Experiments with vegetable, animal, and mineral oils (used as coatings on the eggs) showed that sealing properties are not strictly related to drying properties of the oils. Cottonseed oil makes a very good sealing agent, and the value of mineral oils for the purpose bears a definite relation to their sp. gr., flash pt., and viscosity. Mineral oils are probably preferable to vegetable oils because they are less likely to impart odour to the eggs and are less subject to change during storage. The addition of 1 or 2% of soap increases the sealing value of a mineral oil, but nothing is to be gained by the addition of gums, waxes, or rosin to relatively heavy mineral oils.—W. P. S.

Foods; Method of determining hydrogen sulphide evolved by —— *when cooked at various temperatures.* E. E. Kohman. J. Ind. Eng. Chem., 1922, **14**, 527—529.

The food substance is placed in a 3-litre flask which is fitted in an autoclave supplied with steam from a boiler; the flask is closed with a wooden stopper and a tube extending from just above this stopper to the bottom of the flask allows steam to enter the latter from the autoclave. A delivery tube from the flask passes through the cover of the autoclave and is connected with a condenser provided with a receiver containing bromine solution. The delivery tube is fitted with a tap to control the rate of distillation; if desired, the delivery tube may have a branch capillary tube, which also enters the condenser, this arrangement in conjunction with the tapped tube yielding a more uniform volume of distillate. The distillation is made at 120° C., about 650 c.c. of distillate being collected in 45 mins. The oxidised sulphur compounds in the distillate are determined in the usual way as barium sulphate. In the case of green maize etc., reducing substances other than sulphides are found in the distillate; as measured by permanganate reduction the hydrogen sulphide amounts to about one-tenth of the reducing substances.—W. P. S.

Water-soluble B [vitamin]; Presence of the antineuritic substance ——, *in the chlorophyll-free plants.* C. R. Orton, E. V. McCollum, and N. Simmonds. J. Biol. Chem., 1922, **53**, 1—6.

Vitamin B is present in small quantities in onion roots; it is therefore concluded that this vitamin is not associated with the chloroplasts in plant tissue. The mushroom *Agaricus campestris* is a good source of vitamin B; experiments with Indian-pipe, *Monotropa uniflora*, gave inconclusive results. —E. S.

Water-soluble B [vitamin]; Glacial acetic acid as a solvent for the antineuritic substance ——. V. E. Levine, E. V. McCollum, and N. Simmonds. J. Biol. Chem., 1922, **53**, 7—11.

Glacial acetic is a good solvent for the extraction of vitamin B from plant material. Impurities can be largely removed from such extracts by precipitation with ether.—E. S.

Theobromine and caffeine; Apparatus for the extraction of ——, *with boiling chloroform.* O. P. A. H. Schaap. Pharm. Weekblad, 1922, **59**, 920—923.

The apparatus is a modified Soxhlet extractor, of specified dimensions, the siphon tube being completely outside the extractor tube. The material to be treated is placed in a Schleicher and Schüll thimble, which is supported from below by a wad of cotton wool placed in the extraction tube. A bath of hot water (70°—75° C.) surrounds the latter. The chloroform must boil gently in the extraction tube for ten minutes before siphoning over, and the shape and dimensions of the apparatus and the procedure are of importance in securing this.—S. I. L.

Lye hominy: its discoloration and a new process for its manufacture. E. F. Kohman. J. Ind. Eng. Chem., 1922, **14**, 415—418.

Lye hominy is usually prepared by boiling maize (2100 g.) with sodium hydroxide solution (7 l. containing 52 g. of sodium hydroxide), washing the product with cold water and cooking it; the finished product has a dark or even black colour due to incomplete removal of the alkali by washing. The degree of alkalinity, and consequently the colour, also depends to some extent on the size, shape, and age of the grains. If the grains are subjected to a scrubbing action directly after the treatment with alkali, the outer layer of the grains and the tips are removed, the residual alkalinity is thus decreased, and the product is white.—W. P. S.

See also pages (A) 746, *Digestion of straw* (Blasweiler). 768, *Beef bone fat* (Eckart). 769, *Ability of hardened fats to hold water in suspension* (Brauer). 784, *Creatinine* (Pfizenmaier and Galanos); *Chymosin and pepsin* (Hammarsten). 790, *Ion concentration measurements* (Keeler).

Patents.

Blood; Processes for preserving the fluidity of ——. F. W. V. Fitzgerald. E.P. 183,943, 5.5. and 9.11.21.

The initial coagulation of blood is prevented if the calcium salts in the blood are removed, *e.g.*, by precipitation with a neutral or alkaline solution of a soluble oxalate or fluoride or a mixture of both. In addition a preservative may be added.—J. R.

Pectin-containing material; Process of making —— *and resulting product.* F. G. Beylik and N. W. Schwartzlose. E.P. 184,081, 5.9.21.

Pectous materials, such as pectic acid $C_{16}H_{22}O_{15}$ and pectosic acid $C_{32}H_{46}O_{31}$, are prepared from plant materials containing pectin as follows: The material comminuted by crushing or slicing is dehydrated at a low temperature, ground to a fine condition, and extracted with a solvent (such as alcohol) capable of dissolving substantially all the substances present except pectous material and cellular tissue. The residue has pectin, pectic and pectosic acids uniformly distributed throughout the mass. In making jellies, jam, etc. it is only necessary to add a small quantity of the pectous material to the fruit juices which form the basis of the jelly or jam. The cellular tissue present does not interfere with the making of a clear jelly.—J. R.

Vegetable albuminoid and process of producing it. A. Moffatt, Assr. to E. H. Wolcott. U.S.P. 1,425,033, 8.8.22. Appl., 24.8.18.

Vegetable material is subjected to the action of an "amylolytic" acid and then boiled until all the starch originally present is rendered soluble. The resulting mixture is drained free from liquor and the insoluble residue of albuminoids and fats washed free from the soluble products of the amylolysis.—J. R.

Coffee; Method of roasting and packing ground or whole ——. J. A. Reynolds. U.S.P. 1,426,011, 15.8.22. Appl., 4.12.19.

Green coffee is roasted in a vessel from which air is excluded. The volatile products are removed by evacuation, and condensed on a cellulose menstruum. The roasted coffee is stored, together with a portion of the impregnated cellulose, in sealed containers.—A. G. P.

Preserved eggs and process therefor. A. K. Epstein. U.S.P. 1,426,559, 22.8.22. Appl., 9.12.20.

Eggs, after removal from the shells, are mixed with glycerin, frozen, and stored in a frozen condition till required for use.—A. G. P.

Feeding-stuffs; Manufacture of —— *from straw and the like.* E. Beckmann. G.P. 354,822, 2.2.19.

Straw or the like is digested with alkali carbonate solution. Great care is not necessary in washing out the excess alkali carbonate, since it is not injurious to cattle.—J. B. F.

Dehydrated milk. International Dry-Milk Co., and S. M. Dick. E.P. 184,203, 4.2.21.

See U.S.P. 1,374,555 of 1921; J., 1921, 407 A.

Crystallising oils and fats. U.S.P. 1,426,555. *See* XII.

Albuminous matter from glue solutions. G.P. 355,879. *See* XV.

XIXb.—WATER PURIFICATION; SANITATION.

Aeration of quiescent columns of distilled water and of solutions of sodium chloride. W. E. Adeney, A. G. G. Leonard, and A. Richardson. Sci. Proc. Royal Dublin Soc., 1922, **17**, 19—28.

The aeration of quiescent bodies of water, fresh and salt, under natural conditions is effected by a process of mixing of the exposed layer with the unexposed portions of the water to depths of at least ten feet. The mixing is caused by the downward streaming of the constantly changing layer of water exposed to the air. This process is more rapid and more uniformly downward in salt water than in fresh water. The rate of streaming depends largely on the rate of cooling of the surface layer by evaporation, and it is more rapid at temperatures above 10° C. The optimum rate of streaming is reached with a 1% salt solution.—J. F. S.

Effluent from strawboard mills; Treatment and disposal of ——. H. B. Hommon. Proc. Amer. Soc. Civil Eng., 1922, **48**, 1397—1402.

As a result of tests carried out at 7 strawboard mills in America, it is estimated that about 38,500 galls. of effluent is produced in the manufacture of 1 ton of strawboard; on this basis 20,000,000,000 galls. of waste water, containing approximately 161,000 tons of dry suspended solids, was discharged from the various plants in the United States during 1918. Investigation has shown that this waste can be treated at reasonable cost, so that it may be safely discharged into a body of water affording a dilution factor of 5 or 6. For every ton of strawboard produced per day the following should be provided: settling tanks of a combined capacity of 975 cub. ft., filter bed (for drying sludge) made of unscreened cinders, 10 in. deep and 875 sq. ft. in area; filter for settled effluent made of screened cinders (screened over a ¼″ screen) 5 ft. deep and 4171 sq. ft. in area. The raw effluent should be allowed to settle for 2 hrs. in the settling tanks and then run on to the filter bed. From results already obtained it is believed that filter beds, made as described above, with cinders screened over a ¼″ screen, could be used for years for treating strawboard wastes, but would probably require to be flushed once a year, preferably with fresh water, to remove clogging material. The sludge from the settling tank could be used as a fertiliser.—D. J. N.

Carbonyl chloride; Sorption of —— by beechwood charcoal. H. M. Bunbury. Trans. Chem. Soc., 1922, **121**, 1525—1528.

The sorption of carbonyl chloride by beechwood charcoal at 18° C. and 100° C., as measured by Travers' apparatus (Proc. Roy. Soc., 1904, **74**, 126; 1906, A **78**, 9), agrees with the formula $x/m=kp^{1/n}$. At 18° and 100° C., the values of $1/n$ are 0·231 and 0·488 and of k 0·235 and 0·038 respectively. Approximate equilibrium is established after a few minutes, the velocity of sorption being extremely rapid.

—P. V. M.

Bacteria, erythrocytes, and yeast; Use of the ultramicroscope for examination of the action of poisons on the cells of ——. I. Traube and P. Klein. Biochem. Zeits., 1922, **130**, 477—480.

By means of the ultramicroscope it is possible to follow the adsorption of submicrons present in saturated aqueous solutions of a variety of toxic substances such as xylidine, octyl alcohol, nonylic acid, *m*-cresol, thymol, and vuzin on red-blood corpuscles, Soor's bacilli, and yeast cells. The penetration of these substances into the cells and the subsequent break up of the cells through hæmolysis, plasmolysis, etc. can be followed.—H. K.

Invertase, maltase, and α-methylglucosidase; Action of quinine, narcotics and arsenic compounds on ——. P. Rona, Y. Airilla and A. Lasnitzki. Biochem. Zeits., 1922, **130**, 582—591.

The combined inhibitory action of quinine and narcotics on invertase is less than the sum of their individual actions. Arsenious acid, arsenic acid, and atoxyl had no action on maltase or α-methylglucosidase, but methyl arsenious oxide was inhibitory.—H. K.

Formaldehyde. Kühl. *See* XXIII.

Patents.

Water; Process for softening —— by means of base-exchanging materials and lime. H. Reisert und Co., Komm-Ges. auf Aktien. G.P. 354,315, 22.3.21.

By treating with lime a mixture, in suitable proportions, of water which has been softened by treatment with base-exchanging materials and of unsoftened water, a soft water containing only small quantities of sodium bicarbonate is obtained.

—H. R. D.

Aryl ethers of phenols and cresols for use as insecticides and fungicides. Farbenfabr. vorm. F. Bayer und Co. G.P. 355,206, 4.7.19. Addn. to 343,864 (J., 1922, 193 A).

The aryl ethers of phenols and cresols, *e.g.*, diphenyl ether, cresyl ether, chlorophenyl ether, diphenylene oxide, may be used in the same way as the alkoxyalkyl and alkyl ethers specified in the previous patent.

Water; Process for the softening of ——. G. G. Hepburn. U.S.P. 1,426,638, 22.8.22. Appl., 17.8.21.

See E.P. 173,255 of 1920; J., 1922, 193 A.

Insecticide. G.P. 353,682. *See* V.

Detergent and disinfectant. E.P. 184,248. *See* XII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Alkaloids; Relation between constitution of —— and Vitali's reaction. P. Hardy. J. Pharm. Chim., 1922, **26**, 172—176.

It has been shown that Vitali's reaction, which was considered to be characteristic of atropine and hyoscyamine, is also given by isoatropylcocaine. The author shows that scopolamine also responds to the test, which is a general test for esters formed by the combination of an alcohol with tropic acid and other acids of analogous constitution.

—H. J. E.

Codeine salts: the hydrobromide. Preparation of solutions for injection. F. Martin. J. Pharm. Chim., 1922, **26**, 176—187.

The author's results on the composition and dehydration of crystallised codeine hydrobromide are in agreement with those of Dott (Pharm. J., 1884, **14**, 917), namely that the crystallised salt loses ½ mol. H_2O when heated on a boiling water bath and the remaining 1½ mols. at about 115° C. The solubility of this salt is considerably increased in presence of sodium benzoate or salicylate; the preparation of solutions for subcutaneous injection, based on this increase in solubility, is described.

—H. J. E.

Colchicine: its assay, isolation and special properties. E. C. Davies and J. Grier. Pharm. J., 1922, **109**, 210—211.

In preparing the alkaloid in quantity by the use of phosphotungstic acid, satisfactory precipitation is only possible in presence of sodium chloride. The best results were obtained by the following method: The powdered seeds and corms are treated with methylated spirit in a Soxhlet extractor in which the boiling flask is placed at the side so that the drug is not exposed to heat. The alcohol is distilled off, the residue extracted with hot water, and any oil removed with ligroin. The impure alkaloid is then extracted with chloroform and the chloroform residue extracted with hot water. This extract is filtered and the filtrate precipitated by phosphotungstic acid in presence of 2% of sodium chloride and 0·5% of hydrochloric acid. The precipitate is collected, washed free from sodium chloride with 0·1% hydrochloric acid, and transferred to a separator containing chloroform. A slight excess of ammonia is added, the chloroform evaporated and residue crystallised from 50% alcohol. No difference was found in the product from seed and corm. The most satisfactory solvents for the extraction of the powdered drug were chloroform, ethyl alcohol, methyl alcohol, and methylated spirit. Assay was carried out volumetrically with Mayer's and Schiebler's reagents and also by precipitation with Schiebler's reagent. It was found that 1 c.c. of Mayer's reagent ($N/20$) is equivalent to 0·011 g. of colchicine. The centrifuge was utilised to obtain more rapid separation of the precipitate, thus increasing the sensitiveness of the method. The results of the above and of gravimetric estimations with Schiebler's reagent established the ratio of

1 part of colchicine to 3·3 of phosphotungstic acid as the proportions in which they combine. The precipitation was carried out in the presence of sodium chloride and hydrochloric acid, the precipitate being washed, dried and ignited; it decomposed at 200° C. yielding $P_2O_5, 20WoO_3$. Colchicine gives a green coloration with alkali, and may thus be estimated colorimetrically in dilute solution. An account of the properties of the alkaloid and also those of colchiceine is given together with the methods of preparation of colchicine salicylate and tannate. A list of the usual tests for colchicine is appended. The authors note that phenol, cresol and thymol give precipitates with the alkaloid and suggest that the tannate and salicylate are not true salts but addition products in which the phenolic rather than the carboxylic group is functioning. —H. J. E.

Hyoscyamine and its sulphate. Preparation and racemisation. A. Goris and P. Costy. Bull. Sci. Pharmacol., 1922, **29**, 113—121. Chem. Zentr., 1922, **93**, III., 268—269.

Hyoscyamine and atropine can be separated by making use of the different solubilities of the free bases in benzene or of the sulphates in alcohol. The conversion of crystalline hyoscyamine into atropine is very slow at 100° C., but is greatly increased if the base has previously been dissolved in chloroform. At 118° C. the conversion is complete in 2 hours. In the dissolved state the transformation occurs more readily in aqueous than in alcoholic solutions, but aqueous solutions of hyoscyamine sulphate are stable even on prolonged heating.—D. F. T.

Plants; Chemical constituents of green ——. XIX. Occurrence of lactic acid and succinic acid in the leaves of the raspberry (*Rubus Idæus*). H. Franzen and E. Stern. Z. physiol. Chem., 1922, **121**, 195—220.

The aqueous extract of raspberry leaves after removal of substances precipitable by lead acetate, contains chiefly calcium, magnesium, and manganese salts of lactic acid with a little succinic acid. The dried leaves contain 1% of lactic acid. The isolation and characterisation of these acids is facilitated by fractionation of the esters, conversion into hydrazides, and condensation with benzaldehyde.—H. K.

Emulsin. II. R. Willstätter and G. Oppenheimer. Z. physiol. Chem., 1922, **121**, 183—194.

In continuation of previous work (J., 1922, 228 A) it is found that those enzyme actions of the emulsin complex which proceed best in a decidedly acid medium follow the unimolecular law, as, for instance, hydrolysis of salicin, arbutin, helicin, and phenylglucoside. By comparing the times at which 50% of the following glucosides have been hydrolysed, helicin, salicin, phenylglucoside, arbutin, methylglucoside, prunasin, and amygdalin, by nine totally distinct preparations of emulsin, it is found that the ratio of the time values for helicin, salicin, and phenylglucoside alone is the same in each case. This is the first quantitative demonstration that one enzyme of the emulsin complex can attack different substrates. This enzyme, phenylglucosidase, is most specific for helicin.—H. K.

Ring-substituted phenylphosphinic and phenylarsinic acids; Comparative study of ——. D. R. Nijk. Rec. Trav. Chim., 1922, **41**, 461—500.

The following improved methods of preparation of these acids are given: *p-Aminophenylarsinic acid.* A mixture of 30 g. of freshly-distilled aniline and 22 g. of dry arsenic acid is heated to 170°—200° C. in an hour, and then at 200° C. for two hours; the product is cooled to 100° C., added to concentrated caustic soda and shaken so as to dissolve as much as possible, then filtered. The filtrate is extracted three times with ether to remove excess of aniline, rendered slightly acid with nitric acid, and evaporated to a small volume. The acid which crystallises on cooling is dissolved in dilute caustic soda and the solution heated gently with animal charcoal and filtered into absolute alcohol. The sodium *p*-aminophenylarsinate (atoxyl) separates in colourless crystals. The yield is somewhat increased with an excess of aniline and corresponds to 25—30% of the arsenic acid used. *5-Nitro-2-aminophenylarsinic* (*nitranilinarsinic*) *acid.* Double the usual yield is obtained by the following method: A mixture of 55 g. of *p*-nitraniline and 10 g. of arsenic acid is heated to 206° C. for 15 min., and at 230° C. or below during the subsequent reaction. *Phenylarsinic acid.* 30 g. of aniline is dissolved in 243 g. of 50% nitric acid with 580 c.c. of water, the whole being cooled on ice. The solution is diazotised with 21 g. of sodium nitrite in a little water. Concentrated caustic soda is then added, the temperature being kept down by a freezing mixture, until the mixture is only feebly acid; the last traces of acidity are removed by addition of sodium acetate. The diazonium nitrate is then added drop by drop with constant shaking, to a mixture of cuprous hydroxide suspended in 200—300 c.c. of water, 33 g. of arsenious oxide, 40 g. of caustic soda, previously dissolved in 100 c.c. water, and ether (about 30 c.c.). The completion of the action is ascertained by testing with β-naphthol. The product is filtered, the filtrate acidified with hydrochloric acid, treated with animal charcoal and evaporated on the water bath until the phenylarsinic acid begins to separate in colourless needles. The greater part of the acid is obtained at this stage; the remainder is extracted by hot absolute alcohol after the mother-liquor has been evaporated to dryness. The yield from 30 g. of aniline was 20 g. of the acid.—H. J. E.

o-Toluenesulphonamide; Oxidation of ——. A. W. Pamfilow. Ber. Polytech. Iwanowo-Wosniessensk, 1921, **4**, 167—168. Chem. Zentr., 1922, **93**, III., 353.

Oxidation of 1 mol. of the sodium salt of the amide with 2·4 mols. of potassium permanganate for 6 hrs. at 60° C. gives 80% of the theoretical yield of saccharin. On oxidation of the free amide by similar means the yield of saccharin is 10—15% lower, and the amount of permanganate used i doubled.—J. B. F.

Hydantoins. Synthesis of the soporific 4-phenyl-4-ethylhydantoin [*nirvanol*]. W. T. Read. J. Amer. Chem. Soc., 1922, **44**, 1746—1755

Phenyl ethyl ketone reacts with an absolute alcoholic solution of ammonium cyanide to form phenylethylaminoacetonitrile, $(C_6H_5)(C_2H_5)C(CN).NH_2$; reaction does not take place in aqueous solution and even in 95% alcohol the yields are very low. The nitrile is converted by potassium cyanate in the presence of glacial acetic acid into the nitrile of phenylethylhydantoic acid, $(C_6H_5)(C_2H_5)C(CN).NH.CO.NH_2$, in 80% yield. When this compound is boiled with hydrochloric acid (20%), it is transformed into 4-phenyl-4-ethylhydantoin in 85% yield. The latter substance may be prepared by the procedure outlined above from phenyl ethyl ketone without isolating and purifying the intermediate products, the yield being 62%. (*Cf.* J.C.S., Oct.).—H. W.

Trihalogen tertiary butyl alcohols; Derivatives of ——. IV. Benzoyl ester of tribromo-tert.-butyl alcohol or brometone benzoyl ester. T. B. Aldrich and J. E. Blanner. J. Amer. Chem. Soc., 1922, **44**, 1759—1762.

Tribromo-tert.-butyl benzoate (brometone benzoate), monoclinic crystals, m.p. 90° C., is prepared in excellent yield by heating molecular proportions of benzoyl chloride and brometone on the water bath until hydrogen chloride ceases to be evolved. It is not readily saponified. In contrast to brometone, the halogen atoms are not readily removed by treatment with sodium hydroxide solution. Its insolubility probably accounts for its lack of physiological action. The nitrobenzoates of chloretone and brometone are prepared similarly by the use of the nitrobenzoyl chlorides or, in the case of the meta compounds, by nitration of the parent esters with concentrated nitric acid. They are not as active physiologically as the alcohols from which they are derived, possibly owing to their insolubility in water.—H. W.

Oxyhæmoglobin; Preparation of crystalline ——. M. Heidelberger. J. Biol. Chem., 1922, **53**, 31—40.

The method described depends upon the fact that the washed corpuscles from dog's or horse's blood crystallise almost completely in the presence of toluene when saturated with a mixture containing four parts of carbon dioxide to one of oxygen. The oxyhæmoglobin so obtained may be recrystallised by dissolving in sodium carbonate solution and re-precipitating by saturation with the above mixture of gases. Salts may be removed from the recrystallised product by pressure dialysis. It is essential to perform all operations in the cold and in the presence of excess of carbon dioxide, and to prevent the oxyhæmoglobin becoming dry at any stage. Using this method, preparations with 96—100% of the theoretical oxygen capacity have been obtained. —E. S.

Creatinine; Determination of ——. K. Pfizenmaier and S. Galanos. Z. Unters. Nahr. Genussm., 1922, **44**, 29—41.

The method given in the "Schweizerisches Lebensmittelbuch" for the determination of creatinine is rapid and simple, but can only be successfully used when light coloured solutions are available for the colorimetric comparison and a colorimeter of the Duboscq type is used. If the solutions are dark in colour or contain sugar the method fails, as animal charcoal cannot be used because it adsorbs creatinine. Colorimetric comparison in cylinders (*loc. cit.*) was found to be unsatisfactory. The method of Sudendorf and Lahrmann (J., 1915, 1027) is of general application and is the only one available for use with dark-coloured solutions. If the authors' instructions are exactly followed and too great an excess of potassium permanganate —especially with very dark-coloured solutions— is avoided, accurate results are always obtained. The methods referred to are described in detail. —H. C. R.

Glyoxalinedicarboxylic acid for the recognition and separation of organic bases. H. Pauly and E. Ludwig. Z. physiol. Chem., 1922, **121**, 165—169.

Glyoxalinedicarboxylic acid forms sparingly soluble and well crystallised acid salts with organic bases. The salts of the following are described: Methylamine, m.p. 240°—245°; dimethylamine, 238°—239°; trimethylamine, 264°—265°; ethylamine, 253°—254°; diethylamine, 180°; propylamine, 212°; *n*-butylamine, 225°—227°; piperidine, 221°—222°; *d*-coniine, 208°—209°; atropine, 93°; hydrazine, above 260°; guanidine, 241°—242°; glyoxaline, 245°; and *l*-histidine, 253°—254°. The solubilities of the last four are very small, of the others between 2 and 45%.—H. K.

Chymosin and pepsin. VII. Experiments on their purification. O. Hammarsten. Z. physiol. Chem., 1922, **121**, 240—260.

The starting material was prepared by extraction of the mucous membrane of the pig's stomach with 0·2% hydrochloric acid and precipitation of the "crude pepsin" as a hyaline mass by half saturation with sodium chloride. Preliminary experiments are described in which the sodium chloride was dialysed away in 0·2% hydrochloric acid and the solution kept at 37° to denature. The solution was then either (1) dialysed against water, (2) precipitated by half saturation with sodium chloride, or (3) precipitated by saturation with ammonium sulphate. The present communication deals mainly with the fractional extraction of the "crude pepsin" by water in a centrifuge, dialysis of the extracts, and analysis of their content in organic matter, pepsin, and chymosin. The successive extracts, except the later ones, compare favourably in activity with Pekelharing's pepsin although the qualitative reactions are different. A comparison of the clotting time on milk and the digestive power by Mett's test of the author's preparation with Pekelharing's preparation showed no parallelism under any conditions. The author's solutions are stable, very faintly acid, and inactivated by neutralising.—H. K.

Chymosin and pepsin. VIII. Relative sensitiveness to alkali of the stomach enzymes of the calf and pig. O. Hammarsten. Z. physiol. Chem., 1922, **121**, 261—282.

Michaelis and Rothstein (Biochem. Zeits., 1920, **105**, 60) found that alkali destroyed chymosin and pepsin from the pig's stomach at the same rate, whilst the author (Z. physiol. Chem., 1915, **94**, 291) found that these enzymes when prepared from the calf's stomach were acted upon by alkali at totally different rates. This is now ascribed to the use of different animals. Chymosin from the pig's stomach is destroyed much more rapidly than chymosin from the calf's, and the same probably applies to the pepsin content. The experiments, moreover, point again to the separate entities of chymosin and pepsin as they are destroyed at different rates.—H. K.

Furfural; Commercial ——. *Its properties and uses. I.* C. S. Miner, J. P. Trickey, and H. J. Brownlee. Chem. and Met. Eng., 1922, **27**, 299—303.

The physical and chemical properties of furfural are described in some detail, together with a number of its condensation products with other organic compounds. A method of manufacture on a large scale from oat-hulls (which should yield nearly 20% of their weight in furfural) by digestion with steam and acid under pressure has been worked out and a production of several tons per month is being made by the process. The toxic effect of furfural is about half that of phenol for gold-fish and its bactericidal action is about one-quarter that of phenol.—A. R. P.

Furfural solutions; Distillation of aqueous ——. H. Bergström. Svensk Papperstidning. Zellstoff u. Papier, 1922, **2**, 139—140.

The distillation constants of dilute aqueous solutions of furfural are as follows:—

Percentage of fnrfural by weight—

In solution	0·1	0·2	0·5	1·0	1·5	2·0	2·5	3·0	3·5	4·0	4·5
In vapour	0·7	1·3	3·4	6·5	9·1	11·4	13·1	14·7	16·2	17·6	19·0

The values are very similar to those found for dilute solutions of methyl alcohol.—J. F. B.

Furfural; Commercial ——. *Its properties and uses. II.* C. S. Miner, J. P. Trickey, and H. J. Brownlee. Chem. and Met. Eng., 1922, **27**, 362—366.

The use of furfural in making resins, varnish, dyes etc. is briefly discussed and a complete bibliography

of furfural and its chief derivatives is appended. Preliminary tests show that it may be used as a solvent for nitrocellulose, hydrated cellulose acetates, and oleic acid.—A. R. P.

Formic acid; Catalytic decomposition of —— on surfaces of platinum and silver. H. C. Tingey and C. N. Hinshelwood. Trans. Chem. Soc., 1922, **121**, 1668—1676.

The thermal decomposition of formic acid in contact with platinum yields carbon dioxide and hydrogen exclusively at temperatures from 235° to 80° C. This is not analogous to the decomposition in contact with glass at these temperatures, as carbon monoxide and water are never formed. The temperature coefficient of the reaction in contact with platinum is approximately the same as that of the corresponding reaction in contact with glass, viz., 1·7—1·8. The "heat of activation," calculated from the formula $d.\log.k/dT=Q/RT^2$, is 22,000 cals. per g.-mol. for platinum, and 28,000 cals. for glass. In contact with silver the decomposition yields mainly carbon dioxide and hydrogen. The temperature coefficient for this reaction is again high, 1·9—2·3, corresponding to a mean "heat of activation" of 31,000 cals. Varying amounts of carbon monoxide are also formed, most of which can probably be accounted for by the reaction in contact with the walls of the glass bulbs used. Platinum foil catalyses only slightly, and silver powder not at all, the formation of carbon dioxide from carbon monoxide and water. Platinum is the most efficient catalyst and is associated with the lowest heat of activation with respect to one and the same mode of reaction, *i.e.*, decomposition into carbon dioxide and hydrogen.—P. V. M.

Trimethylene; Preparation of —— in a pure condition. M. Trautz and K. Winkler. J. prakt. Chem., 1922, **104**, 37—43.

Trimethylene is conveniently prepared by the reduction of trimethylene bromide in amyl alcohol by zinc dust at 100°—115° C. The gas evolved is fractionated at a low temperature in an apparatus which is described, and pure trimethylene obtained with the following constants: vapour density, 1·45—1·49; sp. gr. of liquid, 0·720; m.p., −127°; b.p., −34·5° at 750 mm.; $n_{He}=1{\cdot}000977$.
—W. O. K.

Propylene; Preparation of —— in a pure condition. M. Trautz and K. Winkler. J. prakt. Chem., 1922, **104**, 44—52.

Propylene is prepared in very good yield by passing propyl alcohol or, preferably, isopropyl alcohol over aluminium oxide or fragments of graphite crucibles at 360° C., preferably under diminished pressure. It is purified by passing through a receiver cooled in ice, then over calcium chloride and potassium hydroxide, through a vessel cooled in a mixture of toluene and solid carbon dioxide, and finally over calcium chloride. Pure propylene has the following constants: vapour density, 0—2% higher than corresponds to the molecular weight; sp. gr. of liquid, 0·647; b.p., −47·8° at 750 mm.; it does not solidify in liquid air; $n_{He}=1{\cdot}00102$. The specific volumes of mixtures of trimethylene and propylene in the liquid condition are additive.—W. O. K.

Aldehydes; Reduction of acid chlorides to —— by means of nickel catalysts. H. Schliewiensky. Z. angew. Chem., 1922, **35**, 483.

Attempts to prepare benzaldehyde by the reduction of benzoyl chloride with hydrogen in the presence of a nickel catalyst (*cf.* Rosenmund, J., 1918, 442 A) were unsuccessful. Reaction could not be effected in the presence of catalysts prepared from freshly precipitated basic nickel carbonate which was (*a*) ignited while moist in air to the oxide and subsequently reduced by hydrogen in an electric furnace at 310°—320° C., (*b*) heated directly in the tube at 310°—320° C., and subsequently reduced at the same temperature, and (*c*) dried at 100° C. in air and then ignited and reduced in hydrogen at 310°—320° C. Failure cannot be attributed to inactivity of the catalyst, which rapidly caused the hydrogenation of fats.—H. W.

Aldehydes; Reduction of acid chlorides to —— by means of nickel catalysts. K. W. Rosenmund. Z. angew. Chem., 1922, **35**, 483.

In reply to Schliewiensky (*cf. supra*) it is pointed out that attention has already been drawn (*cf.* J., 1918, 442 A) to the variability in the behaviour of palladium and nickel as catalysts in the conversion of acid chlorides to aldehydes by hydrogen. A trustworthy procedure has been given in the case of palladium (Rosenmund and Zetzsche, J., 1921, 321 A); a modified method will be published in the case of nickel.—H. W.

Formaldehyde; Determination of —— in impure solution. F. Kühl. Collegium, 1922, 133—142.

An investigation of the sulphite method (*cf.* Auerbach, J., 1905, 1187), Blank and Finkenbeiner's method (J., 1899, 79), and Romijn's iodine potassium cyanide methods (J., 1897, 366) shows that the potassium cyanide method is the best.—D. W.

Pinene hydrochloride; The borneol obtained from the magnesium compound of ——. G. Vavon and A. L. Berton. Comptes rend., 1922, **175**, 369—372.

Pinene hydrochloride was prepared by treatment of French turpentine with gaseous hydrogen chloride, and was treated with Grignard's reagent. The product on oxidation and subsequent treatment with ice-water, yielded an alcohol which was found to be a mixture of borneol and isoborneol. If oxidation takes place at a low temperature, the proportions in which these two substances are obtained are about equal, but at a higher temperature borneol free from isoborneol may be produced. The determination of the relative quantities of the two substances depends on the fact that the optical rotatory power of borneol varies but little with the nature of the solvent, whilst in the case of isoborneol the variations are considerable.—H. J. E.

Inchi grass (Cymbopogon cæsius, Stapf); Essential oil from ——. K. L. Moudgill and K. R. K. Iyer. Perf. and Ess. Oil. Rec., 1922, **13**, 292—295.

The characters of the oil (yield 0·8%) were: Soluble in 87% alcohol; sp. gr. at 30°/4° C., 0·9187; $n_D^{30}=1{\cdot}484$; $[\alpha]_D^{30}=-38{\cdot}9°$; acid value, 1·7; saponif. value, 5·6; acetyl value, 120; percentage of aldehydes (Bennett's hydroxylamine method), 4·2. The oil is not identical with any of the known commercial oils from allied grasses, and may be used as a substitute for palmarosa oil, which it resembles in odour. It contains *l*-borneol, *l*-camphene, *l*-limonene, *l*-terpineol, and unidentified sesquiterpene constituents.—H. C. R.

Theobromine and caffeine. Schaap. *See* XIXA.

Modified Schiff's solution. Wertheim. *See* XXIII.

Hæmoglobin. Terrill. *See* XXIII.

Patents.

Allylarsenic acid; Manufacture of ——. F. Hoffmann-La Roche u. Co. A.-G. E.P. 167,157, 29.6.21. Conv., 26.7.20.

Allylarsenic acid, colourless needles or coarse prisms, m.p. 129°—130° C., is prepared by treating a tertiary alkali arsenite, in aqueous solution and in the presence of an excess of alkali, with allyl halides.—H. W.

Acetone; Method of manufacturing —— from acetic acid. Stockholms Superfosfat Fabriks Aktiebolag. E.P. 171,391, 9.11.21. Conv., 9.11.20.

A catalyst is employed with metallic aluminium as a carrier. It is prepared by slowly cooling molten aluminium, with vigorous stirring, to obtain it in a porous and granular form. This metal is then placed in a solution or suspension of the catalyst substance and the liquid evaporated off. The tube containing such a catalytic preparation can be uniformly heated without difficulty and the difference of temperature in the catalytic mass nearest to the walls of the tube and in the central parts is small even if a tube of considerable size is employed. Acetone is produced from acetic acid in good yield and of a very high degree of purity by passing acetic acid over the heated catalyst prepared as described.—J. R.

Remedy for malignant tumor [colloidal metallic selenides and tellurides]; Manufacture of a ——. L. Lilienfeld. E.P. 173,507, 22.12.21. Conv., 23.12.20.

Colloidal selenides or tellurides of such metals as gold, iridium, platinum, mercury, silver, copper, etc. are obtained by the action of hydrogen or alkali selenides and tellurides on dilute solutions of the respective metallic salts in the presence or absence of protective colloids, such as gelatin, casein, starch, dextrin, soaps, etc., or the water-soluble alkylpolysaccharides, such as methylcellulose or ethylstarch. If the latter substances are used the colloidal selenide or telluride may be separated by coagulating the alkylcellulose or alkylstarch by heating to 50°—80° C., and the coagulum can be filtered off, and thoroughly washed with hot water, and the product may, if desired, be dissolved in alcohol and precipitated with ether, before it is finally dried. If other protective colloids, or none at all, are used, coagulation by heat is not feasible and other purifying methods such as dialysis must be employed.—G. F. M.

Esters; Process of converting organic acids into ——. P. Haddan. From E. Zollinger-Jenny. E.P. 183,897, 4.4.21.

The conversion of organic acids, other than polyhydroxy-fatty acids, into esters is greatly simplified and accelerated by the use of zinc or tin or other metal of the periodic group including tin. The metal need not necessarily be in the finely-divided state; it may be introduced into the apparatus in the form of a regulus or be applied to the floor or wall or to a body inserted in the vessel. As soon as the temperature of reaction is reached and maintained, the conversion sets in and proceeds with considerable speed until the mixture is neutral. It is not essential to have an excess of the alcoholic component; the mixture may be in stoichiometrical proportions. Organic acids of the highest molecular weight, including resin acids, can be converted into esters in this way and the process can be applied not only to pure, free fatty acids but also to fatty acids mixed with fat or diluted with primary monohydric or other alcohols. An example is given of the esterification of a mixture of copra oil waste and copra fat acids with glycerin. [Reference is directed, in pursuance of Sect. 7, Sub-Sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 112,624; J., 1919, 427 A.]—H. W.

Esters; Process for the manufacture of ——. A. A. Backhaus, Assr. to U.S. Industrial Alcohol Co. U.S.P. 1,425,625, 15.8.22. Appl., 11.10.19.

The ester formed by heating a mixture of an alcohol and an organic acid in the presence of a catalyst is continuously removed by distillation; the major portion of the other vapours accompanying the ester is condensed and returned to the reaction vessel.—D. F. T.

Ichthyol oil, ichthyol preparations and the like; Manufacture of ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 184,292, 21.5.21.

Ichthyol oil is obtained in better yield and containing a higher proportion of sulphidic sulphur than has hitherto been found possible by subjecting Seefeld or other sulphurised shales to high-speed mechanical disintegration in presence of water in a "colloid mill." The oil in the shale is thereby dispersed to form a permanent emulsion with the water, whilst the mineral matter separates out on standing. To obtain the oil from the emulsion, the latter is heated to 60°—70° C., if desired, with the addition of an electrolyte, *e.g.*, hydrochloric acid. The oil can be further purified by solution in an organic solvent. The purified oil contains about 20% of sulphidic sulphur, compared with about 8% in preparations hitherto obtained. The emulsions of oil and water obtained as above described can be themselves used to advantage for therapeutic purposes, either with or without the addition of protective colloids, as they are readily absorbed by the skin. Sulphonation of the ichthyol to obtain a water-soluble product and the concomitant partial decomposition which ensues are thereby obviated.
—G. F. M.

Acetic anhydride; Manufacture of ——. H. W. Matheson and G. E. Grattan, Assrs. to Shawinigan Laboratories, Ltd. U.S.P. 1,425,500, 8.8.22. Appl., 25.4.18.

Acetylene is passed through acetic acid (96—100%) heated to 60°—200° C. in the presence of a finely-divided salt of mercury.—J. R.

Chlorine products from unsaturated hydrocarbons; Process for producing ——. A. E. Maze. U.S.P. 1,425,669, 15.8.22. Appl., 16.8.20.

Acetylene is passed into an alkaline solution of an alkali metal which has been saturated with chlorine.
—D. F. T.

Borneols and camphene; Manufacture of ——. B. T. Brooks, Assr. to The Viscoloid Co. and The Fiberloid Corp. U.S.P. 1,426,036, 15.8.22. Appl., 6.4.20.

The mother liquor obtained after the separation of crystallisable bornyl chloride from the product of the action of dry hydrogen chloride on pinene, is treated with a fatty acid in presence of an alkali salt of a fatty acid, and a bornyl ester and camphene are thereby obtained.—G. F. M.

Methyl sulphites of secondary aromatic aliphatic amines and process of making same. M. Bockmühl and K. Windisch, Assrs. to Farbw. vorm. Meister, Lucius, und Brüning. U.S.P. 1,426,348, 22.8.22. Appl., 16.7.21.

Compounds of the general formula,

$$RR'N.CH_2.OSO_2M,$$

where R and R′ are an aromatic and an aliphatic radicle respectively, and M an alkali metal, or ammonium, are obtained by condensing secondary aromatic aliphatic amines of the type RR′NH with a formaldehyde-bisulphite compound.
—G. F. M.

Pharmaceutical product. H. Weyland, H. Hahl, and R. Berendes, Assrs. to Farbenfabr. vorm. F. Bayer und Co. U.S.P. 1,426,430, 22.8.20. Appl., 8.8.21.

The condensation product obtained from xylene, sulphur, and aluminium chloride is a valuable

remedy for scabies. It forms a dark yellow oil, b.p. 150°—230° C. at 3—5 mm. pressure.
—G. F. M.

Aldehydes; Apparatus for making —— and separating them from other products formed. A. A. Backhaus and F. B. Arentz, Assrs. to U.S. Industrial Alcohol Co. U.S.P. 1,426,449, 22.8.22. Appl., 24.6.18.

The apparatus consists of a combination of a catalyser chamber, a means for passing alcohol vapours through it to form an aldehyde and hydrogen, an alcohol condenser, and a means for separating the resulting aldehyde and hydrogen consisting of a scrubber, by means of which acetic acid is brought into contact with the vapours on the counter-current principle.—G. F. M.

Calcium chloride preparation; Process for preparing a non-hygroscopic, easily soluble ——. Calcion Ges. m.b.H. G.P. 354,247, 12.4.19.

The known process for the preparation of diglycollic acid by introducing lime into monochloroacetic acid is modified by evaporating to dryness the solution of calcium chloride and calcium diglycollate obtained. The product obtained is stable to changes of temperature, easily soluble, contains 30% $CaCl_2$, and is useful in therapeutics. A product developing strong alkalinity in the body is often required in this connexion. This can be obtained by replacing part of the lime with an alkali, such as sodium hydroxide. A mixture of calcium chloride, calcium diglycollate, and sodium diglycollate is thus obtained, and the last-named compound changes to sodium carbonate in the body and facilitates the absorption of the calcium chloride.—H. C. R.

Acridine derivatives; Preparation of ——. L. Casella und Co., G.m.b.H. G.P. 354,400, 21.12.17.

Aliphatic aldehydes are allowed to react, preferably in dilute mineral acid solution, with 3.6-diamino-10-alkylacridinium compounds or their substitution products. With formaldehyde at ordinary temperatures acridinium compounds yield products insoluble in water and useful for antiseptic purposes as dusting powders. If the reaction is carried out at 100° C. the resulting products are more soluble and may be used medicinally for certain skin diseases. With acetaldehyde in *N*/1 hydrochloric acid solution 3.6-diamino-10-methylacridinium chloride gives at ordinary temperatures a powdery dark reddish-brown condensation product that on drying assumes a green metallic lustre. It dissolves in hot water to an orange-red solution which dyes cotton mordanted with tannin in orange-yellow shades which are fast to soap, soda, and acids. If the condensation is effected at 100° C under a reflux condenser, a reddish-brown lustrous powder is obtained, which is readily soluble in water and dyes cotton mordanted with tannin various shades of red. Similar products may be obtained from other acridinium derivatives on condensation with formaldehyde or acetaldehyde; they all dye cotton in yellow to red shades.—A. R. P.

Trypsin-hydrochloric acid preparations; Process for making stable ——. A.-G. für Anilin-Fabr. G.P. 354,481, 19.2.18.

Preparations containing trypsin, such as *Pancreatinum activum* or *absolutum*, or their compounds with tannic acid, are mixed in the dry state with betaïne hydrochloride or betaïne hydrochloride and pepsin. The mixture retains the properties of trypsin even after long storage. It is useful in the treatment of diseases of the stomach and intestines.—H. C. R.

Tropinemonocarboxylic acids; Process for the preparation of ——. E. Merck, O. Wolfes, and H. Maeder. G.P. 354,696, 17.10.20.

A mixture of acetonedicarboxylic acid, methylamine, and succinic dialdehyde is reduced in a neutral or faintly acid or alkaline solution; for example, a mixture of calcium acetonedicarboxylate, methylamine, and succinic dialdehyde is acidified with acetic acid and reduced with 3% sodium amalgam with the addition of acetic acid from time to time to keep the mixture just acid. After acidification with sulphuric acid and removal of calcium sulphate, the solution is rendered alkaline with caustic potash and the tropine bases are extracted by shaking with ether. The alkaline solution is neutralised, concentrated, and stirred with methyl alcohol to precipitate salts which are filtered off. The methyl alcohol solution contains severally optically inactive isomeric tropinemonocarboxylic acids which can be separated only with great difficulty. From one of the isomers, which is identical with ecgonine, a methyl ester, m.p. 122°—126° C., may be obtained. When treated with benzoic anhydride in benzene solution, this yields a benzoyl derivative, which, after recrystallisation from light petroleum ether, melts at 79°—80° C. and is identical with optically inactive cocaine. The reduction process may be carried out in alcoholic or alkaline solution or with metallic sodium in ethereal solution but not with strongly acid reducing agents, such as tin and hydrochloric acid.
—A. R. P.

Esters of tropinonedicarboxylic acid; Preparation of ——. E. Merck, O. Wolfes, and H. Maeder. G.P. 354,950, 29.6.20.

Solutions of succinic dialdehyde in water, of esters of acetonedicarboxylic acid in alcohol, and of methylamine and caustic potash in water are carefully mixed together and the mixture is kept cooled for several hours, after which the product is neutralised with acid and the alcohol distilled off. The residue is treated with ammonia and shaken several times with chloroform. The chloroform solution is separated and the solvent distilled, whereby diethyl tropinonedicarboxylate remains behind as a viscous uncrystallisable oil, slightly soluble in water with a weak alkaline reaction and more readily soluble in alcohol, ether, chloroform, and ethyl acetate. It gives a reddish-violet colour with ferric chloride, instantaneously decolorises bromine water and permanganate solution, and unlike tropinonemonocarboxylic acid esters, forms no solid hydrate with water. Boiling with acids yields tropinone, while careful saponification gives the ethyl ester of the monocarboxylic acid.—A. R. P.

Basic aluminium salicylate; Method for the preparation of ——. Soc. Chim. Usines du Rhône. G.P. 354,698, 29.6.21.

Aluminium hydroxide and salicylic acid are mixed in molecular quantities, in presence of water; warming facilitates the reaction. The product is a colourless, occasionally reddish, powder, containing 25·75% Al_2O_3 and having the formula, $C_6H_4(OH)CO_2.Al(OH)_2$. It is distinguished from the normal salicylate by its stability when heated with water and dilute acid. It passes undecomposed through the stomach and is a remedy for intestinal catarrh and diarrhœa.—J. B. F.

Colloidal suspensions; Process of producing stable —— in organic media immiscible with water. H. Karplus. G.P. 355,109, 31.5.18. Addn. to 293,848.

Two colloidal suspensions prepared in accordance with G.P. 293,848 and 296,637 (*cf.* E.P. 8640–1 of

1915; J., 1916, 601, 823) are simultaneously or successively dispersed in the same organic medium. One of the colloidal substances is a compound of the magnesium or aluminium group prepared in accordance with the previous patents.—J. S. G. T.

Acoine; Process for making clear solutions of —— in oils. G. Hirsch. G.P. 355,121, 13.3.18.

Acoine (di-*p*-anisylmonophenetylguanidine hydrochloride) is gradually added to the oil heated to its boiling point in such a way that the acoine does not come in contact with the walls of the containing vessel. The oily solution is used as a dispersing medium for insoluble mercury salts to allow of the painless incorporation of the latter in the human body.—H. C. R.

Serum and lymph preparations; Process for making stable ——. L. Cassella und Co., G.m.b.H. G.P. 355,415, 21.11.19.

The raw material is treated with acridine dyestuffs. For example, in the preparation of small-pox vaccine, the raw lymph is mixed with 3—5 times the quantity of a sterilised 1% solution of 3.6-diamino-10-methylacridinium chloride (Neutra-trypaflavine), and is then worked up in the usual manner. The trypaflavine lymph is distinguished from glycerol lymph by its green colour and its fluidity. The preservative power of the acridine dyestuffs is greater than that of glycerol or of the phenols usually employed. The action of sera and lymphs is not in any way affected by acridine dyestuffs, which, not being poisonous, are incapable of producing any harmful effects.—H. C. R.

Ethyl alcohol; Production of —— from acetylene or ethylene. W. Karo. G.P. 356,175–6, 16.3.19, and 19.9.20.

Ethylene or acetylene, mixed with hydrogen and oxygen and sufficient inert gas to render the mixture non-explosive, is passed over a catalyst consisting of a mixture of two or more finely divided metals on a suitable carrier, one metal at least being of the platinum group and one a less noble metal, such as copper, nickel, or iron. If the hydrocarbon is purified by passing it through solutions of copper sulphate in sulphuric acid and of bichromate in sulphuric acid no dilution with inert gas is necessary. By passing a mixture of 2 vols. of ethylene, 2 vols. of hydrogen, 1 vol. of oxygen, and 1 vol. of nitrogen or of 2 vols. of acetylene, 4 vols. of hydrogen, 1 vol. of oxygen, and 1 vol. of nitrogen over a nickel-palladium catalyst at 100° C., a yield of 12% of alcohol in the former and 8—10% in the latter case is obtained.—A. R. P.

Acetaldehyde; Process of manufacturing ——. H. W. Matheson. Reissue No. 15,434, 22.8.22, of U.S.P. 1,384,842, 19.7.21. Appl., 5.5.22.

See E.P. 132,557 of 1918; J., 1919, 845 A.

Dinitroglycol and its homologues; Process for the preparation of ——. H. Oehme, Assr. to The Chemical Foundation, Inc. U.S.P. 1,426,313, 15.8.22. Appl., 27.6.19.

See G.P. 338,056 of 1918; J., 1921, 640 A.

Amines. E.P. 184,234. *See* III.

Mercury. G.P. 356,507. *See* VII.

Acids from distillery waste. U.S.P. 1,426,457. *See* XVIII.

XXI. — PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photographic emulsion; Theory of the characteristic curve of a ——. F. C. Toy. Phil. Mag., 1922, 44, 352—371.

The relation between the number of silver halide grains made developable and the light intensity has been studied for a number of grain sizes. The curves obtained by plotting the percentage of grains made developable against the log. of the intensity of light possess the characteristic S shape only for the grain size of $0{\cdot}98\mu^2$. Larger grains give curves in which the first point of inflexion is absent. A theory of the photographic plate is based on these results. The halide grains are assumed to contain sensitive nuclei, which are capable of change under the action of light in such a way as to become developable. These nuclei are produced during the precipitation and ripening of the emulsion and are not composed of silver halide. They are distributed throughout the grains according to the laws of chance, some particles possessing several nuclei. Those in the larger grains appear to be the more sensitive. Svedberg's assumption regarding the similarity of the light-sensitive material in large and small grains is not in agreement with the experimental facts in the case of a fast emulsion.
—W. E. G.

Photographic emulsions; Mutual infection of contiguous silver halide grains in ——. A. P. H. Trivelli, F. L. Righter, and S. E. Sheppard. Phot. J., 1922, 46, 407—410.

The authors claim to show that in the case of an emulsion containing flat, polyhedral grains, the individual grain is not the photographic unit, but that the grains are capable of mutually infecting each other. In the case of a clump of two or more grains, if one grain is reducible, the whole clump develops completely as a unit. This is in direct conflict with the results obtained by Svedberg (J., 1922, 348 A) with spherical grains, and it is suggested that the spherical grains and the flat, polyhedral grains represent two extreme cases.
—W. C.

Photochlorides and colloidal silver; Colour of ——. K. Schaum and T. Marx. Kolloid-Zeits., 1922, 31, 64—70. (*Cf.* J., 1921, 561 A.)

A method of determining the real colour of colloidal particles is described, and using this method it is shown that the faintly reflecting red particles of colloidal silver are in reality yellow, the red colour being due to a colour contrast with the many green particles also present. The colour range obtained in photographic intensification may be completely reversed in photographic reduction as follows: a blue silver sol is mixed with an equal volume of a 10% gelatin solution and allowed to set, then a concentrated solution of ammonia, potassium cyanide or sodium thiosulphate is poured on it and allowed to diffuse. After several days the following range of colours is observed commencing at the top of the tube: colourless, yellow, orange, red, reddish-violet, bluish-violet, and blue. Silver sols of various colours may be produced by the addition of definite amounts of magnesium sulphate, ammonium chloride, sodium chloride, or potassium sulphate. Thus with a yellow silver sol, 0·10 c.c. of $N/2$ magnesium sulphate gives an orange sol, 0·20 c.c. red; 0·25 c.c. purple; 0·30 c.c. reddish-violet; 0·50 c.c. bluish-violet, and 1·50 c.c. blue.—J. F. S.

Patents.

Photography; Process of producing multicoloured screens for ——. I. Kitsee. U.S.P. 1,426,995, 22.8.22. Appl., 17.1.19.

Figurations are produced on the gelatinous sub-

stratum of a moving picture film by means of a coloured alcoholic solution containing a dissolved resin, and the interspaces between these figurations are coloured with the aid of a dye insoluble in alcohol. By this means a multicoloured screen integral with the moving picture film is obtained.
—W. C.

Ferroprussiate paper; Manufacture of ——. E. Bertsch. G.P. 354,388, 16.10.20. Addn. to 320,981 (J., 1920, 676 A).

A simple acid salt is added to the emulsion in addition to excess of normal alkali oxalate. The advantages claimed are quicker printing and that the paper remains yellow for a longer time.—W. C.

XXII.—EXPLOSIVES; MATCHES.

Nitrocellulose; Some changes undergone by ——. A. Angeli. Z. ges. Schiess- u. Sprengstoffw., 1922, 17, 113—115.

The action of pyridine on collodion-cotton (12% N) was studied with the object of elucidating the changes undergone by the basic organic stabilisers usually added to nitrocellulose and nitroglycerin powders. The nitrocotton was extraordinarily easily gelatinised by the pyridine, forming a very viscous liquid which, however, rapidly lost its viscosity and in a few days had the appearance of ordinary pyridine. On adding water to the solution a white resinous mass was precipitated which tenaciously retained the smell of pyridine even after solution in sulphuric acid. The white powder obtained represented 80% of the weight of collodion-cotton used, was easily soluble in acetic acid, soluble in alcohol, but almost insoluble in ether and benzene. It burnt much more slowly than the original nitrocotton. Its nitrogen content varied between 9% and 10%. The substance was similar to that obtained by Berl and Fodor (J., 1910, 978, 1083) by the action of alkali hydroxides or carbonates on very dilute solutions of nitrocellulose in alcohol and ether. Heated in a glass tube the substance began to turn brown at 165° C. and became almost black at 250° C. An alcoholic solution of the substance when poured into water gave a very stable opalescent colloidal solution, which was coagulated by sodium chloride, ammonium sulphate, or gelatin, but gave no precipitate with aqueous tannin. The substance reacts readily with phenylhydrazine. Paper saturated in dimethylaminoazobenzene after a short time becomes intensely red in colour when subjected to the action of the wet compound, showing the development of an acid reaction. This is attributed to the volatilisation of the pyridine or the hydrolysis of the pyridine salt by water. The use of weak organic bases as stabilisers for nitrocottons is considered objectionable on account of the possibility of the production of acidic products through hydrolysis. Diphenylamine remains present as such in nitrocottons much longer than other organic bases. This may be due to it being such a weak base that it is only capable of reacting with nitrous acid to form the nitrosamine.—H. C. R.

Smokeless powders; Testing —— *for acidity.* A. Angeli. Z. ges. Schiess- u. Sprengstoffw., 1922, 17, 115—116.

The propellant is finely divided, suspended in water, and treated with a few drops of a 0·2% solution of dimethylaminoazobenzene. If no acids are present the particles of propellant remain of a lemon-yellow colour. In cases where acidity has developed they are coloured a more or less intense red. The liquid in which the propellant is suspended remains in either case entirely colourless.
—H. C. R.

Mercury oxycyanide; Explosibility of ——. H. Kast and A. Haid. Z. ges. Schiess- u. Sprengstoffw., 1922, 17, 117.

Mercury oxycyanide blackens and gives off smoke without flame on being strongly triturated in a porcelain mortar. It decomposes when struck by a 2 kg. weight falling 40 cm., and explodes with a similar weight falling 60 cm. With a 10 kg. weight the heights are 10 cm. and 16 cm. respectively. It is therefore more sensitive than gunpowder and picric acid and less so than tetryl. Ignited by a flame or red hot substance it burns with a pale red flame, but cannot be ignited by the sparks from pyrophoric cerium alloys. Its rate of burning in the open is greater than that of tubular smokeless powder but much less than that of gunpowder. It ignites at 170° C. in a bath of Wood's metal. Tested in the Trauzl block it gave an increase of volume of 10 c.c. without correcting for the detonator used. Assuming decomposition according to the formula $Hg(CN)_2,HgO=2Hg+C+CO+N_2+64{\cdot}5$ cals., the gas evolved per kg. is 190 l., heat per kg. 138 cals., temperature of explosion 2620° C., and specific energy 2090 kg.-litres, these figures being considerably less than those accepted for gunpowder.—H. C. R.

Patents.

Ammonium perchlorate explosives; Process for making easily cast ——. Chem. Fabr. von Heyden A.-G. G.P. 306,370, 2.9.17.

Ammonium perchlorate is mixed with nitrates of nitrogenous bases, especially ammonium nitrate, and salts of fatty acids or hydroxy-fatty acids, free hydroxy-fatty acids, amides of aliphatic carboxylic acids, sulphuric esters, and where necessary dihydroxybenzenes, aromatic hydroxy-acids and sulphonic acids or their salts. In addition to being easily cast these explosives are characterised by giving little noxious vapour on explosion when the compounds mixed with the perchlorate are in the form of alkali salts.—H. C. R.

Shells; Process for filling projectiles such as —— *with an explosive mixture consisting mainly of ammonium nitrate and charcoal.* Verein Chem. Fabr. in Mannheim. G.P. 310,130, 9.9.17.

The oxidising agent is melted alone and the charcoal is stirred into the melt, preferably in a vessel other than that used for melting the first constituent, *e.g.*, in a measuring vessel containing exactly the charge for one shell, and provided with heating and stirring arrangements. The charcoal mixes better if it is previously briquetted, the binding material used being ammonium nitrate. In this way shells may be rapidly and safely filled with a very effective explosive.—H. C. R.

Explosive and propellant; Process for preparing an —— *from ammonium nitrate and nitrates, oxalates, and similar salts of ammonium and amines.* Verein Chem. Fabr. in Mannheim. G.P. 334,547, 8.12.16.

The mixture is liquefied and re-solidified in a homogeneous or nearly homogeneous condition. For example the solvent is rapidly evaporated from a solution of the components by allowing the concentrated solution to flow over steam-heated rolls, from which the solidified mass may be removed by scrapers. Alternatively the constituents may be melted together at as low a temperature as possible and the melt rapidly cooled.—H. C. R.

Match composition. M. Pohl. G.P. 347,120, 30.5.20.

The addition of lignite to a mixture of potassium chlorate, sulphur, clay, binding materials, and filling materials, is proposed.—H. C. R.

XXIII.—ANALYSIS.

Stalagmometer and stagonometer; A new ——. I. Traube. Biochem. Zeits., 1922, **130**, 476.

The stalagmometer described previously (J., 1922, 121 A) is not suitable for measurements of viscosities.—H. K.

Analysis; Refractometric and interferometric quantitative ——. I. Becka. Z. physiol. Chem., 1922, **121**, 288—299.

The author has extended the observations of de Crinis on the use of the refractometer for the analysis of solutions so as to make it more generally applicable. He also describes the use of the interferometer for more dilute solutions. The experiments have special reference to urine analysis. —H. K.

Ion concentration measurements; Application of —— to the control of industrial processes. E. A. Keeler. J. Ind. Eng. Chem., 1922, **14**, 395—398.

Several forms of electrodes are described which are suitable for industrial work and examples are given of the application of the hydrogen-ion method to the control of neutralisation processes in the case of such materials as pineapple juice, tooth pastes, beet sugar juice (carbonatation process), wool scouring liquor, tanning liquors, boiler feed water, etc. —W. P. S.

Heat of combustion of benzoic acid, sucrose, and naphthalene. W. Swietoslawski and H. Starczewska. Bull. Soc. Chim., 1922, **33**, 654—667.

Further experiments have been made in order to obtain standard values; the results are in accord with those of Dickinson (J., 1915, 411). The most probable value for the heat of combustion of benzoic acid, which is recommended as standard, is 6323 cals. per g. in air, at 15° C., or 6318 cals. per g. *in vacuo*. (*Cf.* J., 1922, 328 R.)—H. J. E.

Osmium; Recovery of —— from microscopical preparations. O. Bosse and H. von Wartenberg. Z. wiss. Mikros., 1922, **38**, 346—349. Chem. Zentr., 1922, **93**, III., 119.

The material is saponified with caustic potash, evaporated, and the soap fused with potassium nitrate in a nickel crucible. The melt is treated with water, and nickel sulphate solution added. On standing nickel hydroxide, part of which becomes oxidised to the hydrated peroxide, settles out carrying with it the osmium. The precipitate is filtered off, and the precipitate and filter transferred to a 250 c.c. flask fitted with a ground-in dropping funnel and provided with a drain tube. The precipitate is treated with a mixture of chromic and sulphuric acids and kept warm. The contents of the flask are then steam distilled, and a solution of pure osmium tetroxide is obtained. An iron crucible cannot be used because too much iron passes into solution during fusion producing an inconvenient amount of hydroxide. In the authors' experiments 70% of the osmium was recovered.—J. B. F.

Micro-analysis of mixtures with special reference to organic ultimate analysis. A. Benedetti-Pichler. Z. anal. Chem., 1922, **61**, 305—331.

The application and advantages of microchemical methods of analysis are described; the importance of obtaining a representative sample for analysis is emphasised and limits of error are discussed. —W. P. S.

Isotopes of lead; Chemical method of separating ——. T. Dillon, R. Clarke, and V. M. Hinchy. Sci. Proc. Royal Dublin Soc., 1922, **17**, 53—57.

Lead chloride recovered from residues from the manufacture of mesothorium has been made to react with magnesium ethiodide according to the equation:

$$2PbCl_2+4MgC_2H_5I=Pb(C_2H_5)_4+2MgCl_2+2MgI_2+Pb,$$

and the atomic weight of the lead in the tetraethyl compound and the metal lead determined. The values 207·1 and 207·4 were obtained, indicating that the isotopes of lead react differently with magnesium ethyl iodide and showing the possibility of separating the isotopes by this reaction.—J. F. S.

Oxygen in organic compounds; Determination of ——. H. ter Meulen. Rec. Trav. Chim., 1922, **41**, 509—514.

The substance to be analysed is heated in a current of pure dry hydrogen and the resulting gas passed over reduced nickel, the water produced being collected and weighed. The results appear to be accurate when proper precautions are taken. The hydrogen is washed in permanganate solution, dried in sulphuric acid, freed from traces of oxygen by passing over heated platinised asbestos and then over calcium chloride. It is then brought into contact with the material to be analysed (0·1—0·2 g. heated in a platinum boat contained in a quartz tube) and passed over finely divided nickel which is maintained at a bright red heat, afterwards being brought into contact with nickelised asbestos heated to 350°—400° C. in a spiral hard glass tube. It is in the spiral tube that the transformation into water occurs and the product is then passed through calcium chloride tubes, and finally through a soda-lime tube to collect any carbon dioxide that has escaped reduction. The method is not applicable to substances which contain halogens or sulphur, which act as catalyst poisons, nor is it available in the case of nitrogenous substances, as the ammonia formed on hydrogenation is retained by the calcium chloride.—H. J. E.

Schiff's solution; A modified —— [for detection of aldehydes]. E. Wertheim. J. Amer. Chem. Soc., 1922, **44**, 1834—1835.

A solution of rosaniline hydrochloride (0·005 g.) in hot water (50—100 c.c.) is filtered, if necessary, diluted to 300 c.c., and cooled with running water. Sodium hydrosulphite (6 g.) is added to the cooled solution. The salt dissolves completely in a few minutes, after which the solution is ready for use. If it is boiled for 1 min. (not longer) it first becomes red and subsequently almost colourless. It may then be heated in testing for aldehydes in order to hasten the test. Used in this manner the solution gives the aldehyde test in about half the time required for the ordinary Schiff's test, although without heating it usually requires a little longer time than the customary Schiff's solution. Special precautions in preserving it are unnecessary.—H. W.

Hæmoglobin; Colorimetric determination of —— with especial reference to the production of stable standards. E. H. Terrill. J. Biol. Chem., 1922, **53**, 179—191.

Two modified methods for the preparation of acid hæmatin standards are described. A concentrated stock solution is prepared by removing the serum from defibrinated or oxalated blood, adding water, acidifying, filtering, and concentrating by means of an electric fan. The second method yields an acid hæmatin protein powder which is quite stable in the dry state and forms clear solutions in water and in $N/10$ HCl. In estimating hæmoglobin, the laking of the blood with water prior to acidification is recommended. Direct acidification produces a turbidity which leads to high results when a clear standard is used.* Heat should not be employed o develop maximum colour as this again produces a turbidity.—E. S.

Suspended matter in gases; Determination of —— by collection on filter paper. S. H. Katz and G. W. Smith. Gas World, 1922, 77, 160—161.

DETERMINATIONS were made of the efficiency of filter paper for the removal of tar (tobacco smoke) from air, the tests being carried out in a " tar camera " (J., 1918, 475 B), and the determination of tar present before and after filtering made by means of the Tyndall effect. The filtering efficiencies of single sheets of filter paper supplied with the apparatus ranged from 63 to 90%. The efficiencies of higher grade filter papers were greater than 90%. Four layers of filter paper retained all tar. For quantitative determinations the paper should be dried and weighed between clipped watch glasses. A period of two hours drying *in vacuo* should be allowed before weighing, followed by a further drying for one hour and check weighing. Quantitative results only can be obtained by comparison of the tar filter with a colour chart, the average error, in the present experiments, ranging from 38 to 57%.—J. S. G. T.

See also pages (A) 738, *Ultimate analysis of coal* (Parr); *Fusibility of coal ash* (Fieldner and others). 739, *Iron oxides for gas purification* (Gemmell). 745, *Asbestos and cotton* (Heermann and Sommer). 746, *Degree of digestion of wood pulp* (Roschier). 750, *Acetone in ammonia* (Bougault and Gros); *Lime* (Holmes and Fink). 751, *Hydrogen peroxide* (Isaacs). 761, *Tin and antimony in red brass* (Mück). 762, *Tin alloys containing iron* (Welwart); *Uranium in carnotite* (Scott). 769, *Unsaponified fat in soap* (Hagen). 773, *Tannins* (Körner and Bosshard); *Tannin analysis* (Pollak, also Kubelka and Berka). 777, *Starch and iodine* (Von Euler and Landergren). 779, *Carbon dioxide in self-raising flour* (Jacobs). 780, *Separating proteins etc.* (Rakusin); *Hydrogen sulphide evolved by foods* (Kohman). 781, *Theobromine and caffeine* (Schaap). 782, *Alkaloids and Vitali's reaction* (Hardy); *Colchicine* (Davies and Grier). 784, *Creatinine* (Pfizenmaier and Galanos); *Organic bases* (Pauly and Ludwig). 785, *Formaldehyde* (Kühl). 789, *Acidity of smokeless powders* (Angeli).

Patents.

Calorific value of gas; Method of and apparatus for measuring the ——. J. S. Withers. From E. R. Lanphier. E.P. 184,025, 6.7.21.

GAS is burned in a Bunsen burner, previously adjusted to burn completely a gas of known calorific value. A sleeve threaded on the burner tube and controlling the admission of primary air to the burner is adjusted until the luminous tip of the flame just disappears. The calorific value is then read by means of a micrometer head, provided on the upper end of the sleeve and moving over a scale of calorific values engraved on the burner tube.
—J. S. G. T.

Analysis and recording [of the volumetric composition] of gases; Apparatus for the ——. A. G. Dale. E.P. 184,279, 12.5.21.

GAS is continuously drawn through a gas analysis apparatus by means of a water ejector, and an oscillating element moving in a cylinder traps a definite volume of gas from the stream and forces it through an absorbing liquid to the recording vessel, such as a float chamber in which hangs an oil-sealed metal float which rises to a height proportional to the volume of gas passing into the float. The rise or fall of the float operates a pen mechanism. A U-tube water gauge connected with the main gas pipe serves to indicate the cleanliness of the pipe line and soot filter employed.
—J. S. G. T.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given; they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Blair, and Blair, Campbell, and McLean. Concentrating liquors to high densities. 25,421. Sep. 20.

Brégeat. Recovery of volatile solvents. 25,711. Sep. 22. (Fr., 21.7.22.)

Chemical Engineering Co., and Spensley. Producing intimate mixtures of substances and obtaining chemical products therefrom. 24,897. Sep. 14.

Dempster and Sons, and Toogood. Regenerator furnaces. 24,743. Sep. 13.

Galloway, Gibson, and Judson. Pipes for use when immersed in chemical liquids. 24,974. Sep. 15.

Greaves. Filtration or drainage of granular material. 24,649. Sep. 12.

Johnson (Badische Anilin u. Soda Fabr.). Means for heating gases under pressure. 25,477. Sep. 20.

Klug. Apparatus for removing suspended particles from gases. 24,822 and 25,050. Sep. 13 and 15.

Mangiameli. Mixing gases under pressure. 24,603. Sep. 11.

Parodi. Purifying distillation apparatus. 24,702. Sep. 12. (Fr., 21.9.21.)

Povey. Machines for disintegrating or emulsifying materials. 25,436. Sep. 20.

Renton. Filter presses. 25,577. Sep. 21.

Soward. Furnaces. 24,907. Sep. 14.

Complete Specifications Accepted.

10,704 (1921). Reid. Furnaces. (185,784.) Sep. 27.

12,220 (1921). Jewell. Stills. (185,451.) Sep. 20.

12,659 (1921). Greenwood, and Carr and Co. Apparatus for baking and drying substances at high temperatures. (185,460.) Sep. 20.

13,411 (1921). Pennell. Filtration of turbid water or liquid. (185,796.) Sep. 27.

15,884 (1921). Buxton and Buxton. Rotary multiple drying cylinder. (185,823.) Sep. 27.

16,394 (1921). Aktiebol. Cellulosa. *See* V.

17,203 (1921). Blair, Campbell, and McLean, and Ferguson. Evaporators and distilling apparatus. (185,873.) Sep. 27.

17,395 (1921). Plauson's (Parent Co.), Ltd. (Plauson). High speed disintegrators. (185,878.) Sep. 27.

22,242 (1921). Hutchins. Making emulsions. (185,618.) Sep. 20.

28,602 (1921). Monkbridge Iron and Steel Co., Kitson, and Brown. Furnaces. (185,668.) Sep. 20.

31,905 (1921). Prym. Filling bodies for absorption and reaction towers. (185,681.) Sep. 20.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Aguillon. Recovering benzol contained in gas. 25,377. Sep. 19.

Breisig. Gasifying bituminous fuel. 25,378. Sep. 19.

Broadhead, and Dempster and Sons. Manufacture of gas. 24,961. Sep. 15.

Day. Extracting hydrocarbon oil material from oil-bearing earthy material. 25,211. Sep. 18.

Evans, and South Metropolitan Gas Co. Manufacture of smokeless fuel. 25,231. Sep. 18.

Johnstone. Purification of lubricating etc. oil. 24,981. Sep. 15.

Neath. Manufacture of gas from coal and oil. 25,790. Sep. 23.

Quick. 25,429. *See* XII.

Roots. Gas-generator. 25,140. Sep. 16.

Sutcliffe. Apparatus for distilling carbonaceous substances. 24,624. Sep. 11.

Sutcliffe. Briquetting fuel etc. 25,731. Sep. 22.

Wilson. Synthetic coal. 25,649. Sep. 22.

Complete Specifications Accepted.

7747 (1921). Goold (Universal Oil Products Co.). Production of cracked petroleum oils. (185,439.) Sep. 20.

8723 (1921). Low Temperature Carbonisation, and Davidson. Retorts for distilling coal and other carbonaceous substances. (185,778.) Sep. 27.

10,084 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of oily pastes or emulsions from mineral and other oils. (185,779.) Sep. 27.

10,230 (1921). Cox, Kerr, and Baty. Gas purification. (185,780.) Sep. 27.

10,692 (1921). Meyer zu Eissen and Kiederich. Increasing the consistency of hydrocarbon oils and other oils and fats. (185,782.) Sep. 27.

12,675 (1921). Woodall, Duckham, and Jones, and Duckham. Carbonising fuel in vertical retorts. (185,461.) Sep. 20.

15,363 (1921). Piron. Recuperative coke-ovens. (185,811.) Sep. 27.

15,458 (1921). Klee. Apparatus for determining the flash point of oils etc. (185,814.) Sep. 27.

17,230 (1921). Deutsche Petroleum A.-G., Kaeser, and Bauer. Retorts for distillation. (165,724.) Sep. 27.

17,879 (1921). Murray. Manufacture of carburetted water gas, blue water gas, methane-hydrogen, and producer gas. (185,887.) Sep. 27.

22,803 (1921). Jensen (Stone). Oil-cracking process and apparatus. (185,624.) Sep. 20.

23,856 (1921). Niece. Cracking hydrocarbons. (185,632.) Sep. 20.

27,626 (1921). Climie. Gas-producers. (185,980.) Sep. 27.

32,546 (1921). Yeadon. System of low-temperature carbonisation. (185,684.) Sep. 20.

32,915 (1921). Healy. Gas-producers. (185,685.) Sep. 20.

III.—TAR AND TAR PRODUCTS.

Applications.

Aguillon. 25,377. *See* II.

Barrett Co. Manufacture of aromatic hydrocarbons. 24,727. Sep. 12. (U.S., 14,11.21.)

Pellegrini and Poma. Manufacture of acid H (aminonaphtholdisulphonic 1.3.6.8). 25,351. Sep. 19. (Ital., 12.12.21.)

Thompson (Atack). Manufacture of anthraquinone and derivatives thereof. 24,753. Sep. 13.

IV.—COLOURING MATTERS AND DYES.

Applications.

Carpmael (Bayer u Co.). Manufacture of intermediate products and their application for dyeing. 25,120. Sep. 16.

Durand et Huguenin Soc. Anon. Manufacture of products for dyeing etc. textile fabrics. 24,602. Sep. 11. (Fr., 16.9.21.)

Imray (Chem. Fabr. Griesheim-Elektron). Manufacture of monoazo dyestuffs. 25,232. Sep. 18.

Johnson (Badische Anilin u. Soda Fabrik). Manufacture of vat colouring matters. 25,121, 25,209, and 25,362. Sep. 16, 18, and 19.

Complete Specifications Accepted.

17,630 (1921). British Dyestuffs Corp., Baddiley, Payman, and Bainbridge. Manufacture of direct dyeing cotton colours. (185,880.) Sep. 27.

21,852 (1921). British Dyestuffs Corp., Green, Saunders, and Bate. Manufacture of triarylmethane colouring matters. (185,612.) Sep. 20.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Bernini. Testing woollen and silk materials. 24,870. Sep. 14. (Ital., 27.5.22.)

British Cellulose and Chem. Manuf. Co., and Dreyfus. Manufacture of artificial filaments, threads, etc. 25,694. Sep. 22.

Hunt, and Hunt, and Moscrop. Boiling kiers for textile fabrics. 25,763. Sep. 23.

Complete Specifications Accepted.

6897 (1921). Du Pont de Nemours and Co. Cellulose ester compositions. (165,439.) Sep. 27.

7077 (1921). Rütgerswerke A.-G., and Teichmann. Dissolution of wood and other vegetable cellulosic material. (160,467.) Sep. 27.

7135 (1921). Cross (Technochemia A.-G.). Preliminary treatment of cellulose intended for the manufacture of viscose. (185,433.) Sep. 20.

7569 (1921). Little. Production of cellulose esters. (161,564.) Sep. 27.

15,959 (1921). Maclennan. Preparation for cleansing and sterilising fabrics etc. (185,828.) Sep. 27.

16,394 (1921). Aktiebol. Cellulosa. Apparatus for evaporating and dry distilling waste liquors from pulp mills and similar liquors. (165,722.) Sep. 20.

16,730 (1921). Govaerts and Dryepondt. Treatment of ramie, flax, hemp, etc. to produce fibre ready for spinning. (185,865.) Sep. 27.

27,439 (1921). British Thomson-Houston Co. (General Electric Co.). Manufacture of indurated materials from woven fabrics. (185,662.) Sep. 20.

18,934 (1922). Little. Cellulose derivative and process of preparing same. (182,820.) Sep. 27.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Carpmael (Bayer u. Co.). 25,120. *See* IV.

Durand et Huguenin. 24,602. *See* IV.

Plauson's (Parent Co.), Ltd. (Plauson). Dyeing. 24,746. Sep. 13.

Complete Specification Accepted.

16,223 (1921). Reichelt. Production of a liquid washing blue and bleaching preparation. (176,747.) Sep. 27.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Barron, Halliwell, and Hindley. Manufacture of a highly concentrated aqueous solution of aluminium acetate. 25,742. Sep. 23.

Garne[illegible], Greenwood, and Reid. Decalcification of dolomite, magnesian limestone, etc., and production of magnesia. 25,415. Sep. 20.

Howard. Purification of hydrofluoric acid. 25,221. Sep. 18. (U.S., 29.9.21.)

Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of alkali carbonates. 24,747. Sep. 13.

Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of alkali salts. 24,748. Sep. 13.

Weyman and Weyman. Treatment and transportation of ammonium sulphate. 24,788. Sep. 13.

Weyman. Drying ammonium sulphate. 24,941. Sep. 14.

Complete Specifications Accepted.

7408 (1921). Nitrogen Corporation. Production of sodium bicarbonate. (159,895.) Sep. 27.

10,489 (1921). Rhenania Verein Chem. Fabr. Manufacture of sulphurous acid. (161,581.) Sep. 27.

21,235 (1921). Riedel. Treatment of ammonium chloride. (167,769.) Sep. 27.

27,196 (1921). Imray (Aquazone Laboratories). Aqueous solutions containing oxygen and process of producing them. (185,659.) Sep. 20.

31,087 (1921). Moritz. Stirring devices for mechanically operated sulphate furnaces. (172,006.) Sep. 20.

13,888 (1922). Wargons Akt., and Lidholm. Production of a solution of cyanamide from calcium cyanamide. (186,020.) Sep. 27.

VIII.—GLASS; CERAMICS.

Applications.

Grace. Separation of micaceous, siliceous, etc. material for clay. 24,723. Sep. 12.

Sutton. Manufacture of imitation stained glass. 24,552. Sep. 11.

Tams. Manufacture of earthenware, china, etc. 25,086. Sep. 16.

Complete Specifications Accepted.

7402 (1921). Marks (Lava Crucible Co. of Pittsburgh). Production of ceramic articles. (185,435.) Sep. 20.

17,135 (1921). De Dietrich et Cie. Enamelling processes. (165,785.) Sep. 20.

27,644 (1921). Jones and Jones. Kilns for burning bricks, tiles, terracotta, etc. (185,664.) Sep. 27.

IX.—BUILDING MATERIALS.

Applications.

Bergsma. Manufacture of stone-like materials. 24,600. Sep. 11. (Holland, 12.9.21.)

Rigby. Cement manufacture. 25,113. Sep. 16.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Allgem. Deuts. Metallwerk. Bronze alloys and their production. 25,198. Sep. 18. (Ger., 20.9.21.)

Allgem. Deuts. Metallwerk. Copper and zinc alloys and their production. 25,199. Sep. 18. (Ger., 21.9.21.)

Atkinson, and Stein and Atkinson. Muffle furnaces. 24,695. Sep. 12.

Barry. Aluminium alloy. 24,562. Sep. 11.

Barry, and Hughes and Co. Aluminium solder. 25,781. Sep. 23.

Bèque and Burlet. Cleansing and coating metals by dipping. 25,285. Sep. 19. (Belg., 19.9.21.)

Fox and Hayes. Flux. 25,611. Sep. 21.

Giesecke. Agglomerating mixtures of fine ore and fuel in shaft furnaces. 24,854. Sep. 14.

Goldschmidt A.-G. Bearing-metal alloy. 24,696. Sep. 12. (Ger., 15.9.21.)

McMorland. Flux for soldering etc. 24,655. Sept. 12.

Mathesius and Mathesius. Lead alloys. 24,925–6. Sep. 14.

Mathesius and Mathesius. Making alloys of lead with calcium, strontium, and barium. 25,609. Sep. 21.

Mehner. Production of zinc in reverberatory furnaces. 25,670. Sep. 22.

Minerals Separation, Ltd., and Williams. Concentration by flotation. 24,836. Sep. 13.

Mond (Chem. Fabr. Griesheim-Elektron). Treatment of chrome-iron ore. 25,720. Sep. 22.

Complete Specifications Accepted.

10,494 (1921). Isabellen-Hütte. Treatment of copper alloys. (161,537.) Sep. 27.

15,047 (1921). Thompson (Aikens). Electrolytic refining of tin. (185,808.) Sep. 27.

15,840 (1921). Akt. Svenska Kullagerfabr. Hardening of steel and hardened steel articles. (164,749.) Sep. 27.

16,148 (1921). Pearson, Craig, and Durelco, Ltd. Electrolytic treatment of metalliferous materials containing tungsten or molybdenum. (185,842.) Sep. 27.

16,489 (1921). Fairweather (Hybinette and Peek). Treatment of matte ond other materials and solutions containing copper and nickel. (185,859.) Sep. 27.

18,258 (1921). Dickins. Case hardening, hardening, tempering, etc. (185,564.) Sep. 20.

XI.—ELECTRO-CHEMISTRY.

Applications.

David and Dutt. Electric cells. 25,307. Sep. 19.

Gross. Accumulator electrodes. 25,282–3. Sep. 19. (Norway, 17.10.21.)

Teale and Whitehead. Electric accumulators. 24,776. Sep. 13.

Complete Specifications Accepted.

13,398 (1921). Garbutt. Electric accumulators. (185,797.) Sep. 27.

15,047 (1921). Thompson (Aikens). *See* X.

16,148 (1921). Pearson and others. *See* X.

23,066 (1921). Palmer and Ashton. Electric accumulators. (185,946.) Sep. 27.

XII.—FATS; OILS; WAXES.

Application.

Quick. Method of thickening oils. 25,429. Sep. 20.

Complete Specifications Accepted.

10,084 (1921). Plauson. *See* II.

10,692 (1921). Meyer zu Eissen and Kiederich. *See* II.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Barry. Aluminium paint. 24,561. Sep. 11.

McDougall. Linoleum, floor coverings, etc. 25,623. Sep. 21.

Complete Specification Accepted.

19,340 (1921). British Thomson-Houston Co. (General Electric Co.). Coating materials and methods of forming same. (185,910.) Sep. 27.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Bateman. Rubber solutions or cements. 25,229. Sep. 18.

Bigger and Falls. Rubber substitutes. 25,431. Sep. 20.

Schidrowitz. Manufacture of rubber. 24,950. Sep. 14.

XV.—LEATHER; BONE; HORN; GLUE.

Application.

Duckworth. Treatment of skins. 25,275. Sep. 19. (Australia, 28.9.21.)

Complete Specification Accepted.

19,841 (1921). Collard. Extraction of gelatin. (166,896.) Sep. 20.

XVI.—SOILS; FERTILISERS.

Application.

Asahi Glass Co., and Igawa. Application of colloidal magnesium silicate as a forcing agent of manure. 25,538. Sep. 21.

XVII.—SUGARS; STARCHES; GUMS.

Complete Specification Accepted.

9151 (1922). Jacobs (Jacobs). System of pan boiling in sugar manufacture. (185,707.) Sep. 20.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Board and Gills. Rubbing-plate for milk-drying machines. 25,474. Sep. 20.

Carpmael (Chem. Fabr. Weiler-ter Meer). Manufacture of insecticides. 24,939. Sep. 14.

Elrod. Sewage disposal plant. 24,672. Sep. 12.

Hartley and Hartley. Purification of sewage. 25,398. Sep. 20.

Hoare. Manufacture of milk products. 24,896. Sep. 14.

Sawada. Cleaning rice grain. 24,924. Sep. 14. (Japan, 27.9.21.)

Complete Specifications Accepted.

9776 (1921). Green. Purification of sewage by treatment in centrifugal separators. (185,444.) Sep. 20.

13,411 (1921). Pennell. *See* I.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Calvert. Treatment of alcohols. 25,803. Sep. 23.

Goldschmidt and Neuss. Manufacture of condensation products. 25,489. Sep. 20.

Complete Specifications Accepted.

14,986 (1921). Meister, Lucius, u. Brüning. Manufacture of methylsulphites of secondary aromatic-aliphatic amines. (164,002.) Sep. 20.

19,536 (1921). Imray (Soc. Chem. Industry in Basle). Manufacture of amino-alcohols of the quinoline series. (185,913.) Sep. 27.

21,567 (1921). Meister, Lucius, u. Brüning. Manufacture of aliphatic dialkylaminoalkyl compounds. (167,781.) Sep. 20.

14,537 (1922). Meister, Lucius, u. Brüning. Manufacture of sulphonic acids of the 2.3-oxy-naphthoic acid arylides. (183,428.) Sep. 20.

I.—GENERAL; PLANT; MACHINERY.

Maximum temperatures [developed in chemical reactions, e.g., combustion] Rapid calculation of ——. G. G. Brown. Chem. and Met. Eng., 1922, **27**, 497—500.

The maximum temperature developed in a chemical reaction may be calculated by the graphical method, by trial, or algebraically. The last-named method depends upon the solution of a quadratic equation which may be conveniently solved either graphically or by use of the slide rule. The various methods are described.—J. S. G. T.

Colloids; Theory of the mechanical synthesis of ——. F. Sekera. Kolloid-Zeits., 1922, **31**, 137—147.

The theory of the production of colloids in Plauson's colloid mill is briefly as follows: The mechanical grinding process bursts the active molecular compounds in the interior of the solid substance and produces particles of colloidal dimensions. The residual valencies, active at the surface of these particles, tend to cause an aggregation of the particles, so that secondary to the dispersion an aggregation process will take place. To retard or prevent the aggregation the residual valencies are saturated by the addition of an electrolyte, whereby salt complexes are produced and the particles become electrically charged.—J. F. S.

Colloids; "Fog process" for the preparation of ——. F. Sekera. Kolloid-Zeits., 1922, **31**, 148—149.

A manufacturing process by which solid colloids may be prepared is described. The principle of the process is best explained by an example: to a 30% solution of sulphur in carbon bisulphide 5% of a high molecular organic salt is added, in this case sulphonated naphthenic acid, and the mixture placed in a heating chamber at 85° C. The solution is then dispersed by a stream of nitrogen, and a fog produced; the carbon bisulphide is condensed and runs away, whilst the colloidal particles are left suspended as a fog. The fog is condensed on two wire nets covered with parchment which spread right across the chamber and from which point electric discharges are passing. The colloid, which settles as a light powder, is soluble in water.

—J. F. S.

Patents.

Transfer of heat between liquids and gases; Apparatus for effecting ——. Atkiebolaget Ljungströms Angturbin. E.P. 162,250, 21.4.21. Conv., 23.4.20.

A cylindrical tube is divided by a diametral plane into two equal flues of semicircular cross-section. The hot gases flow in one direction through one of these flues, and the gases to be heated flow, usually in the opposite direction, through the other flue. At a suitable position in the tube the internal partition is removed, and in the space thus provided is mounted a rotating disc together with its driving gear. This disc may be made up of a series of radial plates. In the larger units the disc is built up of a series of concentric rings, each ring being attached to the next by a series of short radial plates. The chambers thus formed in the disc may be packed with materials, such as gravel, slag, tiles, etc. This disc is caused to rotate across the line of flow of the hot gases in the one flue and the gases to be heated in the other and transfer heat from one flue to the other.—S. G. U.

Selective corrosion; Prevention of —— in machines or apparatus of metallic parts made of copper and copper-containing alloys, and subject to the corrosive action of water containing ions. F. von Wurstemberger. E.P. 174,059, 29.12.21. Conv., 17.1.21.

The water is prevented from becoming stagnant anywhere in contact with the vessel, *e.g.*, by means of a special circulating pump; in the case of a heat exchanger, the pump may have a much reduced delivery when the apparatus is out of use.

—B. M. V.

Refrigerating apparatus. J. G. Deremer. E.P. 182,528, 24.3.21.

Two cylinders, one the compressor, the other the evaporator, are connected together by a tube so that their axes lie on a straight line. The compressor is fitted with a hollow plug which forms a low-pressure chamber at the evaporator end and a high-pressure chamber at the other end of the compressor cylinder. These chambers are connected by a helical passage, cut on the outer surface of the plug, and of gradually diminishing cross-section. The compressor casing forms the outer wall of this passage. Fixed to the low-pressure end and passing through the plug is a pipe which extends into a recess formed in the outer cover of the compressor cylinder. In the annulus formed by this pipe and the plug is fitted a second helix having its pitch in the same direction as the outer. As this helix does not reach the end of the plug a second high-pressure chamber is formed which is connected to a cooling coil surrounding the compressor cylinder. The compressed refrigerant fluid after passing through this coil enters a pipe placed inside the connecting tube and is discharged into a sealed tube forming an extension of the connecting tube inside the evaporator. The discharge from this sealed tube enters an annular chamber placed inside and in direct communication with the evaporating chamber. From this chamber the fluid passes through a coil surrounding the evaporator and is then returned to the sealed tube. On again entering the evaporating chamber the liquid portion is circulated through the surrounding coils, whilst the gaseous portion enters the connecting tube and is returned to the compressor. To deal with the accumulation of excessive amounts of propelling liquid in the evaporator when the machine is at rest, an arrangement is provided for returning this liquid direct to the compressor cylinder when the plant is started. The unit comprising the evaporator and compressor is supported at its ends, so as to be inclined at about an angle of 45° to the driving shaft by which the unit as a whole is rotated. In addition bevel gearing is employed to give the unit rotational motion about its own axis. The compressor cylinder rotates in a chamber provided with a spray which plays upon the coils and cylinder. The evaporator rotates in another insulated chamber provided with a circulating device which brings the liquid to be cooled into contact with the coils on the evaporating cylinder. Mercury and sulphur dioxide are recommended as the propelling and refrigerant fluids respectively.

—S. G. U.

Steam; Generation and superheating of ——. F. Lamplough. E.P. 183,261, 21.4.21.

Exhaust steam is led through the annulus formed by two coaxial pipes, whilst live steam passes through the inner pipe. The outer pipe is heated by furnace gases, thus superheating the exhaust steam which in turn conveys heat to the live steam. After passing through this heater the exhaust steam enters a chamber fitted with a series of coils, one end of which is coupled to the inlet end of the live steam pipe already mentioned and the other end to the outlet pipe from the feed water heater. In this chamber the live steam is generated. The exhaust steam next passes through a feed water heater and ultimately through a condenser. A pump forces the condensed water and feed water into a receiver which is in direct communication with the live steam side of the plant. This receiver also communicates with a cylinder containing two spring-loaded pistons operated by the pressure in the receiver. One of these pistons actuates a mechanism for altering the stroke of the feed pump, shortening the stroke as the pressure rises, and the other operates a valve whereby the pump delivery can be by-passed and returned direct to the condenser.—S. G. U.

Grinding, refining, and mixing machines. J. McIntyre. E.P. 183,399, 10.12.21.

A cylinder jacketed to take either hot or cold water or steam is placed with its axis horizontal; its ends are fitted with covers, one of which is provided with a suitable opening for introduction of the material to be treated and the other with a long stuffing-box and gland which also acts as the bearing for the main shaft of the machine. This shaft is hollow and is driven at the outer end through worm and screw gearing.· At the inner end it is keyed to a wheel which carries round its circumference a series of rockers, which can swing through a limited arc. A flexible blade, as described in E.P. 181,877, is attached to each complete rocking unit. Round the rim of the wheel is a slip ring, provided with slots which engage with these blades in such a way that any movement given to one blade is immediately communicated to all the others. Through the hollow shaft passes a spindle carrying bevel gear at its outer end and rigidly fixed to a disc crank at its inner end. The pin of this crank is connected through a link with one of the rocking levers. The bevel gear at the outer end is so mounted that it rotates with the main shaft, but by the insertion of a pin in one or other of two holes provided in the casing can be given a motion relative to the main shaft, thereby altering the pressure between the blades and the casing. The outlet valve of the machine is of the piston type, so arranged that when closed the top of the valve is flush with the inside of the cylinder and on lowering the piston its inner edge uncovers a port permitting the finished material to flow out.—S. G. U.

Disintegrating minerals and similar materials; Machines for reducing or ——. A. G. N. Burden. E.P. 184,609, 28.5.21.

In a rotary disintegrator, in order to reduce wear on the impellers, the material is fed as nearly as possible to the centre of the runner, which is shaped so as not to be subject to the impact of the material, *e.g.*, it may take the form of a disc with guide vanes so designed that there is no relative peripheral motion between the material and the runner, centrifugal force alone being relied on to provide the impact with the stationary outer ring or anvil, which is serrated so that its working faces are approximately perpendicular to the flying particles. After impact the crushed material is not allowed to become entagled with the runner again, but it is allowed to fall clear, and if desired may be re-ground in a similar apparatus. [Reference is directed, in pursuance Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 444 of 1876, 533 of 1882, 5837 of 1884, 3654 of 1901, 25,880 of 1903, 17,990 of 1908, 29,717 of 1910, and 160,933.]—B. M. V.

Pulverising mill. D. V. Sherban. U.S.P. 1,427,234, 29 8.22. Appl., 23.12.21.

A ball mill is provided with an axial suction duct or screen extending right through the mill for withdrawing ground material.—B. M. V.

Dry-pulverising apparatus. R. E. H. Pomeroy. U.S.P. 1,427,322, 29.8.22. Appl., 30.6.20.

A rotating casing is provided with inlets for air on its periphery. Other apertures are provided for the entry of unground material and for the discharge of the air current carrying the ground material.—B. M. V.

Cooling towers; [Distributing troughs for] water ——. C. M. Bennett, and Film Cooling Towers, Ltd. E.P. 184,653, 2.7.21.

In the ordinary distributing troughs at the top of cooling towers, provided with short vertical pieces of pipe to deliver the water, the upper ends of the pipes are subject to partial obstruction by vortices. To avoid this the upper ends of the pipes are provided with return bends lying within the troughs, converting them into siphons, and causing a more rapid and more uniform discharge of the water. —B. M. V.

Furnaces; Regenerative ——. H. Wade. From The Union Trust Co. E.P. 184,877, 20.5.21.

At each end of a reverberatory furnace are three ports, all of which communicate *viâ* downtakes with the usual regenerator chambers. The downtakes from the outer (auxiliary) ports are provided with dampers or valves, but the central ports and downtakes are not so provided. At the outlet end of the furnace all the ports are used to carry away the products of combustion, but at the inlet end the auxiliary ports are closed and the fuel (gas, oil, or powdered coal) is supplied to the central port where it mixes with the heated air, so that the flame enters only by the central port, which is not enlarged beyond the point of entry of the fuel. —B. M. V.

Furnaces, stoves or the like; Method of and means for raising and maintaining the temperature in ——. I. E. Robinson. E.P. 185,217, 31.5.21.

The greater part of the products of combustion containing partially consumed fuel is returned to the combustion space or fireplace of a furnace, and while circulating is expanded and contracted one or more times. The expansion and contraction may also be applied to that portion (the waste gases) that passes to the exit flue. A self-contained boiler is described which generates superheated steam for effecting the circulation.—B. M. V.

Evaporators or heaters, heated by waste hot gases; Water or other liquid ——. H. Hocking. E.P. 185,134, 18.2.21.

The liquid to be heated is contained in a casing, into which projects a nest of outer fire-tubes or "radiators" with one end closed, which are secured at their open ends in a tube-plate. The tube-plate has a hollow cover provided with inlet and outlet ports for hot gases, also with a diagonal partition or tube-plate carrying smaller inner tubes open at both ends which are inserted into the outer fire-tubes and form the only passage for the hot gases between the inlet and outlet ports. —B. M. V.

Electrical precipitation; Apparatus for ——. C. Le G. Fortescue, Assr. to Westinghouse Electric and Mfg. Co. U.S.P. 1,427,370, 29.8.22. Appl., 15.2.19.

A porous ionising electrode is disposed within a treatment chamber in which baffles are arranged, so that the stream of fluid to be treated is subjected, during its passage through the chamber, several times to the ionising action of the electrode. —J. S. G. T.

Electrode for precipitating apparatus; Ionising ——. C. Le G. Fortescue, Assr. to Westinghouse Electric and Mfg. Co. U.S.P. 1,428,839, 12.9.22. Appl., 25.2.19.

In an electrical precipitation system, a collecting electrode is formed as a treating chamber, and the reticulated discharge electrode employed may be charged to different potentials substantially simultaneously.—J. S. G. T.

Electrical gas-cleansing apparatus. Metallbank u. Metallurgische Ges. A.-G. G.P. 354,623, 27.7.20.

Discharge electrodes are carried by conducting laminæ disposed in the conduit for supplying gas to the plant and supported by transverse insulated bars.—J. S. G. T.

Catalysing apparatus. J. McC. Selden, Assr. to The Selden Co. U.S.P. 1,427,554, 29.8.22. Appl., 22.3.18.

The catalyst is contained in a number of troughs arranged in staggered relation, one above the other, within a casing, a conduit for a heating or cooling fluid being buried in the catalyst in each trough. The reacting gases are admitted to the lower, and removed from the upper, part of the casing.
—B. M. V.

Stills. A. C. Jewell. E.P. 185,451, 28.4.21.

See U.S.P. 1,369,438 of 1921; J., 1921, 249 A.

Distilling and rectifying column. E. A. Barbet. U.S.P. 1,427,430, 29.8.22. Appl., 22.9.20.

See E.P. 151,988 of 1920; J., 1922, 43 A.

Condenser; Air-cooled or evaporative surface ——. J. MacLeod, Assr. to H. Reid. U.S.P. 1,427,159, 29.8.22. Appl., 28.2.21.

See E.P. 167,803 of 1920; J., 1921, 682 A.

Absorption and reaction towers; Filling bodies for ——. H. Prym. E.P. 185,681, 29.11.21.

See G.P. 344,139 of 1920; J., 1922, 165 A.

Decantation apparatus. J. Denoël. U.S.P. 1,427,446, 29.8.22. Appl., 7.7.20.

See E.P. 149,551 of 1919; J., 1920, 647 A.

Atomising more or less viscid materials; Method and means for ——. A. Sonsthagen and E. H. Harberd. U.S.P. 1,427,559, 29.8.22. Appl., 25.3.20.

See E.P. 143,289 of 1919; J., 1920, 475 A.

Catalytic material employed for the promotion of synthetic chemical reactions; Apparatus for carrying out the preparation of ——. H. Lane. U.S.P. 1,428,965, 12.9.22. Appl., 27.10.19.

See E.P. 115,924 of 1917; J., 1918, 397 A.

Heat-exchanging bodies; Production of ——. H. F. B. Jorgensen. U.S.P. 1,428,638, 12.9.22. Appl., 24.7.20.

See E.P. 165,691 of 1920; J., 1921, 591 A.

Transport of loose materials by means of gaseous mediums; Process and apparatus for regulating the ——. A.-G. Brown, Boveri & Co., E.P. 181,712, 14.6.22. Conv., 14.6.21.

Regenerators for heating air or gas for combustion. H. Schulz. E.P. 184,744, 29.12.21.

Air or other gases; Cleansing and/or humidifying apparatus for ——. A. Welford. E.P. 184,871, 19.5.21.

Heat interchanging devices. J. Jeffreys and Co., Ltd., J. W. Cooling, and H. A. Stirzaker. E.P. 185,531, 14.6.21.

Drying peat etc. E.P. 182,157. *See* IIA.

IIA.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal from the deeper workings of the Kenadza (Algeria) mine; Composition and calorific power of ——. A. Foix. Bull. Soc. Chim., 1922, **31**, 813—816.

The samples examined were found to contain about 7% of ash, 3% of sulphur, and 2·5% of nitrogen, the corresponding values for coal from the surface workings being 3%, 1%, and 0·5% respectively. A detailed analysis of the ash is given, from which it is inferred that the whole of the sulphur is in the form of iron pyrites. This accounts for all the iron present, whereas the iron in the surface coal exists chiefly as ferric oxide. Determinations of the calorific value do not agree so closely with the value calculated from Goutal's formula as those given by the surface coal. The heat evolved on combustion varies from 8240 to 8270 g.-cals. per g., being 3—4% above the calculated value.
—H. J. E.

Coals; Comparison between the American and S. African methods for the determination of volatile combustible matter in ——. J. A. McLachlan. J. S. Afr. Chem. Inst., 1922, **5**, 6—11.

In the S. African method 1 g. of the sample is heated in a covered platinum crucible over a gradually increasing Bunsen flame until the sample ceases to give a flame at the lid, and the heating is then continued for exactly 30 secs. The American method consists in heating 1 g. of the sample in a covered platinum crucible over a full Bunsen flame for 7 mins., the size of the crucible, its height above the flame, and the size of the latter being definitely prescribed. At present it would seem that neither method yields concordant results. Only one detail as regards the heating is specified in the S. African method, a fact which allows a wide variation in the results; the fuller specification in the case of the American method enables consistent results to be obtained when the determinations are made over one and the same burner, but different burners, having the same length of flame, have different heating values, and in this respect the method is defective.—W. P. S.

Coal; Cleaning ——, *specially for the production of coke low in ash.* A. Thau. Stahl u. Eisen, 1922, **42**, 1153—1158, 1242—1249.

The flotation process is a valuable addition to the mechanical methods of removing the ash components of coal. In some cases the ash content may be reduced 70%. There is also a considerable reduction of the sulphur content, which is chiefly carried by the finest ash and coal particles. The treated slime from the flotation process gave excellent coke, and when added to coking coal had a favourable influence on the character of the coke both from a chemical and physical point of view. Coal treated by the flotation process can be brought to so high a degree of purity that it is better suited for chemical use and for the manufacture of electrodes than the raw materials previously used. The waste from the flotation process may be used, according to its chemical constitution, as raw material for ceramic products. Calculations are made showing the economic advantages of the flotation process and of the purified coke produced.—T. H. Bu.

Coal; Spontaneous ignition of ——. T. Drescher. Chem.-Zeit., 1922, **46**, 802—803.

The paint industry employs as a black pigment what is essentially coke (lignite-coke, bone-charcoal, etc.) sold under various trade names. The grinding of this material often extends over 24 hrs. and is carried out in edge-runner mills or closed drums, the powder being discharged warm, but notwithstanding this no case of spontaneous ignition is known. When, however, an attempt was made to use coal as a substitute, the coal being of good quality but containing pyrites, the powder took fire while in store. The material was therefore stored in bags in the open, the ground being frozen. When after 14 days the upper bags were removed the lower ones with a good part of their contents were found to have been burnt. The material was repacked in fresh bags and in a few days took fire again. This case is held to support the view that such fires are due to the oxidation of pyrites by air and moisture. There will always be sufficient air between the particles of a dump of small coal to start the action.—C. I.

Coke; Dry cooling of ——. P. Schläpfer. Stahl u. Eisen, 1922, 42, 1269—1275.

The mean specific heat of a coke containing 10·5% of ash was found to be as follows for various temperature intervals: 18°—100°, 0·214; 18°—400°, 0·273; 18°—477°, 0·286; 18°—577°, 0·305; 18°—800° C., 0·333. In a dry cooling installation described, the coke is discharged from the oven into an enclosed chamber, and air is admitted. A small portion of the coke is thus burnt, until all the oxygen of the air admitted has been utilised, after which the inert gases, consisting of nitrogen, carbon dioxide, and carbon monoxide, are circulated through the cooling chambers until the temperature of the coke has fallen to about 250° C. The sensible heat of the circulating gas is utilised for generating steam or for preheating boiler feed water. The speed of circulation can be regulated to suit the steam requirements of the plant. In one test, lasting 17 days, the weight of coke cooled per day was 23·6 tons, and the water heated amounted to 9·4 tons, converted from water at 50° C. into steam at 94·5 lb. per sq. in. pressure (saturated), *i.e.*, 0·398 kg. of steam per kg. of coke. Over a test period of 285 days, the steam generated amounted to 0·383 kg. per kg. of coke. A complete description is given of the lay-out of the plant.
—A. G.

Coke; Volumetric determination of the true and apparent specific gravity of ——. A. Schmolke. Stahl u. Eisen, 1922, 42, 1237—1240.

A weighed piece of dry coke is introduced into a volumenometer, the volume of which has previously been determined by displacing the contained air by means of carbon dioxide into an absorption vessel containing a solution of caustic potash and reading off the volume of the air in a graduated glass tube. The volume of air in the glass vessel when containing the coke is determined by a similar procedure, the carbon dioxide displacing the air in the pores of the coke. The weight of the coke divided by the difference between the volume of the vessel and the volume of air in the vessel when containing the coke gives the true density of the coke. The experiment is then repeated, using mercury instead of carbon dioxide; the mercury does not displace the air in the pores of the coke, and consequently the apparent density of the coke is obtained. The method is rapid and accurate.—T. H. Bu.

Calorific power; Calculation of the —— *of a commercial fuel in terms of its content of water and mineral matter.* J. Fohlen. Chim. et Ind., 1922, 8, 275—277.

The application of nomographs to the determination of calorific powers of fuels of known content of water and mineral matter is explained and illustrated in the cases of four varieties of coals, for which rectilinear nomographs are given.
—J. S. G. T.

Metaldehyde as a fuel. H. Danneel. Chem. and Met. Eng., 1922, 27, 216—218.

The manufacture of metaldehyde on a commercial scale has become possible through the production of acetaldehyde from calcium carbide. A study of the acetaldehyde-metaldehyde-paraldehyde equilibria shows that at low temperatures the conversion of acetaldehyde into metaldehyde can be accelerated more than that of acetaldehyde into paraldehyde by the use of sulphuric acid or certain other catalysts. As the formation of paraldehyde is accompanied by the evolution of heat, careful control of the reaction temperature is necessary. The precipitated metaldehyde is removed when a maximum quantity has been formed and before equilibrium is reached. Paraldehyde, with small quantities of acetaldehyde, is separated in a hydro-extractor and, unless pure paraldehyde is desired as a product, is transformed into acetaldehyde for further use. Metaldehyde is recovered in the form of small needles and is compressed before being used as a fuel. During combustion the heat radiated from the flame converts the metaldehyde into acetaldehyde, which itself feeds the flame; thus the conversion controls the rate of combustion. The formation of acetaldehyde and the combustible properties of the compressed metaldehyde are very largely determined by the presence of traces of catalysts.—H. Hg.

Hydrocarbons; Determination of —— *in technical gases.* G. Wollers. Stahl u. Eisen, 1922, 42, 1449—1455.

Gases of the acetylene series may be separated quantitatively from those of the ethylene and methane series by shaking with a few c.c. of a solution of 25 g. of mercuric iodide and 30 g. of potassium iodide in 100 c.c. of water. Ethylene and its homologues may be separated from the residual gases by shaking them with a solution of 1 g. of vanadic acid in 100 c.c. of concentrated sulphuric acid, but it is impossible to effect a separation of the ethylene homologues from each other by agitation with sulphuric acid of different strengths. All the unsaturated hydrocarbons on being passed over palladium black saturated with hydrogen are converted quantitatively into the corresponding saturated compounds. The various members of the different series may be separated by cooling the gas mixture in liquid air to −185° C., whereby oxygen, hydrogen, carbon monoxide, methane, and nitrogen remain in the gaseous state and are determined in the usual manner. The liquid is heated to −115° C., when ethylene, ethane, and part of the propylene and propane distil off, and then to room temperature, when the rest of the propylene and propane, together with a little butylene and butane distil. Each fraction is analysed by the absorption method described above combined with combustion of another portion.—A. R. P.

Hydrogen and methane mixed with atmospheric air; Fractional combustion of ——. P. Rischbieth. Chem.-Zeit., 1922, 46, 784—785.

The combustion is carried out in a pipette, or flask, in which is a spiral of platinum wire which may be raised to any desired temperature by an electric current. The pipette is connected by a pipe provided with a glass cock with a graduated burette fitted with a levelling bottle. For the combustion of hydrogen the wire is heated to a temperature below redness. Methane is only burned by raising the wire to a bright red or white heat. The combustion takes place without explosion. After combustion the gas is withdrawn into the burette and the contraction in volume estimated. If desired the amount of methane may be found by estimating the residual oxygen by a phosphorus pipette and thus ascertaining the volume of oxygen used.—H. M.

Natural gas; Composition of Japanese ——. T. Ohno. Kôgyô-Kwagaku Zasshi (J. Chem. Ind. Japan), 1922, 25, 783—788.

Samples of natural gas from Haneda-machi (Tokyo Prefecture), Mohara-machi and Tsuchimutsumura (Chiba Prefecture), Niitsu oil-field, and Nuttari petroleum refinery gave the following results on analysis: CO_2 1·2—14·9, C_nH_{2n} 0—0·1, O_2 0·2—0·7, CO 0—0·2, CH_4 79·1—92·1, N_2 4·6—11·3%; sp. gr. 0·577—0·725, calorific value 7023—8444 g.-cals. per litre. A sample from Nishiyama oil-field (Niigata Prefecture) proved to be a natural petroleum gas and gave the following results: CO_2 0·2—0·5, C_nH_{2n} 0·7—1·0, O_2 0·5—0·6, CO 0·4, CH_4 22·8—44·0, C_2H_6 54·2—71·3% (saturated hydrocarbons were calculated as CH_4 and C_2H_6), sp. gr. 0·807—0·963, calorific value 13,090—13,293 g.-cals. per litre. —K. K.

Kukkersite, the oil shale of Esthonia. E. H. C. Craig. J. Inst. Petrol. Tech., 1922, 8, 349—375.

The Esthonian oil shale is the oldest and richest known, if torbanites be excluded. The oil shale is found a few yards above the base of the lower silurian limestone, attains a maximum thickness of 8 ft., and is interbedded with limestone containing bituminous matter. The strata have never been disturbed since their formation. The shale is grey to green, but red when weathered, and is crowded with fossils, principally trilobites and brachiopods. The sp. gr. varies from [illegible]2 to 1·4, and the yellow colour of the impregnation is similar to that of the richest shales of Colorado. The material contains no sand. Analysis of the mineral (inorganic) matter shows 49·64% of lime. The moisture varies from 33·7 to 11·0%, but after six weeks' drying at ordinary temperature this is reduced to 6·84—2·34%. The average percentage of volatile matter is 54—56. The nitrogen content is low, 0·30—0·68%, and the oxygen content high, 16·24—21·98%; the sulphur content is 1·60%. Kukkersite may be distilled at a temperature not above 500° C. and yields 70—80 galls. per ton of an oil of 0·92—0·93 sp. gr. It is not likely that the shale originated from algæ or from peat, but it is most probable that it has been formed from inspissated petroleum, the underlying Cambrian sandstone presenting the typical appearance of oil sands. The quantity of proved oil shale is about 1000 to 1500 million tons, extending over an area 36 miles long by 7 miles broad. Along the outcrop and for some miles to southward the shale may be worked by open cut.—H. M.

Kukkersite; Chemical composition of the Esthonian Middle Ordovician oil-bearing mineral ——. P. N. Kogerman. Pamphlet. Dorpat, 1922. 25 pages.

The available supply of Esthonian oil shale is estimated at 1,500,000,000 tons. It is not a true shale. A review is given of former researches on kukkersite from its discovery in 1789 to the present day. The shale rarely contains more than 35% of moisture. When air-dried it contains about 7% of moisture and when dried in a desiccator over sulphuric acid about 2·38%. The ash content varies from 20 to 50%, and the yield of volatile matter is 50·7—58·4%. The ultimate composition of the dry organic substance is C 71·58%, H 7·40%, N 0·48%, S 1·50%, O 19·04%. From 0·27 to 0·77% of the mineral was dissolved by eight different organic solvents, but tetrachloroethane dissolved 2·20%, the time of extraction varying from 48 to 124 hours. By boiling in a 20% solution of potassium hydroxide, neutralising, and allowing to stand, a white precipitate not exceeding 4% of the weight of the mineral was obtained. In one series of tests 10 g. of shale heated to 250°—255° C. gave off 27 c.c. of gas containing 8·7% of carbon dioxide, 0·6% of heavy hydrocarbons, and 13·7% of carbon monoxide. Distillation at 600° C. gave 74·8 galls. of oil and 3000 cub. ft. of gas per ton. By steam distillation 28·5% of light oil of sp. gr. 0·795 was obtained, containing about 60% of unsaturated open-chain compounds. Heavy oil obtained by steam distillation contained 77% of such compounds. The kukkersite is formed from a soft cyanophycean alga. Under the action of chloral hydrate the algæ swell and assume their original form.—H. M.

Petroleum; Origin of ——. [*Nitrogen compounds of petroleum, and particularly of Baku petroleum.*) E. Pyhälä. Petroleum, 1922, 18, 1069—1073.

Acid sludge from the refining of kerosene from Baku petroleum was diluted with water, when a violet oil separated, leaving a yellow acid solution, which gave a flocculent precipitate on the addition of an excess of alkali. The precipitate, washed and dissolved in hydrochloric acid, was brown, but turned carmine-red in a few hours. A thick red oil separated on the addition of common salt. This was dissolved in chloroform and the solvent then distilled off. On distilling this oil a pale yellow oil passed over between 60° and 80° C., and afterwards some water, sulphur dioxide, and turbid oil with odour of pyridine. Between 250° and 270° C. the greater part of the material distilled over as a substance similar to Canada balsam. This was dissolved in water, filtered, and evaporated at 80° C. A hygroscopic brittle mass was obtained, smelling and tasting like quinoline, with acid value 261 and possessing both acid and basic qualities; it is probably an amino-acid. In the distillation of the kerosene fractions of many kinds of petroleum a red to violet fugitive coloration is observed, and this is in proportion to the nitrogen content of the petroleum. The filtration of a petroleum from Surachany through floridine left a red coloured oil in the filtering medium. The yellow filtrate was shaken with sulphuric acid and the precipitated acid sludge diluted with water, rendered alkaline with sodium hydroxide solution, and shaken with ether. The ether layer was yellow, but on distilling off the solvent a syrupy carmine-red product remained, with a smell of quinoline and containing bases. The bases seemed to consist of the hydrogenised derivatives of pyridine and quinoline, and probably have been taken up by the petroleum from decomposed organic matter.—H. M.

Absorption plant [for recovery of gasoline from natural gas]; Design and operation of a low-pressure ——. W. P. Dykema and A. A. Chenoweth. U.S. Bureau of Mines, Tech. Paper 263, 1922. 40 pages.

The plant described deals with 2,000,000 cub. ft. of gas daily, and the yield of gasoline has ranged from 0·52 gall. per 1000 cub. ft. when the plant first started (May, 1917) to 8·45 galls. in Dec., 1919. A vacuum of 19—20 in. of mercury is maintained on the wells, with the result of a much increased production. A pressure of 4—6 lb. is maintained on the two absorption towers, which work in series. The gas is cooled by passing through pipes sprayed with water before going to the towers, which are filled with wood strips, to effect the distribution of the oil. The velocity of flow of gas in the towers varies in different parts from 7·5 ft. to 15 ft. per minute. The oil circulation is 100 galls. per minute. The gas, after passing through the towers, has a gasoline content of only 0·055 gall. per 1000 cub. ft. Its heat value is 1900—2000 B.Th.U. The results of fractionations of the gasoline from different points in the system are given. The absorbing oil is a gas oil of 35°—37° B. (sp. gr. 0·838—0·848). Graphs showing the heat exchange are given, as also drawings illustrating details of the plant, and tables showing results of working.—H. M.

Petroleum products; Temperature-pressure curves of ——. M. B. Cooke. Chem. and Met. Eng., 1922, **27**, 504.

Curves showing the relation of vapour pressure to temperature are given for casinghead gasoline, motor gasoline, kerosene, and a transformer oil, for temperatures ranging from 20° C. to 260° C. The respective distillation ranges are likewise shown graphically. In general, the pressures generated by petroleum products at high temperatures vary inversely as the average boiling point of the product.—J. S. G. T.

Paraffin wax; Composition of ——. F. Francis, C. M. Watkins, and R. W. Wallington. Chem. Soc. Trans., 1922, **121**, 1529—1535.

A paraffin wax of Scottish origin, melting at 55°—56° C., and showing a mol. wt. of 366, and sp. gr. 0·7628 at 85°/4° C., was subjected to twenty-one successive fractionations under a Young column at a pressure of about 0·1 mm. After seventeen fractionations large amounts of material were obtained boiling over small ranges of temperature, and the total boiling range had spread out from 170°—230° C. to 125°—280° C., though the amount boiling above 240° C. probably did not amount to more than 2—3%. Making allowance for the unavoidable loss during the distillations, it is considered that about 80% of the paraffin is composed of seven substances of constant boiling point. Of the remainder 8—10% is composed of material boiling at 220°—240° C. and containing probably not more than two such substances. It is as yet undetermined whether these constant-boiling substances are pure hydrocarbons, or mixtures of hydrocarbons. The physical properties, m.pts., densities, solubilities, etc., of the constant-boiling substances show a perfect regularity with increasing b.p., with the sole exception of the fraction boiling at 217°—219° C., but there is no evidence that they are normal paraffins as assumed by Krafft (J., 1908, 68); in fact the physical constants of synthetic dotriacontane do not fit into the series, although its mol. wt. is the same as that of the fraction boiling at 196°—198° C.—G. F. M.

Paraffin wax and vaseline; Examination of ——. E. Pyhälä. Petroleum, 1922, **18**, 1164—1165.

The sp. gr. is determined by the flotation of wax or vaseline in an alcohol-water solution. The substance in a melted state is dropped from a glass rod into warm alcohol, when it may be observed whether any air bubbles are present. The drops free from air are transferred to a measuring cylinder, and water is added till the aqueous alcohol is of the same sp. gr. as the drops, which then neither rise nor fall in the liquid. The gravity of the aqueous alcohol is then determined by ordinary methods. The importance of ensuring the absence of air bubbles in the determination of the drop point by Ubbelohde's apparatus (J., 1905, 941) is emphasised. The effect of different methods of filling the glass vessel is noted. A variation of about 3° in the results may be brought about by incorrect methods of filling.—H. M.

Boring and cooling oils (soluble oils); Examination of ——. T. Kaleta. Chem.-Zeit., 1922, **46**, 783—784.

For the estimation of soap, mineral oil, and fatty oil, 3—5 g. of the sample is mixed with 100 c.c. of cold water and treated with solution of calcium chloride. The precipitated calcium soap is washed with water and acetone, dissolved in hot benzol-alcohol mixture, and boiled with dilute hydrochloric acid. After cooling the mixture is extracted with ether and washed with water. To the solution is added 50 c.c. of neutral alcohol, and it is titrated with *N*/2 alcoholic potash solution, evaporated, dried, and the resulting soap weighed. The filtrate from the calcium soap is diluted with 100 c.c. of water and shaken with ether. The extract, containing the mineral and the fatty oil, is washed with water, and the ether evaporated off. The fatty oil is saponified by boiling with 50 c.c. of alcoholic potash solution, the alcohol is evaporated, and 100 c.c. of water added. The mixture is warmed and the fatty oil precipitated as calcium soap, which is filtered off and the fatty oil determined as potash soap. The mineral oil, which remains, is extracted by ether, washed, and filtered. The ether is distilled off and the mineral oil weighed. Alternatively, the saponification value of the mixed mineral and fatty oil may be determined, a correction made for free alkali in the soluble oil, the amount of fatty oil determined, and the mineral oil calculated by difference. The molecular weight of the fatty acids may be calculated by the formula: mol. wt. = (g. fatty acids × 56)/g. KOH used.—H. M.

Maximum temperature of combustion. Brown. *See* I.

Benzol in gas. Bähr. *See* III.

Butadiene from ethylene. Zanetti and others. *See* XX.

Patents.

Peat; Treatment of ——. T. Rigby. E.P. 182,149, 3.1.21.

Peat is dehydrated in stages which comprise, first, mechanical removal of the bulk of water (after, if necessary, hydraulic transportation in cases where the water content of the original peat will permit), and, secondly, evaporative drying of the pulpy product in a film dryer operating in multiple effect (E.P. 181,035; J., 1922, 574 A) or on the vapour compression principle (E.P. 149,055, 150,068, and 150,807; J., 1920, 682 A, 712 A).—A. R. M.

Peat and the like; Drying of ——. T. Rigby. E.P. 182,157, 25.2.21.

The material to be dried is carried in a comparatively finely divided state in suspension in a current of hot gaseous products of combustion along a duct. The carrying current is, for the most part, composed of gaseous products which have already once passed along the duct whilst functioning as a drying medium, only a portion of the cooled current being exhausted, the remainder, after the addition of fresh hot gases, being re-circulated. The material when sufficiently dried is separated from the current by a cyclone separator. The pressure at the point or points where fresh drying gases are introduced into the system and where the material to be dried is admitted, is kept below that of the atmosphere.—A. R. M.

Peat; Process and means for dehydrating raw ——. C. Glinka. G.P. 355,865, 24.7.21.

Raw peat is continuously conveyed through a chamber in which it is subjected at a suitable temperature to high pressure by means of rollers.
—A. J. H.

Coal briquettes; Production of ——. W. W. Stenning, W. H. Beasley, and Minerals Separation, Ltd. E.P. 185,216, 31.5.21.

A mixture of crushed coal and about its own weight of water, such as is produced by the froth-flotation process, is mixed with a binding agent such as pitch. The pitch is preferably added in a powdered or molten condition, while the mixture is being agitated and aerated. Naphthalene or coal tar may be added to facilitate the subsequent dissemination of the pitch. The mixture is heated to about 80° C. and submitted to a rolling form of agitation in a horizontal rotary drum, so that air is eliminated and the coal is agglomerated. Rods may be placed in the drum to knead the mass. Water is drained away from the agglomerated coal, which is briquetted while still hot.—H. Hg.

Oven for semi-coking of fuels. H. Lentz. E.P. 166,544, 15.7.21. Conv., 15.7.20.

Fuel is passed downwards over a series of inclined surfaces arranged in stepped formation over heating flues. The passage of fuel on to each step is controlled by a flap which is operated through the end wall of the oven in such a manner that the fuel is turned over during its passage. The flaps may be operated by a common drive. The gases evolved from the fuel are withdrawn through the top of the oven. The coked fuel passes from the lowest step through crusher rollers into trucks. The gas from the heating flues is passed through the fuel in a chamber above the upper end of the oven and serves to prevent access of air to the oven during the operation of the top flap. Several ovens may be arranged in series, the first being used for a preliminary drying of the fuel.—H. Hg.

Coke-oven. E. Artzinger. G.P. 354,153, 1.2.21.

In a vertical coke-oven with vertical heating flues, a recuperator with vertical flues is provided on either side of the oven for preheating the gaseous fuel and air, which pass through the flues from top to bottom in parallel. The recuperators are so placed that the temperature of either wall of the oven can be regulated independently of the other and so that the general design of the oven is as simple and as sound as possible with regard to thermal expansion.—H. C. R.

Drying and carbonising fuel; Apparatus for ——. A. Holzhausen. G.P. 355,386, 6.2.21.

Two cylinders, one inside the other and both revolving on the same axis, are connected by means of an interceptor, through which the fuel is transferred by means of gravity or other suitable means from the inner to the outer cylinder, but the passage of vapours or gases from one cylinder to the other is prevented. The transferring device is so operated that the fuel may be loosened, compressed, or briquetted whilst being conveyed from one cylinder to the other.—A. J. H.

Gas generators and/or retorts. F. Umpleby and H. Powers. E.P. 184,887, 23.5.21.

Solid or liquid fuel is gasified by being passed downwards into a cylinder composed of porous refractory material or of a perforated heat-resisting metal which is heated by surface combustion. Gas and air for combustion are supplied to an annular space surrounding the cylinder at a pressure exceeding that within the cylinder. This annulus, together with the upper and lower parts of the generator, is surrounded by a water jacket. Metallic flanges are provided to conduct heat from the outer surface of the cylinder to the water jacket. Solid fuel is introduced in powdered form through a rotary valve, or liquid fuel through a jet, at the top of the generator, or fuel may be injected by means of air or of steam generated in the cooling jacket. Lime or chalk may be introduced with the fuel. Baffles may be provided within the cylinder to impede the flow of the fuel and may be composed of catalytic material. Surplus water from the cooling jacket may flow into a tank at the base of the generator, and ash may be discharged into this through a rotary valve. The steam generated, if not used for the injection of fuel, is introduced into the top of the cylinder. The gases resulting from the interaction of fuel, steam, air, and products of combustion are withdrawn from the bottom of the cylinder under pressure or suction and may be supplied to internal-combustion engines. —H. Hg.

Coal, hydrocarbons, and the like; Process for decomposing —— under high temperatures and pressures. S. Löffler. G.P. 306,356, 24.1.15.

The temperature of the reaction chamber is controlled and the pressure on the walls of the chamber counterbalanced by means of a fluid (*e.g.*, oil) bath under pressure, stable under the necessary high temperatures employed. The pressure on the fluid bath may be slightly greater than that in the reaction chamber, and it is advantageous to use for the fluid bath hydrocarbons of high b.p. similar to those employed in the reaction chamber, so that in the event of the walls of the latter becoming damaged, harmful contamination of the reaction mixture does not occur.—A. J. H.

Blast-furnace and like gases; Pre-heating —— in dry gas-purifying plants. Dinglersche-Maschinenfabrik A.-G. E.P. 182,102, 1.6.22. Conv., 24.6.21.

In preheating blast-furnace and like gas by surface radiators heated by gas burners, compressed air is supplied to the gas burners, thereby avoiding the use of exhaust fans for drawing off the hot gases of combustion. Independent gas burners are preferably employed for the heaters of the individual units.—A. R. M.

By-products; Apparatus and process for recovering —— from distillate gases. A. Roberts. E.P. 184,507, 12.2.21.

In the recovery of by-products from distillate gases, *e.g.*, coke-oven gas, a suitable medium is injected for the purpose of increasing the vapour tension and lowering the temperature of the gas to that slightly above the dew-point of the heaviest constituent to be removed. The gas is then passed through a series of condensers, which may be jacketed if desired, and are each maintained at the dew-point of the constituent to be separated. Oils, emulsions or other by-products, having substantially the same composition as the by-products subsequently removed at a later stage of the process, are sprayed into the condensers, and are evaporated therein, serving at the same time to condense the heavier constituent which it is desired to remove. An ammonia saturator may be located at such a point in the system that gas entering it has its temperature above the dew-point of water vapour, so as to avoid excessive condensation of water in the acid. To remove products the dew points of which are lower than that of water-vapour, *e.g.*, benzol from coke-oven gas, a condenser is placed after the ammonia saturator and the gas sprayed therein with a suitable liquid, after suitable preliminary cooling.—A. R. M.

Alcohol fuel. J. Hawes. E.P. 184,607, 27.5.21.

The fuel consists of 96—98% alcohol, 96 pts.; petroleum naphtha, 2 pts.; nitrobenzene, 1 pt.; and amyl alcohol, 1 pt.—T. A. S.

[Hydrocarbon] oils; Process and apparatus for catalysing —— and revivifying the catalyst. E. V. Owen, Assr. to The Hoover Co. U.S.P. 1,427,626, 29.8.22. Appl., 31.3.22.

Low-boiling hydrocarbons are produced by passing high-boiling hydrocarbons with "aluminium chloride hydrocarbon catalyst" through a catalysing chamber maintained at a suitable temperature. After passing through the catalysing chamber the oil is separated from the catalyst and returned to the chamber. The returning oil passes along the outer wall of the catalysing chamber and is heated to maintain the chamber at the correct temperature. Low-boiling hydrocarbon vapours are removed from the chamber.—T. A. S.

Mineral oils and the like; Process for refining ——. Plauson's Forschungsinstitut G.m.b.H. G.P. 352,189, 11.3.20.

Alkali bisulphates or pyrosulphates are used, at temperatures between 110° and 250° C., if necessary under pressure, the sulphur dioxide produced being converted into sulphuric acid, which is used to produce bisulphates from the alkali sulphates recovered from the residues. The saturated hydrocarbons are scarcely attacked and are recovered in a high degree of purity.—A. G.

Hydrocarbon oils; Process for the purification of ——. Deutsche Erdöl-A.-G. G.P. 352,917, 18.2.21.

The oils are treated with more than 5% of paraffin monocarboxylic acids or their halogen derivatives or anhydrides until colourless and odourless, and free from resin and asphalt. Mineral oil is treated, *e.g.*, with acetic acid or concentrated formic acid, with stirring, or, in a continuous process, in a packed washing column on the counter-current principle. The process is simpler and cheaper than that using sulphuric acid.—A. G.

Paraffin; Continuous production of ——. W. Scheffer. G.P. 353,780, 23.11.17. Addn. to 352,919 (J., 1922, 661 A).

The melting process is employed in the absence of air. Danger from fire is minimised and an increased yield is obtained.—A. G.

Sulphonic acid [from mineral oils]; Process of cleaning [removing inorganic salts from] ——. A. Wolff, Assr. to The Chemical Foundation, Inc. U.S.P. 1,428,197, 5.9.22. Appl., 20.4.16.

Inorganic salts are removed from sulphonic acids prepared by treating mineral oils with sulphuric acid, by washing at about 140° F. (60° C.) with a quantity of 40—50% sulphuric acid approximately equal to 20% of the weight of the sulphonic acids under treatment.—L. A. C.

Raw peat and the like; Process of drying and compressing ——. A. J. H. Haddan. From Torfverwertungsges. Pohl und von Dewitz. E.P. 165,445, 10.5.21. Addn. to 158,513 and 159,464.

See G.P. 342,337 of 1920; J., 1920, 130 A.

Gasfication of coal or other carbonaceous material. A. McD. Duckham. U.S.P. 1,428,421, 5.9.22. Appl., 2.5.21.

See E.P. 164,935 of 1920; J., 1921, 572 A.

Methane and hydrogen; Apparatus and method for production of a gaseous mixture of ——. L. Colson. U.S.P. 1,428,879, 12.9.22. Appl., 12.12.18.

See E.P. 121,124 of 1918; J., 1919, 620 A.

Mineral oils obtained from earth oil; Method of refining ——. C. R. Ehlers. E.P. 184,991, 29.7.21.

See G.P. 348,342 of 1920; J., 1922, 362 A.

Motor fuel; Aeroplane ——. W. T. Schreiber, Assr. to U.S. Industrial Alcohol Co. U.S.P. 1,428,913, 12.9.22. Appl., 25.6.18. Renewed 11.8.19.

See E.P. 128,915 of 1919; J., 1920, 651 A.

Lubricating oils. G.P. 352,726 and 353,497. *See* III.

Iron oxide sludge. U.S.P. 1,428,521. *See* VII.

Lubricating oils etc. G.P. 353,222. *See* XII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Thermal conductivity at temperatures of incandescence [e.g., of incandescence filaments]; Determination of ——. M. von Laue and W. Gordon. Sitzungsber. Preuss. Akad. Wiss. Berlin, 1922, 112—117. Chem. Zentr., 1922, 93, IV., 689.

The thermal conductivity of the filaments of electric lamps in a state of incandescence may be determined by heating the filament with alternating current and measuring the difference in phase between the temperature and the heat liberated, or by determining the variations in the temperature of the surface of the filament. The variations in the electrical and thermal conductivity, due to local or temporary variations in temperature, may be neglected. The variations in temperature must not be too great. The filament must be of such a length that the flow of heat to its ends does not need to be taken into consideration.—A. B. S.

Patents.

Peat and the like; Dry distillation and coking of raw ——. A. J. H. Haddan. From Torfverwertungsges. Pohl u. [illegible]n Dewitz. E.P. 169,952, 10.5.21. Addition [illegible] 158,513 (*cf.* G.P. 337,097; J., 1921, 618 A).

A modification of the original process in which the moisture of the peat is liberated by heating only a selected zone of the charge, preferably the interior, or heating one zone more powerfully than the surrounding zones, and allowing the steam thus generated to penetrate the charge and expel the moisture to an outlet or outlets. A water discharge pipe has a stop-cock which can be kept closed until the water to be discharged has collected in the pipe.—A. R. M.

Carbonisation of coal, shale, peat, and the like; Apparatus for ——. H. P. Hird. E.P. 184,525, 20.12.21.

Within the carbonising retort a shaft or shafts of suitable cross-section are caused to revolve, so that a passage is formed within the body of the charge, external to the shaft, thus permitting ready escape of gas from the retort. A tapering shaft may be used, and it may have a combined reciprocating and rotary motion.—A. R. M.

Pitch and the like; Carbonisation of ——. K. Kubierschky. G.P. 354,213, 30.11.20.

Pitch is worked up into solid briquettes by admixture while hot with coke, coal, or sawdust, and the product is distilled. The coke formed during distillation can be readily removed from the retorts. —L. A. C.

Wood and similar materials; Method for obtaining chemical products from ——. Chem. Fabr. Kalk G.m.b.H., und H. Oehme. G.P. 354,865, 7.4.20.

A dry mixture of wood flour and magnesium chloride is heated in a current of dry steam and the products of decomposition of the wood, such as acetic acid, methyl alcohol, acetone, furfural, etc., are partly removed during the process of decomposition and finally by steam distillation. The residue is used in the preparation of artificial wood and similar products.—A. J. H.

Electric discharge tubes [*; Gas-filled —— with independent discharge*]. Naaml. Vennoots. Philips' Gloeilampenfabrieken. E.P. 162,268, 18.2.21. Conv., 20.4.20.

In gas-filled electric discharge tubes in which an electric discharge is started by supplying current to the electrodes, the starting potential is reduced by combining magnesium or beryllium or their alloys with the metal, *e.g.*, iron or aluminium, forming the electrodes. Thus magnesium or beryllium may be mechanically applied to the electrodes, and material disintegrated from the electrodes by the discharge is prevented from forming a deposit upon the walls of the discharge tube by suitably shaping the electrodes, *e.g.* by partly surrounding the auxiliary metal or alloy by the electrodes.
—J. S. G. T.

Distillation of material carrying a percentage of volatile matter [*e.g., shale etc.*]. G. McD. Johns, Assr. to The Industrial Process Engineering Co. U.S.P. 1,423,527, 25.7.22. Appl., 16.7.20.

See E.P. 172,392 of 1920; J., 1922, 92 a.

Carbonaceous materials; Heating of vertical retorts for the distillation of ——. W. Wild, Assr. to West's Gas Improvement Co., Ltd. U.S.P. 1,427,426, 29.8.22. Appl., 5.6.20.

See E.P. 153,139 of 1919; J., 1920, 813 a.

[*Incandescence electric lamps;*] *Hermetical seal* [*for leading-in wires of ——*]. W. L. Van Keuren, Assr. to General Electric Co. U.S.P. 1,427,870, 5.9.22. Appl., 15.6.18.

See E.P. 130,212 of 1918; J., 1919, 675 a.

III.—TAR AND TAR PRODUCTS.

Low-temperature coal-tar and pitch therefrom [*; Composition of ——*]. J. Marcusson and M. Picard. Z. angew. Chem., 1922, 35, 493—494.

The presence of carboxylic acids in low-temperature tar previously reported by the authors (*cf.* J., 1921, 462 a) has been confirmed by examination of two other industrial samples. These acids are considered to be not phenolcarboxylic acids but acids allied to humic acid, as are similar compounds found in wood-tar. Pitch from low-temperature tar and ordinary coal-tar pitch of similar melting points show wide differences in composition. Determinations of the degree of softness by the Richardson penetrometer and of the elasticity of different qualities of pitch from low-temperature tar and pitch derived from ordinary coal tar and lignite tar are given. These properties are of importance from the point of view of suitability for the preparation of asphalt. In the case of material derived from coal, pitch from low-temperature tar is far inferior to a similar quality of ordinary pitch for this purpose. With lignite pitch the difference is not quite so great.—C. I.

Benzol; Estimation of —— in gas. H. Bähr. Chem.-Zeit., 1922, 46, 804.

The apparatus consists of a jacketed metal cylinder, the inner portion of which is filled with activated charcoal. This cylinder is placed in a vertical position and the gas is passed into it after passing through a gas meter. After the absorption the cylinder is placed horizontally, the jacket partly filled with naphtha of b.p. 160°—170° C., and the latter heated to boiling, while a current of superheated steam is passed through the charcoal. The benzol is condensed and the vessel finally swept out with heated gas. Tests with this apparatus showed that at two coke-oven installations some 20% of the benzol was escaping absorption. Part of this loss, however, is inevitable, the charcoal apparatus recording as benzol fractions of very low boiling point which could not be retained by wash-oil.
—C. I.

Coumarone-resin. Hirano. *See* XIII.

Patents.

Tar; Distillation of ——. Thermal Industrial and Chemical (T.I.C.) Research Co., Ltd., J. S. Morgan and D. Rider. E.P. 184,624, 7.6. and 20.12.21.

The difficulties of frothing in tar-stills and the removal of constituents of lower boiling point from viscous pitch are overcome by feeding the crude preheated tar under the surface of molten metal which is kept at such a temperature that hard pitch is discharged. The vapours from the still, which is kept at about 350° C., are passed through a small fractionator, kept by the incoming tar at about 120° C. The vapours leaving at this temperature consist of water and light oils. The condensed liquid from the fractionator is led into a secondary still also containing molten metal and maintained at about 230° C. This removes the usual tar fraction boiling at 170°—230° C. The residues pass on to a third still kept at 270° C. where the fraction boiling at 230°—270° C. is removed. The residue constitutes another well-marked fraction boiling between 270° and 350° C. A modification of the process consists in keeping the first still at 275°—290° C., whereby the anthracene remains in the pitch. The pitch is then sprayed in a tower with superheated steam which removes the anthracene.
—T. A. S.

Waste sulphuric acid [*from refining tar oils*]*; Process for treatment of ——* [*to recover resinous products*]. S. Hilpert, Assr. to Deutsch-Luxemburgische Bergwerks und Hütten A.-G. U.S.P. 1,427,386, 29.8.22. Appl., 9.7.21.

The waste sulphuric acid obtained in the purification of light coal-tar oils is treated with an aromatic hydrocarbon to recover resinous products.—T. A. S.

Lubricating oils; Production of highly viscous —— from coal-tar oils. Chem. Fabr. Worms A.-G. G.P. 352,726, 8.12.17. Addn. to 350,801 (J., 1922, 539 a).

Acid gases, particularly gaseous hydrogen chloride, are used as condensing media, and are brought into contact with the oils at high pressures and elevated temperature. Anthracene oil is saturated with hydrogen chloride in an autoclave, the charge being stirred at about 100° C. under pressure of 1—2 atm. until a sample shows the desired viscosity. The viscosity increases from 4·52° Engler at 40° C. to 12·5° Engler at 50° C. Sulphur dioxide may be used in place of hydrogen chloride.—A. G.

Thionaphthenesulphonic acid; Process for preparing ——. Ges. für Teerverwertung m.b.H., and R. Weissgerber. G.P. 353,932, 22.2.21.

The sulphonation of thionaphthene is carried out in the presence of at least sufficient acetic anhydride to combine with the water present in the sulphuric acid and that produced during the reaction. The free acid is a difficultly crystallisable, syrupy mass, easily soluble in water. The potassium salt forms colourless easily soluble laminæ. The acid is decomposed on heating with dilute sulphuric acid to 140° C. into thionaphthene and sulphuric acid.
—H. C. R.

Purification of waste liquid [*containing hydrocarbons*]. F. W. Wagner. U.S.P. 1,428,618, 12.9.22. Appl., 24.8.20.

Hydrocarbon compounds are removed from aqueous solutions by passing a stream of a reducing gas through and intimately mingling it with the solution in presence of a catalyst.—B. M. V.

Hydrocarbon oils. G.P. 352,917. *See* IIA.

Sulphonic acids. U.S.P. 1,428,197. *See* IIA.

Carbonisation of pitch. G.P. 354,213. *See* IIB.

IV.—COLOURING MATTERS AND DYES.

Colour of the azo-dyes and related coloured substances; Calculation of the ——. J. Moir. Chem. Soc. Trans., 1922, **121**, 1555—1562.

The method of representing coloured substances by hydroxylated formulæ which may then be dissected into a fundamental skeleton or parent substance and a number of subsidiary groups or linkages (Chem. Soc. Trans., 1921, **119**, 1655), has been successfully applied to the simpler azo-dyestuffs, and numerical values have been found for the subsidiary groups, so that, for example, the colour of ionised benzene azophenol or the wave length of the absorption band may be calculated from that of ionised phenol as parent substance, by multiplying its wave length ($\lambda = 287$) successively by the respective numerical factors for the subsidiary groups. From the values for the hydroxy-compounds those for the aminoazo- and dimethylaminoazo-compounds can be calculated by using the factors for the ratios NH_2/OH and $(CH_3)_2N/OH$, viz., 1·1 and 1·19 for the lower bands and 1·18 and 1·27 for the higher bands respectively. By introducing other interposition factors the values for azomethine, stilbene, and higher azo-dyestuffs can be calculated. The following are colour factors for groups interposed in the chain: $—CH_2—$ 0·92, —NH— 1·09, —O— 1·0 and 1·4, —CHOH— 1·01, —NOH— 1·20; as second linkage to two rings the factor for $—CH_2—$ is 0·95, —NH— 1·13, and —O— 1·02 and 1·4. The naphthalene/benzene factor is 1·15, and the phenyl factor 1·135.—G. F. M.

Cyanine dyes. V. Virtual tautomerism of the thiocyanines. W. H. Mills and W. T. K. Braunholtz. Chem. Soc. Trans., 1922, **121**, 1489—1495.

The thiocyanines produced by the condensation of 5-methylbenzothiazole ethiodide with 1-methylbenzothiazole ethiodide on the one hand, and 1.5-dimethylbenzothiazole ethiodide with benzothiazole ethiodide on the other hand, are identical substances, whereas in the absence of any intramolecular change, two isomeric thiocyanines would have been expected, differing in the nitrogen atoms to which the acid radicle was attached. The facts therefore demonstrate the existence of virtual tautomerism in this class of dyestuffs, involving the transference of the acid radicle from one of the two nitrogen atoms to the other with a correlated shift in the conjugated double linkings of the connecting chain. In view of the close correspondence in properties between the various classes of cyanine dyestuffs, there can be little doubt that the other classes of this group, the cyanines, carbocyanines and their isomerides, are capable of showing the same phenomenon.—G. F. M.

Pyrylium salts of anthocyanidin type; Synthesis of ——. D. D. Pratt and R. Robinson. Chem. Soc. Trans., 1922, **121**, 1577—1585.

Derivatives of 3-hydroxybenzopyrylium salts related to the naturally occurring anthocyanin plant pigments have been synthesised by condensation of *o*-hydroxyaldehydes and ω-alkyloxy- or ω-aryloxy-acetophenones. The direct condensation is exemplified by the preparation of 7-hydroxy-3-ethoxy-2-phenylbenzopyrylium chloride by passing hydrogen chloride into a glacial acetic acid solution of β-resorcylaldehyde and ω-ethoxyacetophenone. It forms orange-red needles which decompose at 210° C., and gives a ferrichloride in the usual way, crystallising in diamond-shaped prisms, m.p. 170° C. 3-Ethoxy-2-phenylbenzopyrylium ferrichloride was, on the other hand, obtained by two steps, first the preparation of phenyl-2-hydroxy-β-ethoxystyryl ketone from salicylaldehyde and ω-ethoxyacetophenone, and secondly the conversion of the styryl ketone into a pyrylium chloride by means of hydrogen chloride in dry ethereal solution. The ferrichloride crystallises in bright golden plates, m.p. 121° C.—G. F. M.

Naphthalene and its derivatives; Electrolytic reactions of ——. *III. Electrolytic oxidation of α-naphthylamine and ar-tetrahydro-α-naphthylamine.* K. Ono. Mem. Coll. Sci. Kyoto Imp. Univ., 1922, **5**, 345—357.

α-Naphthylamine is oxidised electrolytically in a divided cell in which a small sheet lead cathode is immersed in sulphuric acid (20%) and the anode liquid is a solution of α-naphthylamine in acetone and dilute sulphuric acid. Platinum, graphite, and lead peroxide respectively may be used as anode materials, the last-named giving the best results. Under these conditions, α-naphthylamine is converted into a mixture of Naphthylamine Violet and α-naphthoquinone. Its behaviour thus differs from that of aniline which, at a platinum electrode, is transformed solely into Aniline Black, but the apparent stability of the latter may be due entirely to its insolubility in the anode liquid. The current yield diminishes with increasing current density but attains its maximum at approximately 1 amp. per 100 sq. cm. Raising the temperature of the electrolyte does not necessarily favour the yield. A suitable concentration of sulphuric acid is 10—30%, the best results being obtained with a 10% solution. Potassium chromate, chrome alum, potassium chlorate, and ferric sulphate act effectively as oxygen carriers. Under closely similar conditions, *ar*-tetrahydro-α-naphthylamine is oxidised to *ar*-tetrahydro-α-naphthoquinone. Platinum, lead peroxide, and graphite may be used as anode material and, of these, lead peroxide gives the best results. The most suitable conditions are a current density of about 1 amp. per 100 sq. cm., a temperature between 18° and 23° C., and a concentration of sulphuric acid between 10% and 30%. Chrome alum, potassium chromate, potassium chlorate, and potassium ferrocyanide are efficient oxygen carriers. —H. W.

Triphenylpararosaniline hydrochloride; Formation of —— *from diphenylamine and chloral-ammonia.* R. Horiuchi. Mem. Coll. Sci. Kyōtō, 1921, **5**, 1—7.

The small yield of triphenylpararosaniline hydrochloride obtained by heating diphenylamine and chloral-ammonia directly to 130° C. is greatly increased by maintaining the temperature at 100° C. for some time prior to heating to 130° C. The author has investigated the reaction of diphenylamine with various compounds containing the CCl_3 and CHO groups respectively and concludes that compounds containing the former group are alone concerned in the formation of Diphenylamine Blue, the chlorine atoms being replaced by the phenyl group, and the resulting product reacting with part of the hydrogen chloride produced. —J. S. G. T.

Carbamides of anthraquinone. M. Battegay and J. Bernhardt. Chim. et Ind., 1922, **8**, 305—306.

The three isomeric dianthraquinonylcarbamides show a gradation in properties in which the αβ′-isomeride approaches more nearly to the

$\beta\beta'$-isomeride than to the $\alpha\alpha'$-isomeride. The two first-named may be used as vat dyes by preliminary reduction with alkaline sodium hydrosulphite at 30°—40° C., but under similar conditions the $\alpha\alpha'$-isomeride undergoes hydrolysis unless the temperature is kept below 18°—20° C., and then the material is so insoluble as to render it useless as a dye. If, however, two hydroxy, methoxy, or benzoylamino groups are introduced in para positions to the carbamide group, one in each anthraquinonyl nucleus, then the products are stable in the reducing bath and may be used as dyes.—W. G.

Urethanes of anthraquinone. M. Battegay and J. Bernhardt. Chim. et Ind., 1922, 8, 307.

The urethane group exercises a greater auxochrome effect when introduced into the anthraquinone molecule than does the benzoylamino group, both in the α and the β derivatives. The α-urethanes, like the $\alpha\alpha'$-carbamides, on reduction in alkaline medium give products which are immediately hydrolysed, and this is not checked in the case of the urethanes by the introduction of a nitro, hydroxy, methoxy, or benzoylamino group into the para position prior to the reduction.—W. G.

Reduction of colouring matters by light. Ihran. *See* XXI.

Brominated isocyanines. Moudgill. *See* XXI.

Patents.

Anthraquinone dyestuffs; Manufacture of ——. F. W. Atack and C. W. Soutar. E.P. 185,137, 23.2.21.

The dull shade of halogenated N-dihydro-1.2.2′.1′-anthraquinoneazine dyestuffs, which are obtained by condensation of halogenated aminoanthraquinones in the presence of a copper salt, is due to the presence of traces of impurities which are rendered soluble and therefore capable of easy removal, by halogenation of the crude dyestuff. For this purpose, the crude dyestuff is treated in suspension or solution in an inert liquid with chlorine or bromine or substances which produce these *in situ.* When purified by this process, 3.3′-dibromo-N-dihydro-1.2.2′.1′-anthraquinoneazine yields a dyestuff having a redder and purer blue shade.

—A. J. H.

Acridine series; Compound of the —— and a process of making the same. Acridinium compounds and a process of making the same. L. Benda, Assr. to L. Cassella und Co. G.m.b.H. U.S.P. (A) 1,427,431, and (B) 1,427,432, 29.8.22. Appl., 14.7.21.

(A) 3.6-Diamino-10-alkylacridinium compounds are treated with formaldehyde in the presence of dilute mineral acids at the ordinary temperature. (B) Readily-soluble salts of 3.6-diamino-10-methylacridinium are treated with tannin in the presence of acid-binding agents, yielding a tasteless, bright orange-yellow powder suitable for use in the manufacture of lake colours.—L. A. C.

Isatin-α-arylides; Process for the preparation of compounds of —— with sulphur dioxide. C. Stephan. U.S.P. 1,427,863, 5.9.22. Appl., 24.8.21.

The acid mixtures produced by interaction of isatin-α-arylides and sulphuric acid are treated with basic sulphites in such a manner that the sulphuric acid is neutralised rapidly and completely before decomposition of the sulphites can take place.

—L. A. C.

[Triphenylmethane] dyestuffs; Manufacture of chlorinated products of toluene and —— therefrom. J. Schmidlin, Assr. to L. Cassella und Co. U.S.P. 1,428,984, 12.9.22. Appl., 12.3.15.

See E.P. 13,970 of 1915; J., 1915, 1243.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Pines and spruces; Investigations on Swedish ——. H. E. Wahlberg. Svensk Pappers-Tidning, 1922. Papierfabr., 1922, 20, 1097—1100, 1133—1137, 1178—1181.

Numbered discs and sectors were cut from test stems of spruce and pine and subjected to a close systematic examination. In the spruce the limits between heart and sapwood are not very clearly defined but could be distinguished after staining with perosmic acid. The heart wood does not extend equally in all radial directions, but the differences do not cover more than one or two annual rings. For the estimation of moisture the wood was exposed *in vacuo* for 72 hrs. at the ordinary temperature over phosphorus pentoxide. In a sector which was closely studied the specific gravity of the whole sector, dried *in vacuo*, was 0·345; that of the spring wood was 0·307 (average), and that of the autumn wood 0·601. A cold, wet season apparently tends to give rise to wood of lower density. The shrinkage in volume of the freshly felled wood in drying to the air-dry condition ranged from 6·5 to 11·6%. The ash constituents were slightly concentrated in the outer and higher portions of the stem. Estimations of fat and resin vary greatly according to the solvent employed; the determinations were made by extracting first with benzene for 8 hrs. and then with alcohol for the same length of time. Storage for 80 days made no difference in the resin values as compared with storage for 10 days; any modification of the resin after felling must therefore have been complete in the first 10 days. Drying at 105° C. considerably decreased the amount of benzene extract. The distribution of resin in the stem was irregular, but the general tendency was for the resin to increase from the outside towards the heart; its distribution was more regular near the apex of the stem where no secondary processes had taken place. Cellulose was determined by digestion for 18 hrs. with bisulphite solution at 125° C., followed by repeated treatments with bromine. The percentage of cellulose did not show large variations, but small variations were observed which were in the reverse direction to the variations in the resin-content.

—J. F. B.

Wood; Cellulose value of pulp ——. H. E. Wahlberg. Papierfabr., 1922, 20, 1216—1218.

The percentage of cellulose in wood, calculated on the resin-free dry weight, shows only minor variations round about an average of 49—51%. The yield of cellulose is lowest at the centre of the stem and this is due either to secondary changes which render the fat and resin insoluble in the extraction media or to the presence of increased quantities of other non-cellulose compounds, such as lignin. The apparent specific gravity of the wood, however, is subject to large variations, and since pulp-wood is always dealt with in terms of volume rather than weight, the cellulose value at the pulp mill is subject to corresponding variations. The cellulose value, kg. of pulp per cub. m. of solid wood, may be expressed by the formula $m=K(100-h)S$, where K is practically a constant depending on the method of digestion, S is the apparent specific gravity, when the volume is measured on the moist wood and the weight is the dry weight, and h is the percentage of resin. In the method employed by the author for the determination of cellulose (digestion with bisulphite at 120° C. and repeated bromination) the value of K could be taken as 5. The area of the disc of wood was determined by tracing its outline on a sheet of paper of known area-weight and weighing the paper template. In calculating the cellulose value of the whole stem by the above formula the stem was divided into four equal lengths and a sample disc was cut from the middle of each, the area of the discs being taken to represent the quantitative value of the portion of the stem from which it was cut. Examined in this way, two stems of spruce, grown under equally favourable conditions, gave cellulose values of 125 and 263 respectively, and a stem of pine grown on poor soil showed a cellulose value of 220 kg. per solid cubic metre. Hence it follows that different trees of the same origin have very different values for the pulp maker owing to differences in the specific gravity of the wood, ranging from 0·348 to 0·551.—J. F. B.

Cellulose; Viscosity of —— in cuprammonium hydroxide solution. I. Determination of the viscosity. R. A. Joyner. Chem. Soc. Trans., 1922, 121, 1511—1525.

IMPROVEMENTS have been made in the falling-sphere viscosimeter method of Gibson, Spencer, and McCall (J., 1920, 541 A, 558 A) for determining the viscosities of cuprammonium solutions of cellulose. A different method for the preparation of the Schweitzer reagent was used, the solution being made by bubbling air through a mixture of copper turnings in strong ammonia, with the addition of about 1 g. of sucrose per litre to hasten the dissolution of the copper. Solutions containing more than 30 g. of copper per litre can be obtained, and by determining the copper and ammonia in the usual way solutions of any desired strength can be prepared by suitable dilution. A modification of the method of preparing the cellulose solutions and filling the viscosimeter tube was developed, in order to eliminate errors due to oxidation and to the presence of air bubbles in the viscous solutions. The cotton was packed in a glass tube, 5 cm. wide and 10 cm. long, drawn out at each end to a narrow tube 0·7 cm. wide, and connected below with rubber tubing to the bottom of the viscosimeter tube on the one hand, and above through suitable taps to a reservoir containing the reagent, and sources of vacuum and pressure. The tube was evacuated, the copper reagent admitted, any residual air removed by further suction, and the tube was finally closed and shaken to dissolve the cellulose. Finally by means of slight pressure (air is quite suitable provided the top layers of the solution are rejected) the solution was transferred to the viscosimeter tube. An increase of about 12% on Gibson, Spencer, and McCall's figures was observed by the new method. Experiments were undertaken to determine the effect of the concentration of copper and ammonia, and small percentages of sucrose or salts on the viscosities. The latter had no appreciable effect. The best copper concentration for general use is 13 g. per litre with 20 g. of cellulose and 200 g. of ammonia per litre. With low viscosity cotton a 4% solution of cellulose is necessary; this is prepared with a reagent containing 20 g. of copper and 200 g. NH_3 per litre, and the viscosity for a 2% solution is calculated by the Arrhenius formula.
—G. F. M.

Rubber latex in paper making. F. Kaye. India-rubber J., 1922, 64, 435—442.

RUBBER latex is introduced during the beating process, a coagulant such as magnesium sulphate, acetic acid, or alum being added if necessary. The process of hydration involved in beating is accelerated even by small quantities of latex, while the tensile strength and bursting strain of the paper are increased in a marked degree. The rubber, which may conveniently amount to approximately 1% of the paper, is as durable and resistant to spontaneous chemical change as the paper itself.
—D. F. T.

Paper; Determination of mechanical wood pulp in printing ——. H. Krull and B. Mandelkow. Papierfabr., 1922, 28, 1213—1216.

THE determination of the phloroglucinol absorption value, carried out exactly according to the method of Cross, Bevan, and Briggs (J., 1907, 942), affords a convenient and accurate measure of the percentage of mechanical pulp in "news" and similar printing papers. In calculating the results, however, the original factors 8 for mechanical wood and 1 for sulphite pulp cannot be accepted as sufficiently accurate. The true average values for these factors are 7·84 for mechanical and 1·34 for unbleached strong sulphite pulps. The error involved by using the original factors is negligible for papers containing between 65 and 75% of mechanical wood pulp, but becomes very considerable in the case of papers containing low percentages of that constituent. The corrected formula for calculating the result, expressed on the dry substance, is $H = 100(P-1{\cdot}34)/(7{\cdot}84-1{\cdot}34)$, where H is the percentage of mechanical pulp and P is the phloroglucinol absorption value of the paper.—J. F. B.

PATENTS.

Viscose; Manufacture and treatment of ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 184,533, 11.4.21.

MONOSODIUM- (or disodium-)viscose is made from highly dispersed cellulose (*cf.* E.P. 183,908; J., 1922, 748 A); *e.g.*, monosodium-viscose is made by treating a paste containing 32 pts. of cotton, 8 pts. of caustic soda, and 600—800 pts. of water in a colloid mill for ½—1 hr., and then adding 7—8 pts. of carbon bisulphide; after treatment for a further 10 mins. in the mill the reaction is complete. The viscose solution thus obtained may be filtered, and, if required for the manufacture of artificial silk, concentrated *in vacuo* at temperatures not above 40° C. to the required strength, or the viscose may be coagulated by heating it at 80°—100° C., in which case resin, rubber, etc. may be added during the dispersion treatment to modify the properties of the final product. By adding to the viscose solution a non-injurious electrolyte, *e.g.*, salt, viscose is precipitated and after washing and drying remains as a fine water-soluble powder, which, however, gradually changes into an irreversible colloid unless kept *in vacuo*, or in an atmosphere of an inert gas such as nitrogen or hydrogen. This powder may be used for the preparation of compact masses by heating it in moulds at 120°—150° C. under 200—500 atm. pressure. The advantages claimed for this process are that theoretical quantities of alkali and carbon bisulphide are used, the whole operation is rapidly carried out, and the viscose produced requires very little "ripening" even when used for the manufacture of artificial silk.
—D. J. N.

Hydra-oxy-cellulose, a xanthogenated compound obtained therefrom and a solid compact material obtained by coagulation of the latter; Manufacture of ——. C. C. L. G. Budde. E.P. 184,610, 28.5.21.

BY treating cellulosic material containing one half to twice its weight of water first with chlorine gas in sufficient excess to react with the non-cellulose matter and convert the cellulose into oxycellulose, and then with strong hydrochloric acid, a hydra-oxy-cellulose is obtained. This substance gives a xanthate, which readily mixes with water—a solution containing 20% of hydra-oxy-cellulose will spread itself evenly and rapidly over a flat surface—and can be used for the manufacture of artificial silk, paper size, leather boards, etc. The process may be conducted, for example, as follows: Wood pulp (100 pts.) reduced to the size of small crumbs with an equal weight of water, is exposed for some hours to the action of chlorine gas until about 10 pts. by weight of chlorine has been absorbed. Materials such as oat straw require 30—50% of chlorine gas. The oxycellulose thus obtained is air-dried to concentrate the hydrochloric acid (a by-product in the chlorination process) and convert the oxycellulose into hydra-oxy-cellulose. The resulting brittle product is transferred to a mixing machine with 275 pts. of an 18% solution of caustic soda, and, after mixing for about 2 hrs., 40 pts. of carbon bisulphide is added: the reaction is allowed to proceed for about 4 hrs., with cooling if necessary. The solution obtained may be used for all purposes for which viscose is used, but is particularly suitable for the manufacture of compact solid bodies, *e.g.*, a 16% solution (16% hydra-oxy-cellulose) with addition of such fillers as zinc oxide, clay, starchy matter, paper pulp, esparto resin, waxes, fats, resins, glycerin, dyes, etc., is poured into moulds, and, when free from air bubbles, heated to 40° C. for about 12 hrs. when a homogeneous compact mass is obtained. This is dried, either direct or after washing in a current of water at 50° C., and if a waterproof product is required, heated at or above 100° C. Imitation leather may be made by mixing 50 pts. of zinc oxide and 50 pts. of resin oil with the xanthate derived from 100 pts. of hydra-oxy-cellulose, and impregnating the product with glycerin.—D. J. N.

Cellulose derivatives [acetate]; Manufacture of solutions, compositions, preparations or articles made with ——. H. Dreyfus. E.P. 184,671, 20.7.21.

Cyclobutanone (b.p. 99°—101° C.), either alone or in admixture with other solvents, such as methyl or ethyl alcohol, acetone, methyl acetate, etc., is used as a solvent for cellulose acetates in the manufacture of varnishes, plastic masses, and the like. Cellulose acetate varnish, for example, may be made by dissolving 100 pts. of cellulose acetate in 1000 pts. of cyclobutanone or in 100—500 pts. of cyclobutanone and 900—500 pts. of methyl acetate or acetone; a plastic mass may be made by dissolving 100 pts. of cellulose acetate and 12—15 pts. of triphenyl phosphate in 50 pts. of cyclobutanone and 100 pts. of methyl acetate, acetone, or alcohol. —D. J. N.

Spun material resembling wool, cotton, or chappe; Process for producing —— from viscose solutions. P. H. Minck, Assr. to The Chemical Foundation, Inc. U.S.P. 1,428,246, 5.9.22. Appl., 16.5.19.

Cellulose material is treated with a solution of a caustic alkali sufficient to produce incomplete hydration without an excess of water, and is then treated with carbon bisulphide and the cellulose xanthate thereby formed is dissolved in a 3—5% solution of caustic alkali and afterwards spun in a bath containing a mineral acid.—A. J. H.

Cellulose esters and ethers; Composition and film containing mixtures of ——. L. J. Malone, Assr. to Eastman Kodak Co. U.S.P. 1,429,153, 12.9.22. Appl., 7.1.22.

The composition consists of 1 pt. of a mixture of a cellulose ester and a cellulose ether dissolved in not more than 6 pts. of a liquid containing pyridine. —A. J. H.

Cellulose-ether composition. P. C. Seel, Assr. to Eastman Kodak Co. U.S.P. 1,429,169, 12.9.22. Appl., 5.1.22.

The composition contains a cellulose ether and dichloropropane.—A. J. H.

Cellulose ether solvent and composition. S. J. Carroll, Assr. to Eastman Kodak Co. U.S.P. 1,429,188, 12.9.22. Appl., 5.4.21.

A viscous composition suitable for producing films consists of a solution of an alkyl ether of cellulose in a mixed solvent containing 90 to 40 pts. of ethylene chloride and 10 to 60 pts. by weight of a lower monohydric aliphatic alcohol.—A. J. H.

Artificial silk filaments; Process for the manufacture of fine ——. Vereinigte Glanzstoff-Fabrik A.-G. G.P. 308,427, 7.4.18.

Regulated quantities of viscose solution are squirted into a coagulating bath under conditions (low temperature) such that the coarse filaments at first formed are incompletely coagulated and are then stretched to form very fine filaments. —A. J. H.

Cellulose threads; Method for quickly drying freshly precipitated ——. Vereinigte Glanzstoff-Fabrik A.-G. G.P. 312,393, 27.11.18.

The freshly precipitated cellulose threads are subjected to a suitable counter current of air, or other gas inert towards cellulose, at 100°—130° C. The threads do not suffer a loss of strength if they have been well washed and if the current of air is correctly adjusted to have a suitable thermal capacity.—A. J. H.

Cellulose xanthate [viscose] solutions; Preparation of —— suitable for the manufacture of threads. R. Linkmeyer. G.P. 337,672, 31.5.19.

In the preparation of viscose solutions, the crude brown cellulose pulp is boiled with acids before conversion into xanthate. Thread prepared from the resulting viscose solutions possesses a high breaking strain and can be satisfactorily used as a substitute for cotton. The breaking strain and lustre of the thread increase with the concentration of the viscose solution employed.—A. J. H.

Fibres; Process for making artificial ——, such as artificial silk, from cellulose ethers. Farbenfabr. vorm. F. Bayer und Co. G.P. (A) 352,191, 16.1.19, and (B) 352,192, 4.2.19.

(A) Saline solutions are used as a precipitating bath. Examples are calcium chloride solution of sp. gr. 1·3 at 15° C. or crystallised calcium chloride ($CaCl_2,6H_2O$) in the molten state at 70° C., or zinc chloride solution of sp. gr. 1·85 at 40° C. (B) Instead of saline solutions, substances may be used which are capable of taking up the solvent of, but do not act as a solvent or swelling agent for, the cellulose ether. For example, a 75% aqueous solution of urea may be used as the precipitating liquid.—H. C. R.

Artificial fibres; Manufacture of —— from solutions of cellulose in concentrated salt solutions. F. Beck. G.P. 353,662, 20.7.20.

The cellulose threads are coagulated by means of concentrated solutions containing the same salts as are used for preparing the cellulose solution. By this process the recovery of the salts is possible. —A. J. H.

Fibre liberation; Process of ——. G. A. Richter, Assr. to Brown Co. U.S.P. 1,427,125, 29.8.22. Appl., 21.2.21.

Cellulosic material is digested with a sulphurous acid solution of a soluble sulphate.—D. J. N.

Fibres and cellulose; Process for obtaining textile —— from plants containing much bast and little wood, such as flax straw, sisal, and jute. G. Odrich. G.P. 327,912, 22.1.18.

The raw material is first treated with hot water in the usual way and then with a 40—50% solution of sodium, potassium, magnesium, or magnesium-calcium bisulphite containing free acid at such a temperature that the bast fibres are not damaged. During the treatment and before the highest temperature is reached the lye becomes only weakly acid owing to the loss of sulphur dioxide from the boiling solution.—H. C. R.

Fibres; Process for the recovery of —— from mixtures. R. O. Herzog. G.P. 350,638, 15.5.20.

The disintegrated material is treated with a mixture of liquids such that each liquid wets one of the kinds of fibre. For example, a mixture of animal wool and vegetable fibre (cotton wool) is shaken with a mixture of water and an immiscible liquid, such as paraffin, carbon tetrachloride, or benzene. The animal wool collects at the dividing line between the two liquids and the cotton wool is taken up by the aqueous layer.—H. C. R.

Hair; Process for improving the textile qualities of human and animal ——. P. Krais and K. Biltz. G.P. 352,961, 28.7.20.

The hair is treated first with dilute alkali hydroxides, then with soap or organic solvents or with a mixture of soap solution and organic solvents. It is rinsed and then treated with solutions of calcium or magnesium chlorides or their mixtures, the excess of solution removed, and the hair dried at the ordinary temperature or slightly above it. Hair so treated is soft, flexible, and elastic and can be spun, without further treatment, either alone or mixed with wool, giving a round and uniform yarn.—H. C. R.

Felting; Preparatory treatment of hair for ——. Soc. du Feutre. G.P. 353,947, 29.12.20. Conv., 12.8.20.

Hair is treated with weak aqueous or feebly alkaline solutions containing the sulphide of an alkali or alkaline-earth metal, so that the so-called "ripening" of the hair is unnecessary and the treated hair can be directly employed in the operation of felting. Skins which have been treated with the hair on, may be tanned in the usual manner after the removal of the hair.—A. J. H.

Typha and rush fibres; Method for improving ——. J. Elster. G.P. 355,023, 18.5.18.

Typha and rush fibres are treated with strong caustic soda or with caustic potash or sodium sulphide and the like. The lower the temperature of treatment the more dilute may be the liquor used.
—A. J. H.

Cork substitute and process of manufacture. E. E. Graham. U.S.P. 1,427,682, 29.8.22. Appl., 14.1.20.

Wood is impregnated with an aqueous solution of sodium bicarbonate, and then with wood-ash lye, the temperature during both operations being maintained at 180° F. (82° C.).—D. J. N.

Paper; Process for the chemical and mechanical disintegration of raw materials used in the manufacture of ——. O. Herdey. G.P. 352,693, 9.10.20.

A rotary digester, a mixer, and a mechanical disintegrator, to which is attached a grading arrangement, are arranged so that after leaving the digester, the pulp is fed into the rotary mixer from which it passes into the disintegrator. The disintegration and grading of the fibrous material, usually carried out in separate stages, are thus effected in one process.—A. J. H.

Paper; Process for loading —— in the hollander. K. Joost. G.P. 354,544, 23.12.20.

During the rosin-sizing of paper pulp in the hollander, sulphates present are precipitated as calcium sulphate on the fibres by means of calcium chloride. Suitable additions of soluble compounds to the pulp may also be made, so that an increased amount of sulphate is precipitated and the paper pulp thereby loaded to a greater extent.—A. J. H.

Waste gases from chemical processes, especially from cellulose manufacture; Method of disposing of —— by burning. Zellstoff-fabrik Waldhof. G.P. 353,832, 21.5.19. Addn. to 304,999 (E.P. 115,350; J., 1918, 367 A).

Only a part of the waste gases is led with the primary air into gas-producers or similar plant and burnt there, the remainder being used with the secondary air for the combustion of the producer gas.—H. C. R.

Carrotting fur and hair. Soc. du Feutre. E.P. 167,748, 7.7.21. Conv., 12.8.20.

See G.P. 353,947 of 1920; preceding.

Cellulose ethers; Process for the manufacture of moulded articles from ——. G. Leysieffer. U.S.P. 1,427,690, 29.8.22. Appl., 7.1.21.

See E.P. 156,752 of 1921; J., 1921, 732 A.

Indurated materials; Methods of manufacturing —— from woven fabrics. British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 185,662, 15.10.21.

Aluminium sulphate. G.P. 352,289. *See* VII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Bleaching, past, present and future. G. Braam. Z. angew. Chem., 1922, 35, 501—502.

After reviewing past and present methods of bleaching the author describes a new apparatus for conveniently preparing an aqueous solution of chlorine when and where required. The apparatus is made of earthenware and consists essentially of an upper and lower chamber, the upper part of the upper chamber communicating with the bottom of the lower chamber, so that the water which initially fills the lower chamber is displaced into the upper chamber by introducing chlorine from a gas cylinder into the upper part of the lower chamber. The apparatus is provided with a graduated level gauge so that the amounts of water and chlorine respectively can be directly read off. After charging the apparatus in the manner described, the various cocks are closed and solution is rapidly effected by means of a small vulcanite propeller in the bottom of the apparatus which whirls the water on to the walls of the lower chamber, and as the gas is absorbed the water displaced into the upper container gradually flows back into the lower one, and the solution can be run off as required.
—G. F. M.

Bleaching of cotton with acid and alkaline liquors. E. Ristenpart. Textilber., 1922, 3, 363—364.

A critical investigation of the bleaching process described in G.P. 352,845 (J., 1922, 666 A) in which fibrous cellulose material is treated with acid and then with alkaline bleach liquors. When fabric which had been treated in an acid bleach liquor of 1° B. (sp. gr. 1·007) containing 2·5 c.c. of sulphuric acid per 500 c.c., was washed and then further treated in a similar but alkaline bleach liquor containing 1 c.c. of caustic soda of 32° B. (sp. gr. 1·285), it gained in strength and whiteness. When these bleaching treatments were reversed, the samples of fabric were inferior in strength and whiteness to that which had received the acid-alkaline bleach. Fabric, after an acid-alkaline bleach in liquors containing 1 g. of available Cl per l. was equal in appearance to but stronger than fabric which had been bleached in a liquor containing 4 g. Cl per l. In another instance, a similar result was obtained by using bleach liquors containing ½ g. and 2 g. of Cl per l. respectively. The process avoids the formation of oxycellulose and enables a large saving of bleaching powder to be effected.—A. J. H.

PATENTS.

Scouring, dyeing and similarly treating with liquids fabrics in piece form in continuous process; Apparatus for ——. M. Silbereisen. E.P. 176,306, 24.5.21. Conv., 2.3.21.

Fabric is continuously plaited down in open width, chain or rope form into one arm of a U-shaped vessel and is then forced forward by its own weight into the other arm, whence it is continuously withdrawn. The lower part of the U-bend in the vessel contains a false bottom consisting of numerous wooden rollers arranged parallel to each other and transversely to the axis of the U-vessel. The scouring or dye liquor, which passes through the apparatus in a direction opposite to that of the fabric, is also continuously circulated upwards between the rollers, between the folds of the fabric and at right angles to its direction of advancement in the U-bend.—A. J. H.

Vat-preparations for dyeing; Manufacture of stable, dry, and readily soluble ——. Farbw. vorm. Meister, Lucius, und Brüning. E.P. 177,526, 21.3.22. Conv., 26.3.21. Addn. to 171,078 (J., 1922, 705 A).

An alkali salt of a halogenindigo capable of dyeing wool from a vat is used instead of an alkali salt of leucoindigo in the process described in the chief patent. For example, a paste containing 250 kg. of monobromoindigo white and 100 kg. of the reduced brown sulphurised quinone vat-dyestuff prepared as described in E.P. 19,599 of 1912 (F.P. 447,592; J., 1913, 226), is dissolved in 300 kg. of sodium hydroxide solution of 40° B. (sp. gr. 1·383) and 300 kg. of water; 150 kg. of 50% molasses and 10 kg. of hydrosulphite are added, and the mixture is evaporated to dryness, first with agitation under high vacuum, and finally in shallow dishes *in vacuo*. The product is readily soluble in water and dyes wool reddish-black tints from a vat.
—L. A. C.

Vat dyestuff preparations for use in printing and dyeing; Manufacture of ——. C. Bennert. G.P. 353,866, 8.1.16.

Preparations containing vat dyestuffs, by means of which it is easy to prepare slightly alkaline or acidic dye vats, consist of a vat dyestuff in its leuco-form and a hydrolysis product of proteins, *e.g.*, protalbinic and lysalbinic acids and the like, or their salts (pure or impure) together with acids, acid salts, or neutral salts of volatile alkalis with organic acids, with the exception of organic hydroxy- and dihydroxy-acids and their anhydrides and salts.
—A. J. H.

Printing of textile fabrics. The Calico Printers' Assoc., Ltd., and G. Nelson. E.P. 185,007, 13.8.21.

Cotton fabric, after being mordanted with chrome and tannin, and dyed with a suitable dyestuff, is printed with a discharge paste containing a caustic alkali, with or without sulphoxylates, glycerin, and Rochelle salt for a white discharge, and together with vat dyestuffs for a coloured discharge, and is then aged, washed, and soaped in the usual manner. This process has the advantage that the dyed ground produced by mordanting and dyeing can be preserved indefinitely and thus be discharged whenever required.—A. J. H.

Printing process. A. Dietz. G.P. 303,055, 5.10.13, and 322,609, 15.2.18.

The process is designed for use with a plate with a matt surface or with glass or porcelain rolls, treated only with a liquid containing glycerin and hydrochloric acid, to which colour may be added preparatory to the transfer of the original and to the application of the printer's ink. A little benzoic acid is added to the above liquid and alcohol is used in place of part of the glycerin, and formic acid in place of part of the hydrochloric acid. The benzoic acid keeps the reprint-plate clean and the addition of alcohol keeps the benzoic acid in solution and transfers it to the reprint-plate in the finest state of division. For example 16·25% of magnesium chloride and 2·25% of aluminium sulphate are dissolved in 30·25% of boiling water and after cooling 1·80% of pure hydrochloric acid, 3·60% of glacial acetic acid, 3·60% of formic acid, 1·35% of benzoic acid, 13·80% of glycerin, and 27·10% of 98% alcohol are added. The plates are prepared with this mixture and the original, written with an ink containing iron salts and ammonia, is lightly pressed on it and after a short time taken off again. The already visible impression is then treated with colour suitable for this class of work. Only the writing takes the colour, the remainder of the plate being unaffected. This process allows of the production of a large number of reprints of great accuracy without the fresh preparation of the plate after each copy. The main patent deals with the employment of printer's ink containing glycerin. If other inks, such as lithographic inks from coal tar dyes, are to be used a little glycol and if necessary a small quantity of a sodium salt such as sodium sulphate, sodium bicarbonate, or especially sodium benzoate, must be added. The glycol unites better with the colour than glycerin, and half the quantity is sufficient. The addition of the sodium salt causes the colour to be retained better by the negative.—H. C. R.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Lead chamber [sulphuric acid] process; Physico-chemical study of the ——. M. Forrer. Bull. Soc. Chim. Belg., 1922, 31, 254—293.

In order to investigate the reactions which take place in the lead chamber process and to determine the temperature coefficient, the apparatus used was such that the five chief gases present during the course of the reaction (sulphur dioxide, nitrogen peroxide, water vapour, oxygen, and nitrogen) were used in mixtures of known composition which could be varied at will. These mixtures were passed at a known rate into a chamber of known dimensions at a definite temperature, each of these factors being susceptible of variation. Numerous experiments were carried out and in each case the quantity of acid produced was measured and the acid itself analysed. The author shows that formation of acid only takes place in presence of a liquid phase, so that the time of formation is decreased and the yield increased by the preliminary addition of a small quantity of liquid in order to start with a heterogeneous system. This liquid should be sulphuric acid itself, as water evaporates and the presence of water vapour is not sufficient to bring about formation of acid. Under certain conditions the acid itself disappears, this being due to reversal of the reaction; these conditions, however, are different from those which obtain in industry. For low concentrations of gas there exists an optimum rate of intake for water; this gives the highest yield and, at the same time, the most concentrated acid. As the gas concentration increases this optimum rate shifts in the direction of diminution of water supply. When the concentration of the liquid phase is constant, the relation between the velocity of the reaction and the concentration of the gaseous phase is much less complex than in the case when the liquid phase is of varying concentration. The rate of supply of sulphur dioxide does not appear to influence the reaction velocity; on the other hand, nitrogen peroxide and water both exert considerable influence. The results point to the formation of an intermediate substance of which water is a constituent but which is decomposed by an excess of water. Under industrial conditions, *i.e.*, in the production of chamber acid, the rate of intake of water is exactly that which corresponds to the optimum reaction velocity.—H. J. E.

Sulphuric acid; [Nitre losses in] the manufacture of —— in tower systems. S. Micewicz. Chem.-Zeit., 1922, **46**, 847.

In a particular tower system in which the nitre consumption was normally 1·0—1·2% HNO_3 on monohydrate acid made, this figure occasionally rose without any evident reason to 2—3%, and even to 4·4%. It was noticed that at times of heavy nitre consumption the acid was cloudy, and a test of Glover acid at such a time showed that after driving off sulphur dioxide the acid still reduced iodine owing to the presence of arsenic, selenium, and ferrous salts. The losses of nitre were therefore attributed to reduction to nitrous oxide or nitrogen by arsenious acid in the towers of the "inner ring," the arsenious acid being regenerated by the action of sulphur dioxide in the Glover towers. The settling out of arsenic accumulations is suggested as a remedy.—C. I.

Boric acid; Determination of ——. W. Strecker and E. Kannappel. Z. anal. Chem., 1922, **61**, 378—397.

The material in which boric acid is to be determined is distilled with phosphoric acid and methyl alcohol, a current of air saturated with methyl alcohol being passed through the apparatus during the distillation; the distillate is collected in a receiver containing sodium hydroxide solution. When all the methyl borate has been collected in the receiver, the contents of the latter are boiled to expel methyl alcohol and to saponify the ester, the solution is then treated with a very slight excess of hydrochloric acid (red coloration towards methyl orange), boiled to expel carbon dioxide, mannitol is added in the proportion of 1 g. for each 10 c.c. of solution, and the mixture is titrated with *N*/10 barium hydroxide solution, using α-naphtholphthalein as indicator.—W. P. S.

Borax; Alternate precipitation of borax and ammonium chloride in the industrial preparation of —— by the double decomposition, $(NH_4)_2B_4O_7+2NaCl \rightleftarrows Na_2B_4O_7+2NH_4Cl$. U. Sborgi and C. Franco. Giorn. Chim. Ind. Appl., 1922, **4**, 245—249.

The results of further investigations of this reaction (J., 1921, 693 A) render it possible to increase the chemical yield of the process to 100% for all the substances used. For the same volume of the original mixture employed, the output of borax per cycle of operations is diminished by 48%, that is, the absolute production of borax is lowered to this extent. Thus, using the new modification, only 489 g. of $Na_2B_4O_7,10H_2O$, is obtained from the volume previously yielding 941 g., but 136·72 g. NH_4Cl is also obtained. The number of operations is not notably increased, since the mother liquor from the borax, if the ammonium chloride is not crystallised from it, would be treated for the recovery of the ammonia. The whole process is as follows. The composition of the initial mixture (I) reacting at 10° C. and the amount of crystallised borax it yields, as well as the composition of the mother liquor (I) remaining after filtration are as before (*loc. cit.*). Mother liquor I is concentrated 2·35 times, yielding a distillate (I) containing NH_3 5·96 g. and H_2O 559·24 g., and a residual solution. The latter, crystallised at 37° C., deposits 136·72 g. NH_4Cl and gives a mother liquor (II) of the composition: NaCl 104·82 g., NH_4Cl 126·86 g., H_3BO_3 43·42 g., and H_2O 425 g. To this mother liquor II are added distillate I and also NaCl 149·48 g., H_3BO_3 316·58 g., NH_3 43·56 g., and H_2O 115·76 g. The resulting mixture (II) of the composition: NaCl 254·30 g., H_3BO_3 360·70 g., NH_3 49·52 g., NH_4Cl 126·86 g., and H_2O 1100 g., is stirred for some hours at 10° C. In this way 489 g. of crystallised borax is precipitated, and there remains mother liquor I, with which the cycle is recommenced. This second batch of precipitated borax and also the ammonium chloride are impure and are washed, the accumulated wash waters being mixed and concentrated, giving a distillate, which is added to distillate I, ammonium chloride, and mother liquor, which is added in suitable amount to mother liquor II.—T. H. P.

Fluorides; Detection and estimation of ——. N. K. Smitt. Bull. Bur. Bio-Tech., 1922, No. 6, 176—178.

Greeff's volumetric method for the estimation of fluorides (J., 1913, 992) may be simplified as follows. To 5 or 10 c.c. of the neutral fluoride solution are added 5 c.c. of 10% ammonium thiocyanate solution and 25 c.c. of alcohol, the mixture being titrated directly with alcoholic ferric chloride solution which has been standardised against pure potassium fluoride under exactly similar conditions. It is essential that the solution be neutral and that the same volumes of indicator and solution be always used, as the presence of more water destroys the final colour and this gives high results. The concentration of the ferric chloride is conveniently 1—3% according to the strength of the fluoride solution to be tested. Sodium salicylate may be used as indicator instead of the thiocyanate. For the detection of a fluoride in a solution, the latter is neutralised and treated with a little thiocyanate solution and then with ferric chloride solution, drop by drop. In the absence of interfering substances, the presence of fluoride is indicated by the rapid disappearance of the colour of the ferric thiocyanate. Insoluble fluorides, such as calcium fluoride, may be detected in this way, if the substance is ground vigorously in a mortar with small quantities of thiocyanate and ferric chloride solutions. Traces of fluoride (0·005—0·0005%) in neutral aqueous solution may be estimated as follows. To 10 c.c. of the solution are added 0·5 c.c. of 10% ammonium thiocyanate solution and next 0·1% ferric chloride solution, drop by drop, from a micro-burette until a pale orange colour appears. To six test-tubes are then added such different quantities of a dilute standard potassium fluoride solution that when the volumes are made up to 10 c.c. and exactly the same amounts of thiocyanate and ferric chloride solution added to each, the colour observed in the unknown solution falls within this standard range; if necessary, intermediate standards are prepared in order to obtain a more exact matching. If a control test is carried out at the same time, the fluoride in 10 c.c. of 0·0001% potassium fluoride solution is detectable.—T. H. P.

Ferrous hydroxide; Reducing action of ——. [Determination of nitrites and nitrates.] S. Miyamoto. Nippon Kwagaku Kwai Shi (J. Chem. Soc. Japan), 1922, 43, 397—438.

Nitrites and nitrates may be estimated as ammonia after reducing with ferrous hydroxide. The nitrite (0·1—0·3 g.) is boiled with ferrous sulphate (15 g.) and saturated solution of caustic alkali (200 c.c.) and the evolved ammonia is absorbed by sulphuric acid. Nitrates are more difficult to reduce, and it is necessary to boil the mixture under a reflux condenser for 3—3·5 hrs., during which hydrogen, nitrogen or air is introduced into the flask. Nitrobenzene is reduced to aniline at the ordinary temperature by ferrous hydroxide.—K. K.

Sodium oxalate; Transformation of sodium formate into ——. C. Matignon and G. Marchal. Bull. Soc. Chim., 1922, 31, 789—796.

The yield of sodium oxalate obtained on heating pure sodium formate to 440° C. varies from 48 to 50%. This may be increased to 85% by adding as catalyst 4% of caustic soda to the formate, but addition of greater quantities of caustic soda results in decreased yield. Commercial formate, which normally contains about 1·3% of caustic soda as impurity, gives a yield of about 70%; addition of a further 2% of soda increases this to 83%. The oxalate is easily separated from the resulting mixture by treatment with a small quantity of cold water, which dissolves carbonate and unchanged formate whilst only a small percentage of oxalate passes into solution. The oxalate is then crystallised from hot water.—H. J. E.

Carbon; Colloidal solutions of —— in water. P. C. L. Thorne. Kolloid-Zeits., 1922, 31, 119—132.

A stable carbon sol may be prepared by the electrolysis of a solution of ammonia for 6 hrs. between carbon electrodes with an anode current density of 0·6—1·2 amp. per sq. cm. and a voltage of 220. After filtering, the solution had an ammonia concentration of 0·145*N* and gave a solid residue of 0·034 g. per 100 c.c. The residue is insoluble in water but forms a colloidal solution again in presence of a trace of ammonia; the excess of ammonia may be removed by boiling and the sol is then more stable than the original sol, which on dialysis is flocculated when the ammonia concentration falls to 0·039*N*. The ammonia-free sol is deep black in layers greater than 1 cm. thick and brown in thinner layers and is made up of particles of about the same size as those of metallic sols. The number of millimols of electrolytes necessary to coagulate 1000 c.c. of the dialysed sol is: hydrochloric acid, 60; sodium hydroxide, 290; ammonium hydroxide, >9000; sodium chloride, 450; barium chloride 0·5; and aluminium chloride, 0·3. The composition of the dry residue is C 66·61%, H 1·99%, O 15·25%, and incombustible residue 16·15%.—J. F. S.

Carbon; Behaviour of —— at high temperatures. F. Sauerwald. Z. Elektrochem., 1922, 28, 183—185. E. Ryschkewitsch. *Ibid.*, 185—186.

On heating rectangular rods of pure graphite in the author's resistance furnace (*cf.* p. 823 A) to the temperature of the positive crater of the arc in an atmosphere of hydrogen, the rod opened out in the middle and eventually broke, the broken ends having a forked appearance and being quite smooth nside but covered with small globules of apparently fused material on the outside. The rod itself contained 0·08% of ash, while the globules contained 78%. The author suggests that the impurities in the carbon had distilled from the inner hot zone and condensed on the outer cooler zone, lowering its melting point and causing partial fusion of a carbide-graphite mixture, while the cause of the rod breaking was the development of a high pressure of carbon vapour inside. If the temperature is kept near that of the arc for a longer period the carbide in the globules volatilises, leaving nearly pure graphite, and the author suggests that this is an explanation of Ryschkewitsch's production of drops of apparently fused graphite (J., 1921, 178 A, 810 A). Ryschkewitsch replies to the above by pointing out that his conditions as regards atmosphere and current density were different from the above and that in his case the whole cross-section of the rods had apparently fused and was of different hardness.—A. R. P.

Aluminium. Clennell. *See* XXIII.

Ferrocyanides. Müller and Lauterbach. *See* XXIII.

PATENTS.

Nitric acid; Process of fixing synthetical ——. M. Buchner. U.S.P. 1,427,441, 29.8.22. Appl., 6.4.21.

Synthetic nitric acid is treated with a sulphide of a metal of which the hydroxide is alkaline.
—L. A. C.

Acids; Process for concentrating volatile ——. C. Uebel. G.P. (A) 306,412, 12.2.16, and (B) 307,044, 29.8.16.

(A) In the concentration of volatile acids by means of liquid or fused dehydrating agents, the concentrator or evaporator is divided into compartments which communicate at the bottom by openings in the partitions and at the top by siphon overflows, and circulation of the contents is brought about by the introduction of weak acid and by the temperature and density differences of the contents in such a way that the entering weak acid meets the hottest and most dehydrated liquid. The vapour space in the evaporator is divided into compartments corresponding with the divisions of the liquid space in order to allow of separate removal and condensation of the vapours evolved. (B) The process is carried out under reduced pressure in apparatus arranged so that the chamber from which the concentrated acid vapour is withdrawn is under higher pressure than that in which dehydration of the weak acid is proceeding.—A. C.

Base-exchanging bodies; Preparation of artificial ——. American Zeolite Corp., Assees. of O. W. Willcox. E.P. 159,196, 18.2.21. Conv., 19.2.20.

A dilute solution of sodium silicate is added to a dilute solution of aluminium sulphate (or salts of other amphoteric metals, such as iron, tin, manganese, lead and zinc). The composition of the precipitate varies with the amount of sodium silicate added. At first the composition of the precipitate approximates to $15SiO_2,2Al_2O_3,9H_2O$; when the solution becomes neutral to phenolphthalein (methyl orange is not a satisfactory indicator) the precipitate approximates to $24SiO_2,3Al_2O_3,Na_2O,12H_2O$. Further addition of sodium silicate enriches the precipitate in silica and sodium oxide; when 40% excess sodium silicate has been added, the composition of the precipitate is $12SiO_2,Al_2O_3,Na_2O,6H_2O$. Ultimately a point is reached beyond which any additional amount of sodium silicate is found undiminished in the mother liquor. At this point the composition of the precipitate is approximately $19SiO_2,Al_2O_3,2Na_2O,7H_2O$. The product may be varied by using a mixture of two or more metal sulphates or a mixture of two or more alkali silicates. The tendency of certain metal sulphates, such as ferric sulphate, to hydrolyse in weak solution is prevented by the addition of alkali sulphates or chlorides, or by the addition of sufficient acid to keep the hydroxide in solution. The precipitate is collected, washed, freed from excess of water by a blast of air, dried in an oven at 60°—100° C., and plunged into water, which causes it to break up into granules of suitable size. Considerable increase in the density and hardness of the product is brought about by the addition of a neutral alkali salt (*e.g.*, sodium sulphate), say 5 pts. of the neutral salt to 1 pt. of the base-exchanging substance. (*Cf.* J., 1917, 1047; 1918, 415 A.)—J. B. F.

[*Silica*] *gels* [*; Preparation of —— impregnated with metallic oxides*]. W. A. Patrick. E.P. 159,508, 26.2.21. Conv., 28.2.20.

A hard highly porous silica gel, stable up to 700° C., prepared as in E.P. 136,543 (*cf.* U.S.P. 1,297,724; J., 1919, 363 A), may be obtained impregnated with a metallic oxide by replacing the hydrochloric acid by a chloride which is readily hydrolysed. For example 100 c.c. of 5·2% ferric chloride solution is mixed with 200 c.c. of sodium silicate solution containing 1·0% Na_2O. After the mixture has set the gel may be broken up and washed free from chlorides without loss of iron. The impregnated ferric oxide may be reduced to iron by the action of hydrogen. Owing to the fine porous structure of such a gel it forms a suitable vehicle for metallic or metallic oxide catalysts.—C. I.

Sulphates [*sodium sulphate*]*; Process and apparatus for the continuous production of ——.* Soc. Anon. de Prod. Chim. Etabl. Maletra. E.P. 163,706, 19.5.21. Conv., 25.5.20.

Sodium chloride is first converted quantitatively into the acid sulphate, the necessary sodium chloride for the formation of the normal sulphate is then added and is so intimately mixed that the particles of sodium chloride become coated with the acid sulphate. The mixture is passed to a calciner for conversion into the normal sulphate. The process is continuous and is automatically controlled, and the three operations are carried out in a single apparatus.—J. B. F.

Aluminium and potassium chlorides; Method of separation of —— in mixed solutions obtained in the treatment of leucite. G. A. Blanc. E.P. 176,770, 15.2.22. Conv., 7.3.21.

The hot solution obtained by the treatment of leucite with hydrochloric acid is cooled, to separate potassium chloride. The mother liquor is then saturated with gaseous hydrogen chloride which causes the complete separation of crystalline aluminium chloride. The residual liquor can then be returned to the process.—C. I.

Aluminium sulphate for paper making; Process for making ——. M. Müller. G.P. 352,289, 11.8.17.

The aluminium sulphate is obtained in the wet way by acting on minerals containing alumina with sulphuric acid or alkali bisulphates, especially sodium bisulphate. The liquid reaction mixture is neutralised with magnesium hydroxide or carbonate or with minerals containing these compounds in one operation and the liquid obtained used directly as a precipitating agent in the sizing of paper. Alternatively the neutralising may be carried out with suitable alkaline-earth or aluminium compounds, such as soluble aluminium hydroxide in conjunction with magnesium compounds. The solidification and drying of the mass may be prevented by adding water and the finished product immediately used in the liquid state for sizing paper, clarifying water, etc.—H. C. R.

Hypochlorites and chlorates; Process for the production of —— and apparatus therefor. M. Wilderman. E.P. 183,671, 16.6.21.

The slow absorption of chlorine in milk of lime can only be accelerated by increasing the surface of contact between the liquid and gas. This is effected by employing chlorination towers filled with glass balls strung on wire coated with chlorine-resisting ebonite (F.P. 395,101 and addition thereto; J., 1909, 319; 1910, 641). The blocking of such apparatus by the settling out of lime is prevented by the addition of the latter in small quantities at a time to mixing vessels at the base of the towers, the initial liquor containing 5% of calcium hydroxide. The temperature of the towers is maintained at 60°—70° C., just below the point at which calcium chlorate begins to decompose. By this means the final liquor is brought (after filter-pressing) in a reasonable time to 60°—64° Tw. (sp. gr. 1·3—1·32). Such a solution is decomposed, still at 60°—70° C., with 2% excess of potassium chloride, yielding a solution which deposits the bulk of its potassium chlorate on ordinary crystallisation and a further pure crop on cooling to −20° C. An efficiency of 90—92% is obtained as against 74% in existing processes and all evaporation of chlorate mother-liquors is avoided. The principle can also be applied to the manufacture of high strength calcium hypochlorite solution.—C. I.

Copper sulphate; Process of, and apparatus for crystallising ——. J. M. Dossett. E.P. 184,527, 31.3.21.

Copper sulphate is obtained in very small crystals ("snow" or "sand" sulphate) by rapidly cooling the liquor in a vessel having a smooth surface. The walls of the container are preferably made of thin copper or enamelled metal and the cooling surface is increased by providing one or more slightly inclined tubes inside the vessel. The container is enclosed at the sides and bottom in a jacket through which cold water circulates, and the copper sulphate solution is kept in agitation by means of compressed air, or a stirrer.—H. R. D.

Electrolytic decomposition of alkali salts [*employing mercury cathodes*]*; Operation of processes and cells for ——.* M. Wilderman. E.P. 184,938, 16.6.21.

In cells for the electrolysis of solutions of alkali salts, *e.g.*, sodium chloride, employing mercury cathodes, as in E.P. 9803 of 1902 (J., 1903, 703), various means are provided for working with high current densities, without the oxidation of the mercury and without the formation of solid amalgam in the cells.—J. S. G. T.

Ammonia; Apparatus for catalytic synthesis of ——. L. Casale and R. Leprestre. E.P. 185,179, 24.5.21.

See U.S.P. 1,408,987 of 1922; J., 1922, 294 A. One or more additional partitions may be provided in the space between the outermost and middle tubes, so that the reacting gases take a tortuous path before entering the innermost tube.

Titanium oxide; Process of producing crystalline ——. G. Carteret and M. Devaux. E.P. 185,374, 27.6.21.

Titanium chloride free from iron is precipitated as gelatinous oxide by an alkali or alkaline-earth oxide or carbonate, the oxide is dissolved in 25% sulphuric acid, and re-precipitated in the amorphous state by boiling in presence of hydrogen. The amorphous oxide is converted into the crystalline variety by calcining.—C. I.

Magnesium carbonate; Process for producing ——. C. Cramer, Assr. to Chem. Fabr. Griesheim-Elektron. U.S.P. 1,427,444, 29.8.22. Appl., 12.6.22.

Magnesium carbonates are produced by the interaction of ammonium carbonate and soluble magnesium salts, the mixture being kept agitated during the reaction.—H. R. D.

Zinc sulphate solutions; Purification of —— [from arsenic]. C. R. Kuzell and J. R. Marston. U.S.P. 1,427,826, 5.9.22. Appl., 15.8.21.

Zinc sulphate solution containing arsenic as impurity is acidified with sulphuric acid, treated with a metallic sulphide, and heated until the arsenic is precipitated as sulphide.—J. B. F.

Iron oxide and other products; Process for recovering —— from spent iron sludge. C. V. Bacon. U.S.P. 1,428,521, 12.9.22. Appl., 2.1.20.

Iron sludge, consisting essentially of iron oxide, is treated with sufficient sulphuric acid to convert it into a dry mixture containing mainly ferrous and ferric sulphates, and this is decomposed by heating, whereby sulphur compounds volatilise off, and iron oxide is recovered.—J. B. F.

Barium chloride; Method of producing ——. J. H. MacMahon, Assr. to The Mathieson Alkali Works. Inc. U.S.P. 1,428,646, 12.9.22. Appl., 20.8.20.

Finely ground barium carbonate is treated with a hot solution of ammonium chloride, the volatile by-products being removed as formed, by aspirating air through the solution.—J. B. F.

Calcium arsenate; Manufacture of ——. C. B. Dickey, Assr. to Pittsburgh Plate Glass Co. U.S.P. 1,428,946, 12.9.22. Appl., 7.8.20.

Calcium arsenate practically free from soluble arsenic compounds is prepared by treating a soluble arsenic compound with calcium hydroxide suspended in water containing 1—5% of salt.
—J. B. F.

Nitrogen; [Electric arc] furnace for oxidation of atmospheric ——. A. U. Avera. U.S.P. 1,429,013, 12.9.22. Appl., 26.3.21.

The furnace consists of a glass, porcelain, or quartz tube containing a hollow iron core through which the ingoing air passes and which forms one pole of a high-tension circuit, the other pole being the tube lining. The air is subjected to a high-tension static charge and to an arc discharge simultaneously. The furnace is placed in a bath of oil of high flash point provided with water cooling coil.—C. I.

Litharge; Process for making —— from molten lead. L. Kübler. G.P. 355,649, 16.11.20.

The lead is oxidised with a mixture of carbon monoxide with excess of air, to which, if necessary, superheated steam is added. The cast iron oxidation vessels are not subject to such heavy depreciation as in other processes.—H. C. R.

Liquid air; Process and apparatus for continuous rectification of ——. E. Barbet et Fils et Cie. E.P. 159,131, 11.2.21. Conv., 11.2.20.

In carrying out the process described in E.P. 131,321 (J., 1919, 766 A) the nitrogen compressor is operated at a higher pressure, viz., at 14 kg. per sq. cm., which is in excess of that necessary for the operation of the rectification apparatus. The portion of the compressed nitrogen remaining unliquefied is then subjected to adiabatic expansion, which effects a lowering of temperature, which in turn provides a reserve of cold units to make good loss of cold by the apparatus.—H. R. D.

Red phosphorus and arsenic; Method for the separation of a mixture of ——. W. Siegel, and J. Michael und Co. G.P. 356,809, 30.4.21.

The mixture, at an increased temperature, is exposed to the simultaneous action of water or steam, and air or oxygen, and from the resulting mixture of red phosphorus and arsenic trioxide the latter is removed by solution. The treatment may be effected in presence of oxygen carriers.—J. B. F.

Alkali metal monochromates; Process for transforming —— into bichromates or chromic acid. G. N. Vis. U.S.P. 1,429,001, 12.9.22. Appl., 10.7.19.

See E.P. 131,289 of 1919; J., 1920, 516 A.

Hydrogen; Process of preparing ——. J. C. Clancy, Assr. to The Nitrogen Corp. U.S.P. 1,425,578, 15.8.22. Appl., 14.5.20.

See E.P. 163,323 of 1921; J., 1922, 631 A.

Electric furnace for production of carbide. E.P. 185,136. *See* XI.

Electrolytic method and apparatus. U.S.P. 1,427,236. *See* XI.

VIII.—GLASS; CERAMICS.

Glass; Effect of manganese in —— melted under reduced pressure. E. N. Bunting. J. Amer. Ceram. Soc., 1922, **5**, 594—596.

The decolorising action of manganese is destroyed by melting and fining glass at 1400° C. under a pressure of 0·03 atm. The decolorising oxide, Mn_2O_3, is decomposed under these conditions into MnO and oxygen.—H. S. H.

Clays; Composition and microscopical structure of ——, their fusibility and behaviour at high temperatures. L. Bertrand and A. Lanquine. Céramique, 1922, **25**, I., 153—157. Chem. Zentr., 1922, **93**, IV., 489—490.

It is established by the determination of the alumina content and fusion points of 101 samples of clay that conclusions as to the refractory qualities cannot be drawn from the content of alumina. Although all clays containing more than 30% of alumina were refractory, some having as little as 8·15% had a fusion temperature of 1650° C. or higher. Four clays containing 16·6% to 21·85% of alumina melted between 1270° and 1120° C.
—H. C. R.

Flint and chalcedony; Products of the calcination of ——. E. W. Washburn and L. Navias. J. Amer. Ceram. Soc., 1922, **5**, 565—585.

The specific gravity at 0°, 25°, and 98° C., the index of refraction, the coefficient of thermal expansion up to 300°, the inversion temperature and volume change on inversion, and the X-ray spectra of quartz, tridymite, cristobalite, silica glass, and raw and calcined flint and chalcedony were obtained. A special vacuum pycnometer was used for determining the specific gravity. The immersed powder was subjected to a pressure of 1000 atm. without any appreciable change in the results obtained. The specific gravity of calcined chalcedony was raised 2% by fine grinding. The densities of raw flint and chalcedony were lower than, but close to, that of quartz, the difference being not greater than that which might arise from the presence of moisture and other impurities in the raw materials. The density of calcined flint was slightly lower than, but close to, that of tridymite. The density of the calcined chalcedony was distinctly lower than that of silica glass, the lightest known form of silica. The indices of refraction of raw flint and chalcedony were substantially the same, and while close to that of quartz were distinctly lower. The refractive index of calcined flint was close to that of cristobalite, while the refractive index of the calcined chalcedony was definitely lower than those of cristobalite and tridymite, but agreed very well with that of silica glass. As far as these two properties were concerned, the calcined chalcedony might be considered as a form of silica glass, while the calcined flints might be either cristobalite or tridymite. Both the calcined flint and the calcined chalcedony exhibited a typical $\alpha-\beta$ cristobalite inversion. X-ray crystal analysis showed that raw flint and raw chalcedony contained large quantities of quartz crystals, and that calcined flint and calcined chalcedony contained considerable quantities of cristobalite crystals, and no other crystals of any kind. It was concluded that flint and chalcedony consist of colloidal quartz. When calcined, the colloidal quartz crystals were, owing to the large surface they exposed, very rapidly transformed into cristobalite crystals. At the same time some of the smaller original colloidal quartz crystals probably "melt," and the silica glass produced immediately proceeds to crystallise slowly, with the formation of colloidal cristobalite crystals. Since there would be a gradual gradation of properties from those of isotropic silica glass to those of macro-crystalline cristobalite, the low index of refraction and low density of calcined chalcedony are explained.—H. S. H.

Vanadium in ceramic materials and products, and its action on the refractoriness, colour and tendency to form scum on pure kaolins and a typical brick clay; Occurrence of ——. O. Kallauner and I. Hruda. Sprechsaal, 1922, 55, 333—335, 345—349. Chem. Zentr., 1922, 93, IV., 701.

Vanadium pentoxide reduces the refractoriness of kaolin. The colouring power of vanadium pentoxide or potassium vanadate is only noticeable when 0·1% or more is present. Barium salts tend to prevent the formation of colour. Burning in a reducing atmosphere reduces the tendency to form vanadium scum, and the presence of calcium and barium compounds has a similar effect.—A. B. S.

Biscuit losses; Control of ——. I. E. Sproat. J. Amer. Ceram. Soc., 1922, 5, 588—593.

The chief factor in the control of the biscuit losses is the transverse strength of the body in the clay state. Biscuit losses decrease with every marked increase in transverse strength up to 300 lb. per sq. in., but if the transverse strength is further increased the body has poor working qualities. It is suggested that the best results are obtained with a body having a modulus of rupture of 280 lb. per sq. in. As much moisture as possible should be expelled from the ware before it is handled.
—H. S. H.

Ground coat enamels; Fish scaling of ——. B. T. Sweely. J. Amer. Ceram. Soc., 1922, 5, 618—622.

The first coat was dissolved with hydrochloric acid from the inside of an enamelled basin, and the corresponding area outside the basin was found to be badly fish-scaled. If the enamel were in compression, the removal of it from one side of the steel would throw the entire stress taken by the inner and outer coats upon one coat, and so exaggerate the tendency to fish-scale over the area from which the one coat of enamel was removed. No fish-scaling developed with a basin coated on the outside only when the same test was made, showing that the results could not be explained by hydrogen penetration. No fish-scaling was produced when the enamel had a greater coefficient of expansion than the steel, and so was in tension rather than compression.—H. S. H.

Patents.

Glass; Production of optical —— almost free from striæ. J. Desenberg. G.P. (A) 300,095, 2.9.15, (B) 302,571, 15.9.15, (C) 303,263, 15.9.15, (D) 303,264, 22.12.15, (E) 303,993, 27.7.16, and (F) 306,308, 17.2.17.

(A) A finished melt, after thorough mixing to remove layers of different fluidity, is cooled rapidly until the viscosity of the mass is such that subsequent separation into layers forming striæ is retarded as much as possible. The process of melting may be continuous if the glass is removed from the furnace for chilling. (B) The glass, in such form that it has a large surface in relation to its mass, is cooled by gases, fluids, or solids so suddenly and to so low a temperature that it disintegrates, and the pieces formed are united into one at a temperature below that at which striæ are formed. (C) The fused, well-mixed glass is poured into moulds in which the surface is relatively large compared with the mass of glass, and cooled so rapidly that segregation is minimised. The strain produced by the rapid cooling is removed by heating and annealing. (D) A portion of the mixed finished glass is separated from the remainder with minimum disturbance and mixing, and this is cooled rapidly to below the temperature at which striæ form. For example, a bell-shaped receiver may be dipped just below the surface of the molten glass, and a cooling agent led into the bell to cool the glass below the temperature at which striæ form. The bell, with adhering solid or semi-solid glass, may then be removed and the cooling completed. (E) The mixing of the glass previous to the rapid cooling is effected by a current of gas, and this current may be continued during the cooling. (F) A separate agitator and cooler may be used, into which the molten glass overflows from a continuous working tank.—A. C.

Porcelain. British Thomson-Houston Co., Ltd. From General Electric Co. , E.P. 184,090, 27.9.21.

Beryl is substituted totally or in part for the felspar or silica usually employed in manufacturing porcelain, a suitable mixture for electric insulating material being clay 291 pts., silica 35 pts., felspar 144 pts., beryl 130 pts. A porcelain having the above composition and fired to cone 10 possesses greater dielectric and transverse strength, and resistance to impact and temperature change than ordinary first quality electrical porcelain.—H. S. H.

Kilns for firing pottery and other ware. C. F. Bailey. E.P. 184,716, 20.9.21.

Three kilns are built together, the outer kilns only being provided with fire-grates, and the flame from the fire-grates is divided, the greater part passing up, over, and down the outer kilns, and then uniting with the lesser part which has passed direct under the outer kilns; the flames from both outer kilns are also combined, and pass up, over, and down the middle kiln and finally up a side passage to the inner cone or conduit of the main chimney. Dampers are provided to regulate the proportions of gases going by the various routes, also a damper at the top of the chimney cone to conserve the heat while discharging and charging the kilns. For cooling the ware after firing, passages controlled by dampers are provided leading from the interior of each kiln to the annular space in the chimney formed by the outer wall and the inner cone.—B. M. V.

Kiln; Ring chamber —— for burning ceramic material, lime, dolomite, etc. H. Koppers. G.P. 352,043, 28.3.20. Addn. to 349,951 (J., 1922, 711 A).

The flues leading from the roof of one chamber to the sole of the next are provided with sand-seals near the sole of the chambers. Sand can be poured through a tube into a pit underneath the partition between the chambers, and opening at one side into a chamber. The side of the pit leading into the chamber has such a slope that the sand-seal can be broken by raking or shovelling out the sand as in the main patent.—H. C. R.

Clay, especially china clay; Refining ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 184,880, 21.5.21.

China clay or other clay is refined by mixing it with nine times its weight of water, and subjecting it for a short time (5—10 mins.) to intensive high-speed mechanical disintegration, preferably in the colloid mill described in E.P. 155,836 (J., 1922, 357 A). A selective colloidising effect occurs, the silicic acid and other impurities not being affected, so that they rapidly settle out of the mixture when it is allowed to stand. The action is facilitated if a dispersion accelerator, such as potassium silicate, tannin or tanning agents, humus, or humic acid, saponin or other soap-like froth-forming substances, is present; 0·5—1% of potash water-glass appears to give the best result. The particles of refined clay show the Brownian movement under the ultra-microscope. They may be collected on an ultra-filter press or ultra-filter centrifuge (E.P. 155,834 and 181,023; J., 1922, 619 A), and the resulting paste may be dried direct or *in vacuo*.—A. B. S.

Clay bodies; Method of producing ——. G. W. Lapp. U.S.P. 1,424,924, 8.8.22. Appl., 27.8.19.

Elastic material for use in the production of ceramic ware is made by forming a slip, filter-pressing the slip, enclosing the filter-pressed cakes in a receptacle, exhausting the receptacle of air and other fluid and compressing the filter cakes into a compact mass while retaining the reduced pressure within the receptable.—H. S. H.

Artificial meerschaum; Method of producing ——. P. Deussing. E.P. 164,319, 25.5.21. Conv., 7.6.20.

See G.P. 334,749 of 1920; J., 1921, 625 A.

Ceramic articles; Production of ——. E. C. R. Marks. From Lava Crucible Co. E.P. 185,435, 8.3.21.

See U.S.P. 1,374,909–10 of 1921; J., 1921, 434 A.

Sheet glass; Method of and apparatus for drawing ——. *Sheet glass drawing apparatus.* W. J. Mellersh-Jackson. From The Libbey Owens Sheet Glass Co. E.P. 184,989–90, 28.7.21.

Bricks or such like; Method and means of utilising waste heat for effecting the drying of ——. C. F. Twigg. E.P. 184,540, 14.4.21.

IX.—BUILDING MATERIALS.

Cement; Thermochemical research on ——. R Nacken. Zement, 1922, **11**, 245—247, 257—258. Chem. Zentr., 1922, **93**, IV., 366—367.

The author deals with the drying of cement in rotary dryers at about 500° C., the expulsion of carbon dioxide at 900° C., incomplete burning between 1000°—1250° C., in which stage exothermic reactions occur, burning at 1250° C., and finally strongly burning at 1400° C. or higher. The development of heat in the burning of cement is low below the stage at which carbon dioxide is expelled. The heat of reaction begins to increase slowly at 930° and rises from 120 to 500 cals. per grm., then more slowly to 600 cals. per grm. The maximum is at about 950° C. Immediately the carbon dioxide is expelled, a vigorous reaction occurs, *i.e.*, the formation of calcium silicates and aluminates, this reaching a maximum at 960° C., after which equilibrium is very quickly reached. Different results obtained in technical practice are due to heterogeneity of the raw materials and the fact that some calcium carbonate has escaped burning until the end. It is calculated that the quantity of heat required to burn 1 kg. of clinker up to a temperature of 1400° C. is about 900 cals.—A. C.

Blast-furnace slags; Conversion of acid —— *into basic slags and cement by remelting.* R. Grün and C. Biehl. Stahl u. Eisen, 1922, **42**, 1158—1167.

Portland cement can be produced from acid blast-furnace slag by the addition to the fluid slag of those oxides (lime and alumina) which are lacking in comparison with Portland cement. It is advisable to add alumina first and lime later. The process is, however, difficult to carry out in consequence of the high temperatures necessary. With increasing lime content the molten slag is only kept fluid with difficulty, stoppages are frequent, and the cost of working is high. The production of blast-furnace slag cement is however, practicable. The transformation of poorly hydraulic German slags into products suitable for this purpose requires relatively little heat consumption, the high temperatures necessary for making Portland cement are not necessary, and the troublesome formation of carbides is avoided. From these enriched slags a good blast-furnace slag cement may be milled which is equally as good as Portland cement. The enrichment of blast-furnace slag with lime alone is impracticable even with the most modern furnace construction. Alumina should be added before or with the lime to keep down the melting point. By this means a large enrichment in lime is possible, and a final product is obtained capable of being finely granulated and which has the latent hydraulic properties desired for blast-furnace slag cement manufacture. The addition of lime in quantity equal to that in Portland cement is not necessary. The lime content can be limited to 50%, by which means a blast-furnace slag may be made similar to basic German foundry slags and suitable for the production of blast-furnace slag cement.—T. H. Bu.

Concrete in sea-water; Tests of ——. L. C. Wason. Proc. Amer. Soc. Civil Eng., 1922, **48**, 1597—1604.

Test specimens of reinforced concrete (of different proportions and different amounts of mixing water) were immersed for 13½ years in sea-water under stringent tidal, abrasive and temperature conditions, portions of the specimens being permanently above high water mark and portions below low water mark. Test blocks were cut from the upper and lower portions of four poor specimens, and crushing tests made to the point of failure. The dry upper portions were found to have a consistent strength of 92% of that of the wet lower ones. From these tests and from others described, the mechanical action of the elements appears more important than the chemical, while dry-casting of concrete work and the quantity of mixing water, are influencing factors. Steel is adequately protected from corrosion, and a rich concrete made of good quality normal cement (or one low in alumina) mixed with 9—10% of water and dry-placed with careful spading gives durability below low and above high tides, enhanced if a protective coating is laid between tidal limits should abrasion be great.
—J. B. P.

Patents.

Wood; Impregnation of ——. Soc. de Recherches et de Perfectionnements Industriels. E.P. 168,045, 19.7.21. Conv., 20.8.20.

Wood is impregnated with crude or purified xylenol (from coal tar), either alone or mixed with other substances, and suspended or emulsified in an inert medium such as water; soap, preferably sodium resinate, is added to stabilise the emulsion.
—A. B. S.

Bituminous compositions; Manufacture of —— suitable for building or for forming road or like surfaces. A. R. Tabary. E.P. 183,914, 28.4.21.

A product for coating or paving roads etc. and for manufacturing building materials is made by adding fine sand or crushed hard material to a mixture of mineral or vegetable pitch, clay, limestone, and asphalt. The product may be incorporated with the ordinary materials used in making a metalled road or superficially distributed with tar, or cast in the joints of stone or wood paved roads.
—H. S. H.

Kilns; Vertical gas-fired —— for burning limestone or the like. C. F. Priest. E.P. 184,057, 3.8.21.

The gas belt of a vertical gas-fired kiln is provided with hoppered cleaning chambers placed between the belt and the gas ports, the chambers being provided with manholes, gas-inlet and control valve, and dust and tar collecting and releasing means. A hopper is provided for discharging the finished lime and has one or more adjustable air inlets. A large storage chamber is placed above and distinct from the preheating zone with a hopper between the chamber and the preheating zone. The products of combustion are passed through the upper part of the kiln to dry and preheat the limestone without passing through the storage chamber of the kiln. The air inlets are provided with protection plates in order to prevent choking.—H. S. H.

Rotary [cement] kilns [; Heat insulation for ——]. O. Faber and H. V. A. Briscoe. E.P. 185,327, 5.9.21.

Lagging made up in the form of sectional plates of non-conducting material is applied to the outside of the steel shell of a rotary cement kiln and is fixed by set screws (or other means) made of fusible metal, melting at say 600° C., so that in the event of the lagging being too effective and causing the steel plates to overheat, the screws will fuse and the lagging drop off and thus call attention to the danger and also to a certain extent automatically cure the overheating. The insulation may be made thicker and more effective at the cooler end of the kiln.—B. M. V.

Roofing material or tile. Durato Asbestos Flooring Co., Ltd., and A. Z. Nemeth. E.P. 184,910, 31.5.21.

Slabs or tiles are made from sawdust, saturated with magnesium chloride solution of sp. gr. 1·07 (10° B.), and then mixed with 1 pt. of magnesite and 3—4 pts. (by vol.) of soapstone (the soapstone being about one-tenth of the whole mass), and the whole mixed with a further quantity of magnesium chloride solution of sp. gr. 1·12 (15° B.), so as to form a homogeneous paste. The faces of the tile are afterwards coated with a waterproofing material.—A. B. S.

Building material; Process for the preparation of a raw material from peat for making a ——. E. Dyckerhoff. G.P. 356,334, 6.5.16.

Peat is treated, without drying, with a chloride solution, such as magnesium chloride mother liquors from working up carnallite, the resulting mass is mixed with cement or the like, and the mixture rolled into plates or shaped into bricks.—A. R. P.

Products from wood. G.P. 354,865. *See* IIb.

Kilns for burning lime etc. G.P. 352,043. *See* VIII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Wrought iron; Direct smelting of —— from ore by Basset's process. I. Móscicki. Przemysl Chem., 1922, **6**, 73—81. Chem. Zentr., 1922, **93**, IV., 372.

Wüst's objections (J., 1922, 59 a) are regarded as unfounded in view of the fact that he did not take the dissociation of carbon dioxide into account in calculating the temperature of combustion. The temperature of 2560° C. quoted by Wüst for open-hearth furnaces should be only 2220°, which is only 25° C. above the value calculated for Basset's process. Further, with the rotary furnace a lower flame temperature than that required in the open-hearth furnace would suffice, and it may be accepted that combustion temperatures quite sufficient for smelting iron can be developed in Basset's furnace.
—A. C.

Iron; Sulphur in the metallurgy of ——. E. Bianchi. Giorn. Chim. Ind. Appl., 1922, **4**, 254—260.

Experiments were made at temperatures up to about 1000° C., in an apparatus comprising two tubular electric furnaces with resistance heating, one for the preliminary heating of the gas used or for the production of carbon monoxide and the other for the actual reaction to be studied. A small arc furnace with immersion electrode and arrangements for sampling the gases and for direct and spectroscopic observations was also employed. The more important results and conclusions arrived at are as follows:—Calcium chloride dissociates only in presence of oxygen or in a strongly oxidising medium; carbon dioxide has little action on it owing to the low temperature at which the chloride volatilises. Sulphides give up sulphur only in a strongly oxidising medium; in presence of carbon monoxide or dioxide they remain fixed or at most form stable metallic oxysulphides. Sulphates are dissociated in presence of oxygen giving sulphur trioxide and dioxide and oxygen, and are reduced to sulphide in a reducing medium containing carbon monoxide. The presence of lime has no appreciable effect on compounds of iron, sulphur, carbon, and oxygen. Consideration of these and of other known reactions in which a metal, sulphur, oxygen, chlorine, and carbon take part shows that the dissociation pressures of sulphur united to fixed bases are little inferior to those of oxygen. When heated these sulphides or oxides may be desulphurised or deoxidised, but the temperatures required at the ordinary pressure are so high as to be unattainable by ordinary means; an intermediate reaction thus becomes necessary. Thus, in a bath of sulphurised iron, the sulphur may be eliminated as sulphur dioxide, which is not dissociated at 1300° C., provided that the quantity of oxygen dissolved in the bath is in excess of the amount necessary to oxidise the carbon, phosphorus, manganese, and silicon; if there is a deficit of oxygen and an excess of carbon, a fixed oxysulphide, undissociable at the temperature of the molten bath, is formed. The pressures both of the chlorine in chlorides and of the vapours of the chlorides are generally so low that, in contact with the bath, these compounds are volatilised or decomposed before they are able to react with the fused metal. The bases contained in the slag are not sufficiently active desulphurising agents to have any practical effect, and the only reagents known to act in this way are the oxygen during the oxidising period of the refining, and the manganese, more particularly during the reducing period. It is possible that calcium and magnesium may be desulphurants even superior in this respect to manganese, but no practical proofs of this are yet available.—T. H. P.

Nickel steel and chromium steel; "Characteristic curves" of ——. H. Jungbluth. Stahl u. Eisen, 1922, 42, 1392—1396.

In the experiments of Portevin and Chevenard (J., 1921, 698 A) on a nickel-chrome steel soft quenchings (overhardening) were not obtained, but the possibility of obtaining them was indicated by the fact that the characteristic curves did not break off at the abscissæ, but bent and turned back into the region of soft quenchings, *i.e.*, the austenitic region, where the Brinell hardness is lower. To confirm this a nickel steel containing 0·5% C and 5·0% Ni, and a chrome steel containing 1·6% C and 1·6% Cr was quenched from temperatures varying from 750° to 1150° C. at varying velocities, four in the case of the nickel steel and seven with the chromium steel, the speeds varying from that of a water quenching to that of furnace cooling. A series of curves was plotted, all with quenching temperatures as abscissæ and with time, Brinell hardness, or quenching velocity, as ordinates. The bending of the curves is clearly shown, also the limiting curves for minimum and maximum hardness. The curve of maximum hardness cuts the family of curves into two parts giving softness on either hand due in one case to ferrite-troostite, and in the other to austenite. This was confirmed by micro-examination, maximum hardness corresponding with pure martensite being obtained for a given cooling speed, whilst higher quenching temperatures gave softness with austenite and lower temperatures softness with ferrite-troostite. From these curves the thermal conditions necessary to attain any desired grade of hardness can be read off directly, also whether the structure obtained will be austenitic or sorbitic.—J. W. D.

Steels; Influence of velocity of solidification on double-carbide ——. P. Oberhoffer. Stahl u. Eisen, 1922, 42, 1240—1242.

To determine the effect of the velocity of solidification on the properties of a series of chromium steels, steels of similar composition were cast in iron chills or allowed to cool down in the crucible respectively. On primary etching the steels cooled in the crucible showed a dendritic structure, those cast in chills an extremely fine globular structure. On secondary etching with a concentrated solution of picric acid in alcohol containing a few drops of nitric acid, a typical steel containing 1·16% C and 6% Cr showed a fine network of carbide when cast in chill, and a large network when cooled in the crucible. On forging down from 45 mm. to 15 mm. square the carbide network was elongated in the direction of rolling. The steel cooled in the crucible showed the eutectic similar to ledeburite in typical form, but in the chill cast steel the characteristics of the eutectic were no longer visible, and the carbide was very uniformly distributed. Mechanical tests on the forged test pieces gave no clear indications except that the shock tests were consistently higher for the chill cast specimens.—T. H. Bu.

Antimonial gold ores of the Murchison Range; Application of flotation to the ——. H. R. Adam. J. Chem. Met. Soc. S. Afr., 1922, 23, 3—9.

A number of tests were carried out to determine whether a flotation treatment of the ore would remove the stibnite in the concentrate and allow a good recovery of gold from the tailings. In every case it was found that the concentrate contained a considerable proportion of the gold, so that further treatment, *e.g.*, by roasting or volatilising roasting, followed by cyaniding, was necessary. The tailings from flotation yielded about 50% of their gold to mercury, but practically none of the remainder could be extracted by cyanide. The best results were obtained by grinding the ore wet to pass a 150-mesh screen, followed by amalgamation and cyaniding of the amalgamation tailing, whereby 87% of the gold was extracted. The gold appears to be associated intimately with tetrahedrite, and only after very fine grinding can it be successfully dissolved from the ore; the application of flotation in the treatment of the ore would simply be in place of the usual cyaniding and as a superior method of concentration to gravity methods.—A. R. P.

Silver-plated work; Cause of red stains on ——. A. Jefferson. Inst. of Metals. Sept., 1922. [Advance copy.] 4 pages.

Nickel-silver discs were silver-plated in a single vat under identical conditions, and finished by widely varying processes. The results obtained, together with those of tests of the rouge-finishing and hand-polishing processes, showed that the indiscriminate application of rouge to an over-heated surface is responsible for the red stains sometimes observed on silver-plated work.—J. B. P.

Brasses; Hardness of the —— *and some experiments on its measurement by means of a strainless indentation.* F. W. Harris. Inst. of Metals, Sept., 1922. [Advance copy.] 27 pages.

The hardness-composition curve of the brasses after sand casting, chill casting, and chill casting followed by hot forging and annealing was determined using the Brinell machine. A slight maximum occurs in the middle of the *α*-phase and a small depression in the *β*-phase. In the range 65—54% Cu the hardness bears an almost linear relation to the percentage composition. It is shown that the relation between the hardness H and the applied load for 70:30 brass could be expressed by $H=P^x+K$, where for zero load $H=K=25·1$, which is the true hardness of the material. The same bar after being indented with the ball was annealed and the ball replaced in the impression under the same load. This was repeated till the area of impression remained constant, viz., after the tenth anneal, when the ball hardness was 20·9. The absolute hardness number of the brasses was then determined, using this method of strainless indentation. The curve agreed in general form with the ordinary one, but was somewhat less sinuous. The relation between the Brinell and absolute hardness numbers is shown to be linear above an initial area of indentation of 9 sq. mm., but the amount of strain is not directly proportional to the size of the indentation. The significance of the maxima and minima in the hardness curves is considered.—T. H. Bu.

Cast metals and alloys; New forms of apparatus for determining the linear shrinkage and for bottom-pouring of —— *accompanied by data on the shrinkage and hardness of cast copper-zinc alloys.* F. Johnson and W. G. Jones. Inst. of Metals, Sept., 1922. [Advance copy.] 28 pages.

In the bottom-pouring method described, the molten metal flows from a heated crucible into the mould and the rate of flow is controlled by a stopper operated by a lever. The apparatus facilitates control of primary temperature and rate of pouring, and the exclusion of dross, and formation of "zinc-fume" or the like is minimised. The shrinkage values of chill-cast copper-zinc alloys found by the authors were higher than those obtained for sand-cast bars by Turner and Murray (J., 1909, 1137), but the curve showing the relationship of shrinkage to composition was similar to that previously obtained, except that no minimum at 60% copper was found. The hardness numbers were determined by the Brinell and the Shore methods, both on the alloys as cast and after annealing, the annealing producing uniformity. The Brinell hardness-composition curve showed an increase of hardness over the range 100 to 88% copper, a constant hardness from 88 to 72%, with a slight fall to 63%, at which point a rapid increase set in with the appearance of the beta constituent, an increase which was maintained to 45% copper with the exception of a small dip between 53 and 50%. The changes of the scleroscopic hardness with composition were of a similar character, but less pronounced, whilst over the range 60 to 53% copper no increase of hardness was shown, indicating a very slight difference, scleroscopically, between the beta and alpha phases. Tests on annealed bars cold rolled showed that the hardening capacity of the alpha brasses increases rapidly with increase of zinc between 100 and 75% copper. Hardness determinations on rolled strips, annealed, confirmed in general the results obtained on the bars cast and annealed.—J. W. D.

Copper wires; X-ray examination of the inner structure of ——. *Strained metals. I.* A. Ono. Mem. Coll. Eng. Kyushu Imp. Univ., 1922, 2, 241—260.

X-ray interference figures of strained metals and of metals annealed after straining show that the crystal lattices form a fibrous structure in the strained state and that this rearrangement becomes more pronounced the greater the strain to which the metal has been subjected. The inclinations of several simple planes in the face-centred cubic lattice and the relative intensity of the rays reflected from them have been calculated, and it is shown that a group of these lattices with the trigonal axis in the longitudinal direction of the specimen gives rise to the pattern obtained in the experiment. It is suggested that the changes in the lattice arrangement of crystals afford a more natural explanation of the changes of properties that occur in metals that have been subjected to strain than does the assumption that an amorphous layer is formed at the slip planes of the grains. —A. R. P.

Aluminium-copper alloys; Copper-rich ——. D. Stockdale. Inst. Metals, Sept., 1922. [Advance copy.] 14 pages.

The equilibrium diagram of copper-aluminium alloys containing up to 20% Al has been investigated by taking cooling curves and by the micro-examination of quenched specimens. Aluminium lowers the freezing point of copper to an amount proportional to the concentration up to 3·5% Al, at which point there is a slight break in the liquidus, which then falls as a smooth curve to a minimum at 1031° C. and 8·3% Al, rises to a maximum again at 12·55% Al and 1047° C., corresponding to the formation of Cu_3Al, and falls away again without another break up to 20% Al. The solidus lies very close to the liquidus for all alloys containing less than 18% Al, the maximum freezing range of these alloys being about 10° C. The eutectic line at 1031° C. has been traced from 7·5 to 8·5% Al and a second eutectic line has been established at 1017° C. in alloys containing 16·5 to 18% Al. Between 10 and 14% Al the liquidus and solidus coincide and above 18% Al the existence of a eutectic line at 868° C. has been confirmed. The α solid solution of aluminium in copper contains 9·8% Al at 20° C. and only 7·4% at 1030° C. Solid alloys containing 10—16% Al show a change point, corresponding to the disappearance of the β phase, at 537° C., and a second slight arrest at 286° C., while those containing 14—16% Al have an additional arrest point at 774° C., corresponding to the disappearance of the γ phase.—A. R. P.

Alloys of aluminium with copper, magnesium, and silicon in the solid state; Constitution and age-hardening of ——. M. L. V. Gayler. Inst. of Metals, Sept., 1922. [Advance copy.] 32 pages.

The solubility of each of the compounds, magnesium silicide and aluminium cupride, in solid aluminium is affected by the presence of the other; both are practically insoluble at 250° C., and at 500° C. the solubility is greatly reduced. The age-hardening of alloys containing copper and magnesium silicide is greater than of those containing either constituent alone and is due to the difference in the solubilities of Al_2Cu and Mg_2Si in solid aluminium at high and low temperatures. Of the two constituents magnesium silicide plays the predominant part. If one constituent is fixed the maximum age-hardening is obtained when the second constituent is present to the maximum amount which can be held in solution at high temperatures. Alloys which had been age-hardened at room temperature were found on further heat treatment to soften slightly, but subsequently showed increased hardness and tensile strength and rapid decrease of percentage elongation. Derived differential heating curves of quenched alloys containing 0·81% Mg_2Si with 1·5, 3·7, and 8% Cu showed three critical points, the highest due to the precipitation of copper, and the second to that of magnesium silicide.—T. H. Bu.

Aluminium; Effects of over-heating and repeated melting on ——. W. Rosenhain and J. D. Grogan. Inst. of Metals, Sept., 1922. [Advance copy.] 11 pages.

Aluminium of the highest obtainable purity (99·65%) and another grade containing 0·77% Fe and 0·72% Si, were cast at 700°, 800°, 900°, and 1000° C. respectively, forged into ⅜-in. slabs and rolled to 0·1 in. thickness. Tensile tests on pieces cut from the annealed sheets showed no evidence of deterioration in quality. The macrostructures of the small ingots were similar, except for an increase in crystal size with higher casting temperature. The highest-grade aluminium was melted and a portion cast at 720° C., other portions being held for 1 hr. at 900°—1000° C. and 1000°—1100° C. respectively before casting. After rolling to 0·5 in. thickness, longitudinal and transverse test-pieces were taken from annealed sheets, but no deterioration was found due to the above treatments. The rôle supposed to be played by oxidation during the melting of aluminium is therefore considerably exaggerated. The two grades were remelted and re-rolled to 0·05 in. thickness ten times, but no systematic change in the properties of the metal was found except a slight increase in the ultimate stress. The results are in contradiction to the views current in the industry, and it is probable that the deterioration ascribed to re-melting under industrial conditions may be due to a slight progressive contamination with other metals.—T. H. Bu.

Aluminium utensils; Cleaning of ——. R. Seligman and P. Williams. Inst. Metals, Sept., 1922. [Advance copy.] 2 pages.

The solvent action of sodium carbonate solutions on aluminium may be entirely prevented by the addition of small amounts of sodium silicate to the solution; thus, a 5% solution of "soda crystals" containing 0·05% of water-glass is without visible action on aluminium at 75° C. Mixtures of sodium carbonate and silicate, containing 10—12% of the latter and sold under the trade names of "Carbosil," "Pearl Dust," and "Aquamol," remove all the grease from aluminium articles without attacking the metal if sufficient is used to precipitate all the lime in the water, *i.e.*, in solutions containing more than 0·5% of the mixture.—A. R. P.

White metals. A. H. Mundey, C. C. Bissett, and J. Cartland. Inst. of Metals, Sept., 1922. [Advance copy.] 25 pp.

ANTIFRICTION alloys and other white metals such as the various classes of printers' alloys, die-casting alloys, metals for chemical works castings, solders, etc. are considered from the point of view of the manufacturer and user. Their composition, mechanical and physical properties are given, and their constitution and microstructure dealt with only so far as the user and the maker are directly concerned. Nine typical bearing metals, chiefly of the tin and lead base varieties, are fully described together with their suitability for particular purposes. The principal value of these alloys is due to the way in which they maintain the oil film, the hard constituent standing up in slight relief to carry the load and the softer matrix forming channels for holding the oil. In the tin-base bearing metals the copper-tin mixed crystals solidify first and entangle the cubes of tin-antimony mixed crystals, thus ensuring their uniform distribution. The functions of tin-base and lead-base alloys are similar. In casting bearing metals the greatest care and skill must be exercised, as overheating causes the oxidation and segregation of the valuable constituents, whilst if the pouring temperature is too low the hardening constituents are left behind in the ladle owing to liquation.—J. W. D.

Uranium alloys [with nickel, iron, and aluminium]. P. A. Heller. Metall u. Erz, 1922, **19**, 397—399.

ALLOYS of uranium with nickel or iron may be produced on a comparatively large scale by fusing suitable mixtures of uranium oxide (U_3O_8) and nickel oxide with the requisite amount of carbon in a carbon crucible by means of an arc. The oxide-carbon mixture is first briquetted by means of tar and the briquettes are heated in a wind furnace to drive off volatile matter before reducing in the arc furnace. Alloys of uranium with nickel containing 67—70% U and 4·5—5·0% C and with iron containing 45% U and 6·5% C have been prepared by this method. Attemps to reduce the carbon content of the nickel alloys by fusing them in a magnesia-lined furnace and adding nickel oxide resulted in the production of an alloy containing less than 1% C but only 26% U, the remainder of the latter having been slagged by the magnesia. The production of aluminium-uranium alloys by the thermit method gives a very poor yield, but satisfactory results may be obtained by reducing a mixture of uranyl fluoride and uranium tetrafluoride (formed by adding U_3O_8 to hydrofluoric acid) by means of metallic calcium in the presence of aluminium, the operation being conducted in an iron bomb. By this method an alloy containing 62·8% U, 34·8% Al, 1·4% Ca, 0·5% C, and 0·25% Si was obtained.

—A. R. P.

Antimony-bismuth system. M. Cook. Inst. of Metals, Sept., 1922. [Advance copy.] 16 pages.

A COMPLETE equilibrium diagram of antimony-bismuth alloys is given for the first time, and several doubtful questions of structure are elucidated in a full microscopical and thermal examination. The freezing points of bismuth and antimony are 270·5° C. and 630·5° C. respectively. The liquidus is smooth and unbroken, and the solidus is horizontal at 270° C. up to 60% of antimony, after which it rises, at first gently, then steeply to the freezing point of antimony, the system being isomorphous but not eutectiferous despite the horizontal solidus. Microscopical examination of chill-cast and slowly cooled specimens (etched with ferric chloride and hydrochloric acid save near the antimony end where copper ammonium chloride was used) revealed dendritic duplex structures which were rendered homogeneous by prolonged annealing at 275° C. Twinning, ascribed to stresses set up by expansion on cooling, and two kinds of banded structures were noted in some of the crystals.

—J. B. P.

Non-ferrous metals used in locomotives; Effect of superheated steam on ——. H. Fowler. Inst. Metals, Sept., 1922. [Advance copy.] 4 pages.

THE most suitable alloy for piston tail rod bushes in locomotives to withstand the action of superheated steam at 340° C. is a phosphor-bronze containing 11% Sn, 1% P, and 88% Cu, while for the piston rod packing (the McNamee rings) an antimonial lead containing 30% Sb is more satisfactory than the usual 20% Sb alloy. Gun-metal, phosphor-bronze, and cast iron were found unsuitable for the by-pass valves which are not only subjected to high temperature but also to a good deal of shock. A complex nickel brass containing small percentages of tin, lead, aluminium, manganese, and iron was found satisfactory, but owing to its high cost was replaced by malleable iron or steel castings.

—A. R. P.

Intermetallic actions. The system thallium-arsenic. Q. A. Mansuri. Inst. of Metals, Sept., 1922. [Advance copy.] 14 pages.

THALLIUM and arsenic do not interact chemically, nor do they form mixed crystals. The equilibrium diagram of the system is a perfect case of the immiscibility type. The freezing point of thallium is depressed by increasing additions of arsenic until the eutectic point (8·01% As, about 215° C.) is reached. After this the freezing point gradually rises to 240° C. All alloys containing 13—40% As begin to freeze at 240° C., and are made up of two layers—an upper layer rich in arsenic and a lower layer rich in thallium. The melting point of alloys containing more than 55% As is higher than 600° C., at which temperature the vapour pressure of arsenic becomes higher than 339·1 mm., and therefore the alloys have to be prepared in evacuated, sealed, hard glass tubes.—J. W. D.

Intermetallic compounds; Question of the existence of —— in the gaseous state. A. Eucken and O. Neumann. Z. Elektrochem., 1922, **28**, 322—324.

DISTILLATION tests on sodium amalgam (Na_2Hg) at pressures between 5 and 10 mm. showed that at 500° C. no appreciable quantity of any mercury-sodium compound could exist, although the boiling point of the liquid, when it had reached the composition, NaHg, remained constant for a considerable time.—A. R. P.

Grain-size and diffusion [in metals]. J. H. Andrew and R. Higgins. Inst. of Metals, Sept., 1922. [Advance copy.] 10 pages.

THE relation between grain growth and diffusion was studied by casting γ-brass (60% Zn) on to a thick rod of pure copper. The composite specimen was sectioned and examined under the microscope. Annealing for 30 hrs. at 800° and 850° C. respectively was found sufficient to promote diffusion and rapid grain growth simultaneously. Annealing at 500° C. for 12 hrs. and at 550°—575° C. for 5 days caused a breakdown of the β-crystals into smaller units but did not alter the α-constituent so markedly. In explanation of the breakdown of grain size by diffusion it is suggested that whilst in the interior of grains the atoms assume the state of closest packing, at the boundaries the atoms touch only at one part of the circumference. Plastic deformation may displace the equilibrium of certain boundary atoms which upon reheating tend to revert to the condition of closest packing, and rows of atoms may be brought into line with unstrained atoms of adjacent crystals. This may result in the breaking up of a grain or its absorption by others. The atoms lying along the grain boundaries have a greater number of free valencies, and this explains the migration of a separating phase to the grain boundaries. If the suggestions advanced are justified, it is not necessary to assume any amorphous material at the grain boundaries.—T. H. Bu.

Eutectics; Structure of ——. F. L. Brady. Inst. Metals, Sept., 1922. [Advance copy.] 45 pages.

Metallic eutectics may be divided into four classes: globular, in which both metals are of fairly high surface tension, and the metal of higher surface tension is present in the smaller amount, *e.g.*, cadmium-tin, cadmium-lead, copper-silver, zinc-cadmium, and zinc-bismuth; lamellar, in which the two metals have nearly equal surface tensions and are present in nearly equal proportions by volume and so separate in continuous curvilinear or reticulated sheets or plates, *e.g.*, lead-tin; angular, in which at least one of the metals has a low surface tension or a high cohesion, when the alloy solidifies as a mass of crystalline contour or arrangement, *e.g.*, antimony-lead, lead-bismuth, tin-bismuth, cadmium-bismuth, silver-lead, silver-bismuth, gold-bismuth, aluminium-tin, copper-bismuth, and copper-lead; crystalline, in which both phases have low surface tensions, and, on cooling, form merely a mass of contiguous crystals of the two phases, *e.g.* antimony-copper antimonide and most non-metallic eutectics. The structure of all the above eutectics is discussed in detail with reference to photomicrographs to substantiate the classification suggested. The eutectic range in the copper-silver series was found to be from 71·6 to 72·3% Ag in the silver-rich alloys and from 71·2 to 71·8% Ag in the copper-rich alloys.—A. R. P.

Corrosive action; The nature of —— and the function of colloids in corrosion, with an appendix on terms used in colloid chemistry. Sixth Report to the Corrosion Research Committee of the Institute of Metals. G. D. Bengough and J. M. Stuart. Inst. Metals, Sept., 1922. [Advance copy.] 80 pages.

A general discussion of corrosion phenomena based on the study of several different metals is presented and an examination of the electrochemical theory of corrosion is made, which shows that it is satisfactory only under certain conditions, while many facts can only be explained by recognising the important rôle of colloids in corrosion phenomena. Corrosion may be produced by chemical means, when the reacting bodies are in contact, or by electrochemical means when they are spatially separated and the reacting substances are capable of ionisation. Facts which are difficult to explain on a purely electrochemical theory are as follows: certain depolarisers do not increase corrosion, but inhibit it; the conductivity of electrolytes is not directly connected with the amount of corrosion; even exceedingly pure metals are corroded by neutral salt solutions and by dilute acids, and in many cases the presence of ions of the corroded metal does not depress corrosion but actually increases it. Again, the order of corrodibility of metals in distilled water, salt solutions, and non-electrolytes is different from that of their electrochemical potentials and the effects of strain and impurity in setting up potential differences between various parts of the metal are very small. It is shown that the amount of corrosion in commercial metals is not proportional to the amount of impurity, and that the depolarising power of atmospheric oxygen at ordinary temperatures is practically negligible, the main function of oxygen in corrosion being to oxidise the metal directly. The following theory is developed to explain the part played by colloids in corrosion. When a metal is immersed in water it becomes negatively charged and sends positively charged ions into the water, at the same time becoming superficially oxidised, if dissolved oxygen is present. The hydroxide so formed takes up the positively charged ions and becomes a positively charged colloid, which diffuses away in part, allowing further oxidation and a new formation of film, which is not further attacked until that portion of diffused colloid first formed has been removed from the solution by precipitation on coming into contact with an electrolyte, the action of which neutralises its positive charge. In this way the metal is gradually coroded unless the conditions cause precipitation of the gel on the surface of the metal itself, thus forming a protective coating which stops further action. The authors conclude that no one "theory of corrosion" can be proposed to account for all the observed phenomena, and that the final condition of a corroded metal is the result of a series of complicated actions, of which the initial action is either chemical or electrochemical, but is not dependent solely or mainly on the hydrogen ion concentration, but on the specific nature of all the ions in solution as well as on the presence of undissociated substances of which oxygen is the most important. The chemical actions which take place may be either ionic, molecular, or colloidal, and all may be influenced by the presence of gels and by the physical changes which take place in these gels.—A. R. P.

[Lead sulphide ores;] Technical working of raw materials containing lead [such as complex ——] by conversion of the lead into tetrachloride. A. Nathansohn and F. Leyser. Z. Elektrochem., 1922, **28**, 310—313.

By passing a current of chlorine into a suspension in water of finely divided ore containing galena, blende, and copper pyrites until an excess is present, the sulphur is converted into sulphuric acid, the zinc and copper to chlorides, and the lead to chloroplumbic acid, a solution containing 8% of lead being readily obtained. After separating the gangue and unattacked ore and passing a current of air through the clear liquor, the bulk of the lead is re-precipitated as lead chloride or sulphate. Wulfenite may be dissolved in a similar manner, but not zinc-lead products containing the metals as such or as oxides unless there is a predominating amount of sulphide present. The author suggests that the method would be useful for working up zinc-lead ores which do not admit of separation by flotation or gravity processes.—A. R. P.

Blast-furnace slags. Grün and Biehl. *See* IX.

Aluminium. Clennell. *See* XXIII.

Patents.

Welding of cast iron; Electrical ——. La Soudure Autogene Française. E.P. 173,486, 28.11.21. Conv., 24.12.20.

An electrode of grey cast iron is employed in welding cast iron, and carbon is added during the welding operation. A convenient method of introducing the carbon in a regular manner is to coat the electrode with powdered charcoal or graphite together with a binding agent, or to use a hollow electrode packed with carbon.—C. A. K.

Ferrotungsten and ferromolybdenum; Manufacture of ——. J. M. Skelley, J. Merson, and Continuous Reaction Co., Ltd. E.P. 184,843, 23.4.21.

Ferrotungsten or ferromolybdenum is made, without the aid of aluminium, by the silico-thermic reduction of iron oxide and tungsten oxide or iron oxide and molybdenum oxide in the presence of an oxidising agent.—J. W. D.

Ferrous alloys; Manufacture of ——. H. A. Skelley, A. B. Smith, and Continuous Reaction Co., Ltd. E.P. 184,844, 23.4.21.

ALLOYS containing iron and chromium, such as stainless steel, high-speed steel, and rustless iron, are made by the silico-thermic reduction of iron oxide in the presence of an oxidising agent and the incorporation of chromium and other metal or metals with the iron produced.—J. W. D.

Ferro-molybdenum; Manufacture of carbon-free ——. W. L. Turner. E.P. 184,912, 1.6.21.

IN the alumino-thermic process for the manufacture of ferro-molybdenum from molybdenite or molybdenum sulphide, a quantity of pyrolusite or manganese dioxide and aluminium is added to the mixture of molybdenum sulphide, aluminium, and iron oxide. The elimination of the sulphur content of the molybdenum sulphide is assisted by the relatively high temperature produced by the interaction of the aluminium and manganese dioxide and by the high affinity of the manganese and manganese compounds for sulphur and sulphur compounds. The molten alloy is subsequently treated with a slag containing a desulphurising agent, *e.g.*, a mixture of equal parts of lime and fluorspar.—T. H. Bu.

Iron, steel and ferrous alloys; Cementation of ——. Cammell, Laird and Co., Ltd., J. M. Allan, A. P. Hague, and T. Middleton. E.P. 184,920, 7.6.21.

THE article to be carburised is immersed in a fused salt bath containing 70% or more of sodium carbonate which may be mixed with barium carbonate or other alkali or alkaline-earth carbonate up to 25% and/or up to 5% of sodium nitrite or other fusible nitrogen-yielding salts. The temperature of the bath is kept above the carbon change point of the material being treated. The article is made the cathode of an electric circuit, the current density being 0·5—2 amp. per sq. in. of cathode surface. The time taken to obtain a given depth of carbon penetration is from one-third to one-sixth of that required by the ordinary process. Articles it is required to soften may be decarburised by immersing in a bath which has recently been used for the cementation process.—T. H. Bu.

Steel; Production of basic ——. Usines Métallurgiques de la Basse-Loire (Soc. Anon.). E.P. 184,957, 2.7.21. Addn. to 163,693 (J., 1922, 714 A).

GREY pig iron is treated by a one-stage blowing process for the production of hard or semi-hard steels with a high carbon content and practically dephosphorised, additions of recarburising agents being dispensed with by regulating the quantities of pig iron introduced into the bath according to its carbon and phosphorus contents.—J. W. D.

Manganese steel; Heat treatment of ——. W. G. Nichols, Assr. to American Manganese Steel Co. U.S.P. 1,427,121, 29.8.22. Appl., 18.9.20.

THE maximum temperature during the heat treatment of manganese steel castings is not allowed to exceed the critical temperature for such castings. —C. A. K.

Ferro-alloys; Production of low-carbon ——. N. Petinot. U.S.P. 1,428,057, 5.9.22. Appl., 26.9.19.

FERRO-CHROME is mixed with a quantity of chromite ore containing oxygen in excess of that required to combine with the carbon of the alloy, and melted in an electric furnace with an acid lining. —T. H. Bu.

Steel and iron alloy. P. de Clamecy, Assr. to B.F. Sturtevant Co. U.S.P. 1,428,534, 12.9.22. Appl., 6.10.19.

AN iron alloy containing 1·25—6·0% Co, 0·5—6·0% Cr, 0·75—7·5% Ni, and 0·5—3·0% Si.—J. W. D.

Metallic electrolytic deposits; Process of obtaining —— *easily detachable from the cathode.* Soc. d'Electro-Chimie et d'Electro-Métallurgie. E.P. 165,082, 13.5.21. Conv., 18.6.20.

A CATHODE of cast iron or steel is coated with an easily detachable film of copper by electrolysis or by immersion in an acid solution of a copper salt, either with or without the addition of alcohol, and the resulting electrode is used for the electrolytic deposition of metals, the deposited metal being readily peeled off together with the copper coating. —A. R. P.

Argentiferous lead-zinc sulphide ores; Treatment of ——. F. E. Elmore, and The Chemical and Metallurgical Corp. E.P. 184,628, 8.6.21.

WHEN treated by the hot brine process, roasted ores give a more complete extraction of silver if hydrogen sulphide is removed from the hot liquor. The use of sulphur dioxide is preferred for this purpose. Lead and silver may be recovered from solution by known methods and the zinc residue may be treated with other solvents, *e.g.*, more strongly acid brine, for the further recovery of silver.—C. A. K.

Refining metals; Apparatus for ——. H. Harris. E.P. 184,639, 20.6.21.

METALS of low melting point (*e.g.*, lead) are refined by passing them through a suitable molten reagent. An apparatus for this purpose consists of a pump which delivers into the upper part of a heated melting pot, a metal stirring gear, and a motor. These parts are carried on a framework, which can be lowered into a metal melting pot. The reagent may be heated by passing part of the flue gases from the metal melter through a jacket surrounding the pot containing the reagent. —C. A. K.

Alloys; Metallic ——. F. H. Rogers. From Calorizing Corp. of America. E.P. 184,840, 19.4.21.

CASTINGS resistant to oxidation at a high temperature are made from an alloy of iron and 19·5% of aluminium, which has a higher tensile strength than any other alloy of these two metals. The grain may be refined by the addition of 1 to 5% of titanium or of other elements. The alloying process is carried out in a neutral atmosphere, and to prevent oxidation the mould is filled with carbon dioxide, a blast of which is also directed on the stream of molten metal.—T. H. Bu.

Titanium ores containing iron; Treating ——. G. Carteret and M. Devaux. E.P. 184,948, 27.6.21.

TITANIUM ore is heated in a reducing atmosphere, and is then treated with successive currents of chlorine gas passed in opposite directions and at different temperatures, viz., 350° and 550°—600° C. respectively, to volatilise and separate the iron and titanium chlorides. The titanium chloride is re-distilled to separate traces of other chlorides, then treated with sulphuric acid to produce titanium sulphate and hydrochloric acid and the titanium sulphate treated to produce titanium oxide and sulphuric acid. The ferric chloride obtained is reduced to ferrous chloride and the latter electrolysed to produce metallic iron and free chlorine. The regenerated chlorine and that produced from the hydrochloric acid are used again in the first chlorination.—J. W. D.

Furnaces [*for melting metals*]. W. Oehm. E.P. 185,320, 27.8.21.

The combustion of gases from, *e.g.*, inferior fuel on a grate, is promoted by a small quantity of high-pressure air issuing through a small hole or jet at the back of one or more hollow burners of refractory material formed with flat converging slots or channels. The gases after complete combustion may be used for heating metal melting furnaces or, while still under pressure, for drying moulds. The high-pressure air may be preheated by being led in a serpentine course through passages adjacent to the burner device.—B. M. V.

Electric-furnace construction [*for reducing ores*]. W. E. F. Bradley. U.S.P. 1,427,436, 29.8.22. Appl., 22.7.18. Renewed 25.1.22.

The charge from a rotary furnace is fed through an inlet into an electric furnace of the tilting type provided with an outlet for removing the slag and reduced charge, the inlet also serving for conveying gases from the electric to the rotary furnace. A reducing gas is passed into the electric furnace through a carbon tuyère so situated that it is independent of the electrodes of the furnace and is covered by the molten charge while the furnace is in the receiving and reducing position, but is removed from the charge while the latter is being poured out of the furnace.—L. A. C.

Roasting furnace; Mechanical —— for pyrites etc. Erzröst Ges.m.b.H., and J. Walmrath. G.P. 351,351, 11.9.20.

The material slides on and under open oblique partitions in the centre of the oven without the use of poking or stirring devices. The partitions are so built that the gases evolved do not come in contact with the incoming ore, thus minimising production of flue dust.—A. C.

Tungsten metal; Process of reducing tungstic oxide to ——. W. F. Bleecker, Assr. to The Tungsten Products Co. U.S.P. 1,427,187, 29.8.22. Appl., 8.7.20.

Heat is applied to the interior of a charge composed of a mixture of tungstic oxides and a suitable reducing agent, the mass of material being provided with passages for the circulation of gases. —C. A. K.

Concentration of ores [*by flotation*]. G. E. Sheridan and G. G. Griswold, jun. U.S.P. 1,427,235, 29.8.22. Appl., 10.1.22.

An ore containing sulphides of iron and of one or more other metals is treated with a cyanide and an alkaline salt and then subjected to flotation under conditions unfavourable to floating the iron sulphide.—B. M. V.

Ores; Method of treating —— by volatilisation. H. R. Layng. U.S.P. 1,427,765, 29.8.22. Appl., 4.11.19.

The ore charge is heated so rapidly that the volatile elements in the ore are removed without any harmful reaction occurring.—A. R. P.

Zirconium ores; Treatment of ——. O. Hutchins, Assr. to The Carborundum Co. U.S.P. 1,427,816, 5.9.22. Appl., 22.9.20.

Pure zirconia is produced from zirconium ores by heating a mixture of ore and reducing agent so that part of the impurities in the ore is reduced to metal, and then separating the impurities from the zirconia.—J. S. G. T.

Beryllium; Process for electrolytically manufacturing compact metallic ——. A. Stock and H. Goldschmidt. U.S.P. 1,427,919, 5.9.22. Appl., 12.5.22.

Compact metallic beryllium is produced by electrolysing a fused bath of alkaline-earth fluoride containing a beryllium compound.—A. R. P.

Metals from metal alloys; Process for the separation and recovery of ——. G. J. Kroll. U.S.P. 1,428,041, 5.9.22. Appl., 21.9.20.

An alkaline-earth metal or magnesium is introduced into the metallic alloy or impure metal, so that the metallic constituent to be separated combines with the alkaline-earth metal to form a compound having a different melting point from and a specific gravity not more than that of the main metal. This compound is then separated from the remaining part of the alloy under treatment.—J. W. D.

Metals; Cleaner for and method of cleaning ——. J. H. Gravell. U.S.P. 1,428,084, 5.9.22. Appl., 4.6.21.

A mixture for cleaning metals consists of colloidal clay suspended in a suitable dilute acid together with a filler, acetone, and an alcohol of higher boiling point than ethyl alcohol.—A. R. P.

Metals; Composition for and method of preventing —— from rusting. Paint for and method of preventing heated [*metal*] *surfaces from rusting. Rust-resisting steel and method of producing same.* J. H. Gravell. U.S.P. 1,428,085–7, 5.9.22. Appl., (A) (B), 4.6.21, (C) 22.6.21.

(A) A rust-preventing coating for metals consists of castor oil, ethyl alcohol, and an alcohol having a higher boiling point than ethyl alcohol. (B) A paint for preventing heated metal surfaces from rusting contains at least 15% of a phosphate which on heating liberates enough phosphoric acid to form a substantial coating of the phosphate of the metal on its surface. (C) A rust-resisting steel consists of a body of metal into the surface of which a coating of phosphate has been pressed.—A. R. P.

Soldering solution. J. H. Gravell. U.S.P. 1,428,088, 5.9.22. Appl., 20.12.21.

A solution of zinc and ammonium chlorides containing fusel oil.—A. R. P.

Vanadium; Process of recovering ——. W. E. Stokes, Assr. to United States Processes, Inc. U.S.P. 1,428,616, 12.9.22. Appl., 19.1.21.

A vanadium ore is mixed with an alkali nitrate and heated.—B. M. V.

Condenser [*for zinc furnaces*]. C. A. Wettengel, Assr. to American Zinc, Lead, and Smelting Co. U.S.P. 1,429,214, 12.9.22. Appl., 4.3.18.

A tapering condenser has a fixed head with two openings at its larger end, one for introducing the zinc bars into the retort and the other for withdrawing the molten metal.—T. H. Bu.

Sulphide ores; Process for the treatment of slimy —— preparatory to roasting. Metallbank und Metallurgische Ges. A.-G. G.P. 355,885, 29.10.13.

The ore is subjected to a sulphatising roast, then moistened, and rendered granular before carrying out the roast proper. In this way the ore is not diluted with a binder which may cause trouble later.—A. R. P.

Iron and steel; Manufacture of ——. T. Rouse. U.S.P. 1,428,061, 5.9.22. Appl., 23.11.20.

See E.P. 152,073 of 1919; J., 1920, 787 A.

[*Zinc*] *solutions; Purification of metallic* ——. S. Field, Assr. to Metals Extraction Corp., Ltd. U.S.P. 1,429,131, 12.9.22. Appl., 26.6.19.

See E.P. 138,950 of 1918; J., 1920, 371 A.

Furnaces [*for heating metal to be forged or steel to be hardened*]. J. A. Innocent. E.P. 185,623, 27.8.21.

Preheating blast-furnace gas in purifying plants. E.P. 182,102. *See* IIA.

XI.—ELECTRO-CHEMISTRY.

[*Electric furnace and*] *apparatus for direct heating to high temperatures by resistance with simultaneous application of mechanical pressure.* F. Sauerwald. Z. Elektrochem., 1922, 28, 181—183.

An apparatus for heating rods of carbon, tungsten, or other material of high melting point to very high temperatures by the passage of an alternating current through the rod is described and illustrated in detail. It consists essentially of a horizontal fireclay tube with an outer sheet-iron casing, provided at each end with a water-cooled bronze electrode in which the rod is secured by two copper wedges. One electrode is fixed while the other is free to move on ball bearings inside a steel cylinder which prolongs the length of the furnace in this direction; in this way allowance is made for expansion and contraction of the rod during heating. Through the middle of the furnace, perpendicular to the axis, an arrangement, consisting of an upper and lower pestle which can be screwed tight against the bar or used for hammering it, is provided and a sight-hole closed with a mica window allows observation of the rod at this spot. The whole apparatus is made reasonably air-tight so that the heating operation may be carried out in a stream of suitable gas, such as hydrogen.—A. R. P.

Electrolytic oxidation of α-naphthylamine and ar-tetrahydro-α-naphthylamine. Ono. *See* IV.

Carbon at high temperatures. Sauerwald. Ryschkewitsch. *See* VII.

Action of brush discharge on fatty acids and glycerides. Eichwald. *See* XII.

Electrolytic oxidation of isoamyl alcohol. Koizumi. *See* XX.

Patents.

Furnace for electric heating. A. H. Pehrson. E.P. 162,285, 25.4.21. Conv., 26.4.20.

Pairs of electrodes making contact at their inner ends, and covered with material protecting them from damage by gases or furnace charge, are introduced through the end walls, and at a suitable distance from the axis of a revolving or oscillating electric furnace.—J. S. G. T.

Electric furnaces. I. J. Moltke-Hansen. E.P. 171,096, 2.11.21. Conv., 3.11.20.

An electric furnace is heated by current applied to a resistance element consisting of granular material, e.g., granulated electrode carbon, contained in channels arranged about the furnace chamber and communicating in pairs at the top through a reservoir into which granular material is supplied to compensate for the consumption of this material during the operation of the furnace. Current is supplied only at the bottom of the respective channels.—J. S. G. T.

Electric furnace [*for production of calcium carbide*]. A. E. Reid. E.P. 185,136, 22.2.21.

An electric furnace for the production of calcium carbide comprises a hearth, a delivery outlet or outlets, electrodes projecting downwards and converging so that they may be adjusted towards and from the hearth and one another, and an additional electrode or electrodes, each located within a delivery outlet, for maintaining the carbide in a molten condition. Preferably, current is supplied to the additional electrodes at a lower voltage than to the downwardly projecting electrodes. The hearth of the furnace comprises a flat bottom portion and upwardly inclined sides in which the delivery outlets are placed.—J. S. G. T.

Electric furnace. E. H. Hurstkotte, Assr. to General Electric Co. U.S.P. 1,427,814, 5.9.22. Appl., 3.5.20.

A resistance heater composed of a number of dished discs in electrical contact at their peripheries but out of contact in their central regions, is arranged within a container, and a refractory shield is disposed between the heater and the charge in the furnace.—J. S. G. T.

(a, b) *Electric furnace.* (c) *Method of operating electric furnaces.* I. Rennerfelt. U.S.P. (a) 1,428,908, (b) 1,428,909, and (c) 1,428,910, 12.9.22. Appl., (a) 3.3.21, (b, c) 12.8.21.

(a) In an electric furnace, an elongated crucible is heated by current supplied to strings of carbonaceous resistance material disposed lengthwise along the crucible and separated from one another by electrically insulating material. (b) An electric furnace comprises an upper chamber separated by a conducting partition from a lower chamber, the walls of which are poor conductors of heat. At least two electrodes project into the lower chamber for generating an electric arc therein. (c) The charge in an electric furnace is heated first by free-burning arcs supplied with two-phase current, and then by means of arcs in contact with the surface of the charge and supplied with three-phase current, the relative distance between the arcs being changed.—J. S. G. T.

Electric batteries. Soc. Anon. "Le Carbone." E.P. 178,804, 10.2.22. Conv., 19.4.21.

The carbon or positive pole of a battery is immersed in an agglomerate of active material and depolariser, the former comprising a salt of cerium which acts as a catalyst during the discharge of the cell The agglomerate is contained in a calico or other bag, surrounded by a paste composed of gum tragacanth 40%, glucose 40%, sodium fluoride 2—3%, powdered pumice stone 17—18%. The agglomerate and paste are covered by anhydrous calcium chloride. The battery is put into operation by addition of water, and is characterised by the prevention of motion of the electrolyte and of the formation of local couples.—J. S. G. T.

Secondary cells or batteries for electricity storage [*; Means of preventing buckling of the plates of* ——]. C. G. Smith. E.P. 184,649, 30.6.21.

In storage cells employing lead plates, gypsum or plaster of Paris is employed to absorb the electrolyte and to separate and support the electrodes, which are inserted in a series of slots or pockets in the gypsum or plaster of Paris. The positive and negative plates are composed respectively of red lead and litharge, to which about 2% of powdered aluminium sulphate is preferably added.
—J. S. G. T.

Electric accumulators [; *Method of drying the negative plates of* ——]. A. Dinin. E.P. 184,658, 8.7.21. Addn. to 14,119 of 1914 (J., 1914, 928).

Lead electrodes used in accumulators are dried in a closed vessel in a heated stream of nitrogen, carbon monoxide, hydrogen, or other non-oxidising gas, the water vapour carried off by the stream being condensed and the gas kept in continuous circulation.—J. S. G. T.

Electrolytic apparatus [*for decomposition of water; Electrodes used in* ——]. A. W. Smith. U.S.P. 1,427,171, 29.8.22. Appl., 8.11.20.

Electrodes employed in the electrolysis of water consist of metals of the nickel group having their faces covered with spongy coatings of metals, such as nickel or platinum, which are unaffected by the electrolysis.—J. S. G. T.

Electrolytic method and apparatus. J. J. Sherwood, Assr. to Hooker Electrochemical Co. U.S.P. 1,427,236, 29.8.22. Appl., 20.3.20.

The gaseous product of an electrolysis (*e.g.*, electrolysis of common salt for production of hydrogen, chlorine, and caustic soda) is diverted from, and a supply of fresh electrolyte supplied to, the active electrode face at a point or points between the top and bottom of the electrode. The apparatus may consist of a cylindrical outer wall forming the cathode within which is a cylindrical diaphragm enclosing a hollow anode, provided with a number of annular projections, at different levels, which make a tight joint with the diaphragm without and project also into the hollow centre of the anode. Diagonal passages are formed in the annuli which serve to lead the evolved gases from the tops of the annular compartments to the central anode space and lead fresh electrolyte from the central space to the lower part of each annular outer space.—B. M. V.

Electrolytic apparatus and method of depolarising the same. W. D. Nickum. U.S.P. (a) 1,428,049 and (b) 1,428,050, 5.9.22. Appl., (a) 8.2.19, (b) 21.4.20. Renewed 5.11.21.

(a) The polarisation of an electrolytic circuit is reduced by the use of a transformer consisting of a low-tension primary coil energised by direct current, and a high-tension secondary coil connected with electrodes immersed in the electrolyte. (b) In an electrolytic apparatus as described under (a) the primary and secondary coils are inductively related so as to reduce the electrolytic polarisation when the current in the primary coil is varied owing to polarisation.—J. S. G. T.

Electrical etching; Apparatus for ——. *Process and apparatus for electrical etching.* R. M. Weeks, Assr. to Weeks Photo-Engraving Co. U.S.P. (a) 1,427,876, and (b) 1,427,877, 5.9.22. Appl., (a) 2.4.21, (b) 25.4.21.

(a) The plate to be etched is supported and employed as anode in an electrolytic bath and the cathode used is composed of material which is resistant to the action of the electrolyte and reduces the formation of hydrogen. (b) During the etching process the plate to be etched is moved in the plane of its face.—J. S. G. T.

Storage batteries. H. E. Smith, Assee. of W. H. Wood. E.P. 160,821, 30.3.21. Conv., 31.3.20.

See U.S.P. 1,405,702 of 1922; J., 1922, 222 a.

Electrolytic cell. Elektrizitäts-A.-G. vorm. Schuckert und Co. E.P. 165,071, 14.3.21. Conv., 14.6.20.

See G.P. 349,538 of 1920; J., 1922, 380 a.

Electrical precipitation. U.S.P. 1,427,370, 1,428,839. G.P. 354,623. *See* I.

Oxidation of nitrogen. U.S.P. 1,429,013. *See* VII.

Electric furnace. U.S.P. 1,427,436. *See* X.

Acetaldehyde from acetylene. E.P. 165,085. *See* XX.

XII.—FATS; OILS; WAXES.

Fatty acids and their glycerides; Action of the brush discharge on ——. E. Eichwald. Z. angew Chem., 1922, 35, 505—506.

If oleic acid is subjected to the action of the brush discharge the iodine value steadily falls, the mean molecular weight steadily rises, and stearic acid is produced. The increase in molecular weight per unit fall in iodine value increases from 6·3 at the beginning of the treatment to 43·5 after treatment for 22 hrs. About 11% of the oleic acid is converted into stearic acid, and this conversion occurs in an atmosphere of air or nitrogen as well as in an atmosphere of hydrogen, though working under the latter conditions gives the slightly higher maximum yield of 15% of stearic acid. It is considered that the bombardment of the molecules causes hydrogen atoms to become detached in a highly active state, and that they immediately saturate the double bonds of other molecules of oleic acid, leaving some highly unsaturated molecules which polymerise and cause the increase in molecular weight. Glycerides show similar effects under the brush discharge, the glyceryl part of the molecule being unaffected. The resulting polymerised oils have high viscosities and flat viscosity-temperature curves and are of value as lubricants. Owing to the possibility of intra-molecular saturation of double bonds in the case of glycerides, the increase of molecular weight in this case becomes even more marked in the later stages of treatment than in the case of the free fatty acids.—H. C. R.

Coconut oil; Oleic acid content of the free fatty acids from the soap stock obtained on refining ——. F. Wittka. Z. Deuts. Oel- u. Fettind., 1922, 42, 377—378. Chem. Zentr., 1922, 93, IV., 598—599.

A comparison of the iodine values of crude and neutralised coconut oils obtained from the rind and from the kernel showed that the hydrolysis of the glycerides begins in the rind of the copra and proceeds faster there than in the inner layers. The oil from the rind has acid value 7·5 and iodine value 38·7, but bears only a small proportion to the total oil content. The further the hydrolysis proceeds, the more free fatty acids will be formed in the white inner layers of the copra and the smaller proportion will the free fatty acids formed in the rind bear to the whole. The characters of the acid oils obtained from such copra will therefore approach those of normal coconut oil. Strongly acid coconut oil will therefore give an acid oil with normal (low) iodine values. Good quality coconut oil, however, will give an acid oil with a high iodine value, and this will be the higher, the better the refining process has been, *i.e.*, the smaller the quantity of neutral fat hydrolysed during the process. Commercial acid coconut oils showing high iodine values cannot on this account alone be safely condemned as adulterated.—H. C. R.

Hydrogenation of oils; Promoters of the ——. I. S. Ueno. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, 25, 777—783. (*Cf.* J., 1919, 20 a.)

Experiments with herring and cottonseed oils showed that the hydrogenation of oils is accelerated by the presence of small quantities of fatty or aromatic acids. The results obtained with 2—3% of palmitic, oleic, butyric, stearic, and benzoic acids, using nickel or nickel sulphate (0·3—0·5% as Ni) as catalyst are given in tables.—K. K.

Brassidic anhydride, and preparation of anhydrides by means of phosgene. D. Holde and K. Schmidt. Z. angew. Chem., 1922, 35, 502—503.

Brassidic anhydride, brassidic acid, and ethyl brassidate were prepared from erucic acid and its corresponding derivatives by isomerisation by means of nitrous acid. Brassidic anhydride crystallised from alcohol in small needles, m.p. 64° C., had the theoretical iodine value, and sp. gr. 0·835 at 70°/4° C. Ethyl brassidate formed leaflets, m.p. 30°—30·5° C., $n^{35}=1·4587$. The anhydrides of the fatty acids of cod liver oil were obtained in an impure condition, containing chlorine, by the action of carbonyl chloride on their alkali salts. They formed pasty products of higher melting point than the corresponding glycerides and acids. The difference frequently observed between the acid and saponification values of the acids of fatty oils may possibly be due to the presence in the acids of a proportion of anhydrides, which do not react normally with cold alcoholic hydroxide solutions. —G. F. M.

Saponification of oils and fats; Studies in the ——. H. M. Langton. J. Oil and Colour Chem. Assoc., 1922, 5, 41—75.

The theory of the hydrolysis of oils and fats is reviewed and the technical methods of hydrolysis are enumerated and described. A summary is given of previous work on the rate and extent of the hydrolysis of different oils and fats and an account is given of the author's large-scale experiments on the rate and extent of the hydrolysis of tallow, palm oil, linseed oil, palm kernel acid oil, No. 1., No. 2 and No. 3 whale oils, using lime and magnesia as catalysts in the autoclave process. In all cases a constant steam pressure of 8 atm., a charge of 3 tons of oil or fat, an amount of catalyst equal to 2½% of the weight of oil, and a period of treatment of 10 hrs. were employed. The results obtained are shown in a series of curves which are of the exponential type, the greater part of the fat being hydrolysed after about 4 hrs. and the rate of hydrolysis after that period being exceedingly slow. Magnesia was the more effective catalyst in the case of tallows, palm kernel acid oil, and the whale oils, whereas lime was superior in the case of palm oil. In the case of linseed oil the rate and extent of hydrolysis were the same with each catalyst. Using magnesia as catalyst, the tallows were hydrolysed most quickly in the first few hours and in decreasing order of speed whale oils, linseed oil, palm oil and palm kernel oil. Beef tallow hydrolyses much more quickly with lime than does mutton tallow under the same conditions. In the case of whale oils the rate of hydrolysis is in the order No. 1, No. 2, No. 3, No. 1 giving the highest value. The practice of blowing the glycerin solution from the autoclave after about 4—5 hrs. and re-starting the hydrolysis was found to offer no practical advantage. A table of average extents of hydrolysis after treatment of various fats with lime and magnesia for 8 hrs. under the conditions outlined above is given. These are the averages of 625 3-ton charges. In general magnesia was found to be more effective than lime.—H. C. R.

Total fat in soaps; Simplification of Goldschmidt's titration method for determining the ——. M. Jakes. Seifensieder Zeit., 1922, 49, 431—432. Chem. Zentr., 1922, 93, IV., 449.

The determination of total fat in curd soaps from coconut or palm-kernel oils and resins according to the standard methods often offers difficulties. The petroleum spirit does not completely dissolve the resin and in drying the fatty acids a temperature of 50°—55° C. is not high enough to remove the petroleum spirit. The following methods are suggested: (a) 7—10 g. of soap is dissolved in water, decomposed with excess of acid, and extracted with ether, washed with water or salt solution, the ethereal solution poured off, the separating funnel washed out with alcohol, and the solution titrated. (b) 50 g. of soap is dissolved in water, decomposed with excess of acid and allowed to settle. The fatty acid layer is poured into hot water two or three times, and 5 c.c. of the clear washed acids is filtered, dissolved in alcohol and titrated. The errors introduced by the solubility of the fatty acids in water and of water in the fatty acids are very small.—H. C. R.

Oil emulsions; Preparation of —— by means of colloidal silicic acid and the relationship to the processes of tuberculosis. S. P. Kramer. Kolloid-Zeits., 1922, 31, 149—150.

When animal or vegetable oils are added to a solution of sodium silicate (2 per 1000) a fine and very stable emulsion is formed at once. The oil drops are so small that many of them exhibit the Brownian movement. The formation of the emulsion takes place as follows: the fatty acid of the oil combines with the sodium to form a soap and liberates colloidal silicic acid which then acts as a protecting colloid. The addition of acid produces a silicic acid gel emulsion and the addition of lime water causes coagulation, forming a cheese-like coagulum and a thin liquid. The above changes are shown to be similar to the processes occurring in the development of tuberculosis. —J. F. S.

Boring and cooling oils. Kaleta. *See* IIa.

Patents.

Regenerating fuller's earth, charcoal and the like purifiers of fats and fatty oils and of catalysts used in hydrogenating fats and fatty oils; Method for ——. E. R. Bolton and E. J. Lush. E.P. 185,174, 24.5.21.

The material to be regenerated is subjected to the action of superheated steam until the mass is raised to a temperature of 230°—300° C., whereby the oil content is hydrolysed and recovered as distilled fatty acids and glycerol. A vacuum may be employed to expedite the distillation of the hydrolysed oil.—H. C. R.

Fish and other oils; Method and apparatus for treating ——. V. F. Feeny. From Title Guarantee and Trust Co. E.P. 185,247, 13.6.21.

The oil is deodorised and sterilised by circulating it through a chamber in which it is exposed to the action of ozonised air and preferably to the action of sunlight. It is delivered at the top of the chamber so as to fall in the form of rain through the upward air current, is continuously withdrawn from the base of the chamber for agitation and heating, and is thereafter returned to the top of the chamber or passed on for subsequent treatment. The oil may also pass in a thin film over the walls of the chamber, and be subsequently treated with pulverulent material and filtered. Heated air may be passed through the chamber, which may also be provided with means for raising the pressure inside it.—H. C. R.

Fatty matter; Recovery of —— from raw materials of organic origin. F. Bergius. G.P. 350,634, 4.8.17.

The raw material, *e.g.*, peat, lignite, etc., is mixed with water, to which may be added a basic material, *e.g.*, soda, and is heated to a temperature not exceeding 300° C. under high pressure. The liquid containing fatty matter is separated from the residue. Raw lignite, for example, containing 50% of water, may be heated with about double the quantity of a 10% soda solution to 275° C. at

90 atm. pressure for 6 hours. After cooling, the mass is filtered and the filtrate is acidified with sulphuric acid, causing separation of fatty acids. —A. G.

Lubricating oils, leather grease, artificial vaseline, lanolin-like materials and the like; Production of highly viscous —— from mineral, vegetable and animal oils. Plauson's Forschungsinstitut G.m.b.H. G.P. 353,222, 20.4.21. Addn. to 347,084 (J., 1922, 300 A).

Vegetable waxes are used in place of bitumen or crude or bleached montan wax. The products obtained from Japan wax, carnauba wax, or beeswax, by treatment with aldehydes in the presence of alkalis, if necessary with the addition of polyhydric alcohols, give, on melting with oils, highly viscous, vaseline-like products, which can be incorporated with water by intimate trituration. —A. G.

Fatty acids with several double linkages or of their glycerides; Conversion of —— into oleic acid-like fatty acids or their soaps. C. Stiepel, Assr. to Persapol Ges. U.S.P. 1,429,114, 12.9.22. Appl., 14.9.20.

See E.P. 141,720 of 1920; J., 1921, 630 A.

Oil bearing material; Art of forming and wrapping —— prior to the expression of oil therefrom. W. J. Mellersch-Jackson. From The Murray Co. E.P. 184,621, 3.6.21.

Presses; Oil and like ——. A. W. French. E.P. 185,532, 14.6.21.

Rubber substitute. G.P. 356,165. *See* XIV.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Graphites and other pencil pigments. C. A. Mitchell. Analyst, 1922, 47, 379—387.

The author gives a further account, illustrated by photomicrographs, of the differences in the markings made by various graphites (*cf.* J., 1919, 381 T), lead-antimony alloys, etc., and a correlation of the microscopic appearances of these markings with the chemical composition of the pencil pigment. The materials used included a number of old graphite or compressed graphite pencils, samples of old Borrowdale graphite, and modern graphites and graphite pencils, and the conclusions previously drawn were confirmed. The pigments in a number of coloured pencils were examined both chemically, and by microscopical observation of their markings on paper. The pigment in blue pencils is either an aniline dye, Prussian blue or other mineral pigment, or a mixture of both. In red pencils the pigment is mostly red lead. Chemically the markings may often be differentiated by their behaviour with $N/1$ potassium hydroxide, or with hydrochloric acid, and differences may also be noted in the reactions given by them for iron. Microscopically differences may be noted in the colour, and the disposal of the pigment on the paper. —G. F. M.

Coumarone-resin; Preparation of ——. S. Hirano. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, 25, 827—833.

On slowly adding 5 c.c. of concentrated sulphuric acid to 100 c.c. of purified coal tar naphtha, b.p. 155°—185° C., with constant stirring, coumarone-resin is produced, with a yield of 9·53% of the naphtha. The naphtha should be previously washed with soda lye (sp. gr. 1·22) and dilute sulphuric acid (sp. gr. 1·20) to remove tar acids and bases, and freed from water. If the alkali washing be omitted, the same yield is obtained, but the product is darker in colour. The initial temperature of the oil should be as low as possible and rise of temperature during the reaction avoided. When more oil is used at a time, the quantity of the acid should be decreased to avoid oxidation. A paler resin is obtained by washing the reaction product with alkali. As polymerisation reagents, stannic chloride (5 c.c.) gives a hard and pale resin (m.p. 85° C.), the yield being 6·06 g. from 100 c.c. of oil, while aluminium chloride (10 g.) gives a soft and dark resin (m.p. 38° C.) with a yield of 32·5 g.—K. K.

Sedimentation analysis. Von Hahn. *See* XXIII.

Patents.

Condensation products of phenolic bodies with aldehydic compounds; Manufacture of ——. Lorival Mfg. Co., Ltd., and A. A. Drummond. E.P. 184,961, 7.7.21.

To the initial condensation product obtained by the interaction of phenols with formaldehyde is added a proportion of glycerin (*e.g.*, 70% aqueous glycerin) such that the proportion of mineral acid used as accelerator is 1 g.-equiv. to at least 900 g. of glycerin.—A. de W.

Artificial [phenol-formaldehyde] resins; Production of ——. A. Heinemann. E.P. 184,984, 27.7.21.

An alkali glycerate is added to artificial resins obtained from phenols and formaldehyde after the elimination of water therefrom, for the purposes of minimising brittleness and increasing toughness, or if desired, raising the melting-point and reducing solubility.—A. de W.

Rosin; Compound for hardening —— and method of using same. W. H. Scheel. U.S.P. 1,428,120, 5.9.22. Appl., 25.3.22.

Coral lime (about 1%) is compounded with rosin whilst in the state of fusion, and the fused mass diluted with a liquid solvent to the proper consistency of a rosin varnish.—A. de W.

Coating composition and process of producing the same. Paint vehicle. W. A. Collings. U.S.P. (A) 1,428,272 and (B) 1,428,273, 5.9.22. Appl., 5.11.21 and 28.2.22.

(A) Hot raw linseed oil is gelatinised by the incorporation of a water-insoluble soap, *e.g.*, aluminium stearate, the jelly allowed to age, and Portland cement added thereto in sufficient proportion to form a stiff paste. (B) A petroleum distillate of high iodine value is subjected to distillation or blown with air to free it from its contained pitchy or waxy matter and a water-insoluble metal soap incorporated therein.—A. de W.

Inks and water-colours; Manufacture of ——. Plauson's Forschungsinstitut G.m.b.H. G.P. 355,117, 22.6.21.

Aqueous colloidal dispersions of substances such as clay, kaolin, phosphates, zirconium earths, metallic oxides, lime and iron compounds, or of other insoluble coloured mineral substances are ground with soluble organic dyestuffs and a protective colloid in a Plauson colloid mill. By this method, only about one-tenth of the usual amount of organic dyestuff is required.—A. J. H.

Resinous products from waste sulphuric acid. U.S.P. 1,427,386. *See* III.

Cellulose acetate compositions. E.P. 184,671. *See* V.

Rust-preventing coatings. U.S.P. 1,428,085-6. *See* X.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Latex and rubber from individual trees. III. Difference in properties of rubber from different trees. Are the properties of rubber from one tree constant? O. de Vries. Comm. Central Rubber Stat. Buitenzorg, 1922, No. 29, 146—162.

Twelve good-yielding trees, on one estate, gave from 9·6 to 68·4 g. of rubber per day. The rubber content of the latex varied from 25 to 46%, and although often very constant over long periods for one tree, sometimes underwent change from alteration in tapping system and other causes. For some trees the tensile strength of the rubber was consistently low. The rate of vulcanisation was fairly constant for each tree and the "slope" in almost all cases fell between 35 and 38. Wide variations, however, were found in the viscosity, which was not always constant for the same tree. (*Cf.* J., 1920, 665 A.)—D. F. T.

Latex and rubber from young trees. O. de Vries. Comm. Central Rubber Stat. Buitenzorg, 1922, No. 31, 296—309.

In the rubber from trees between 6 and 15 years old the differences in properties are small. With trees 3 to 4½ years old, however, the rubber content of the latex was low and the specific gravity tended to be high. The rubber, especially in the form of sheet, showed marked "shortness," and the viscosity was very low, particularly for crêpe. The rate of vulcanisation proved exceptionally high, whilst in "slope" and tensile strength the vulcanised rubber was inferior to the product from older trees.—D. F. T.

Latex and rubber; Influence of soil upkeep on ——. O. de Vries. Comm. Central Rubber Stat. Buitenzorg, 1922, No. 31, 289—295.

No improvement was observable in the rubber from trees over a period of three months during which the ground was kept in good condition and free from weeds, after having been neglected for twelve months.—D. F. T.

Hevea latex; Presence of quebrachitol and sugar in —— under different circumstances. W. Spoon. Comm. Central Rubber Stat. Buitenzorg, 1922, No. 30, 269—287.

Making the assumption that the sugar present in latex is sucrose, comparative estimation of the proportion of quebrachitol is possible by measurement of the optical rotation of the protein-free serum before and after inversion of the sucrose. The removal of protein from the serum can be effected by precipitation with alcohol. Tapping the trees on alternate days instead of daily causes an increase in the proportion of rubber and sugar in the latex and a decrease in the mineral substances and in the quebrachitol. During the first few months after the change the yield of latex per tree decreases by about 40%, but subsequently rises gradually.—D. F. T.

[*Rubber latex;*] *Experiments* [*on* ——] *with Boehringer's coagulating powder* [*aluminium lactate*]. W. Spoon. Comm. Central Rubber Stat. Buitenzorg, 1922, No. 29, 140—145.

The coagulant, which consists chiefly of aluminium lactate, gives a rubber inferior to that obtained with acetic acid in tensile strength, rate of vulcanisation, and viscosity. The use of lactic acid as a coagulant does not harm the rubber, but alum yields a poor grade of rubber, similar to that obtained with the aluminium lactate.—D. F. T.

Rubber latex in paper making. Kaye. *See* V.

Patents.

Rubberised fabric and rubber goods; Preparation of ——. P. Britton, and Griffiths Bros. and Co., London, Ltd. E.P. 184,578, 17.5.21.

Rubberised fabrics are prepared by applying rubber latex, with or without added ingredients, to the material to be treated. After drying and before vulcanisation, the treated material may be washed to remove albuminous matters natural to the latex.—D. F. T.

[*Rubber*] *compounds; Method of working quick-curing* [*quick-vulcanising*] ——. W. A. Gibbons, Assr. to American Rubber Co. U.S.P. 1,427,283, 29.8.22. Appl., 31.3.21.

In order to prevent premature vulcanisation of rubber mixtures containing accelerators, the rubber is maintained in a softened condition during the period of mechanical working.—D. F. T.

[*Rubber*] *latex; Process and apparatus for treating ——.* C. E. Bradley and J. G. Coffin, Assrs. to General Rubber Co. U.S.P. 1,428,526, 12.9.22. Appl., 7.12.21.

Latex is fed on to a moving surface, whence it is discharged as a series of particles, from which the moisture is subsequently removed.—L. A. C.

Rubber substitute; Preparation of coloured ——. Dubois und Kaufmann Chem. Fabr. G.P. 356,165, 6.6.14.

Finely divided factice is dyed in level shades, which are not changed during vulcanisation, by means of organic dyestuffs, especially those of the Indigo series.—A. J. H.

Rubber-containing latex; Process for treating ——. Product obtained from rubber-containing latex. E. Hopkinson, Assr. to General Rubber Co. U.S.P. 1,423,525–6, 25.7.22. Appl., 16.1.20.

See E.P. 157,975 of 1921; J., 1922, 677 A.

XV.—LEATHER; BONE; HORN; GLUE.

Hide soaking experiments. B. S. Levine. J. Amer. Leather Chem. Assoc., 1922, 17, 417—430.

Pieces of hide were soaked in tap water under normal, aerobic, and anaerobic conditions. The hair became loose in the shortest time, viz., 10 days, by the action of anaerobic bacteria. The quantity of water compared to hide should not be greater than 10:4, preferably less. The soak liquor from experiments under aerobic conditions (with a current of air passing during the experiment) were thick and difficult to filter, whilst that from experiments under anaerobic conditions (atmosphere of carbon dioxide) was clear and easily filtered. The number of bacteria per c.c. was less in the anaerobic method than in any of the others. Soaking and hair loosening can be effected in one operation.
—D. W.

[*Hides;*] *Versatility of a plumping method* [*for* ——]. H. C. Reed. J. Amer. Leather Chem. Assoc., 1922, 17, 460—482.

Two grms. of dry hide powder was weighed into a wide-mouthed 6-oz. bottle fitted with a rubber stopper. 100 c.c. of the solution to be tested was added, the contents shaken and allowed to stand for 20 hrs. The solution not retained by the hide powder was filtered off through a cotton plug into a measuring cylinder. The plumping action was expressed in ratio to the plumping action of distilled water as unity. Curves are given showing the plumping action of different acids at different concentrations. Sulphuric acid is differentiated from hydrochloric acid and both from organic acids. The plumping ratio of caustic soda, the repressive action of salts on plumping by lactic acid, sulphuric acid, and caustic soda, and on hide powder swollen by water, are shown graphically. Experiments have been carried out on the plumping ratios of tanning materials, the effect of tannin on hide powder plumped with acid, and the effect of mixtures of tannin and acid on hide powder swollen by water.—D. W.

Goran (Ceriops Roxburghiana) bark: optimum temperature and state of sub-division for maximum extraction. J. A. Pilgrim. J. Soc. Leather Trades' Chem., 1922, 6, 255—260.

In Dhavale and Das's work (J., 1921, 709 A) the ground bark was sifted whereas in practice the coarsely ground material contains some fine powder which is very rich in tannin. The solutions analysed by Dhavale and Das were not of analytical strength. The author has made certain corrections which indicate that the 60-mesh material yields most tannin.—D. W.

Tannin analysis. III. V. Kubelka and B. Köhler. Collegium, 1922, 167—176. (*Cf.* J., 1921, 312 A; 1922, 773 A.)

Experiments show that the results given by the official method of tannin analysis vary considerably according to the concentration of tannin in solution, whereas those obtained by the filter bell method are almost independent of that factor. The differences between the results of the two methods are not caused by the stronger chroming of the hide powder. The official shake method depends on an equilibrium condition which cannot give the best results. The authors favour the filter bell method. —D. W.

Synthetic tans; Comparative observations of the tanning properties of vegetable tanning materials, synthetic tans, and mixtures of vegetable tanning materials with ——. S. Kohn, J. Breedis, and E. Crede. J. Amer. Leather Chem. Assoc., 1922, 17, 450—460.

Hide substance will absorb much smaller quantities of "syntans" than of vegetable tanning materials, but if mixed in certain proportions both act cumulatively. The active principles of syntans are acids having a higher degree of ionisation than the acids in vegetable tannins and approaching that of sulphuric acid. Syntans can be produced which do not manifest the disadvantages of sulphuric acid. The different syntans can be distinguished by evaporating a sample to dryness in a drying oven at 80° C. Unstable syntans decompose under such conditions and the residue will contain some organic base insoluble in water. The acidity will also have increased. Leathers tanned with syntans show free mineral acid by the Procter-Searle method of determination. To determine free mineral acid the leather should be extracted with water to leach out the acids and Immerheiser's ether method applied to distinguish between sulphonic and sulphuric acids. Another useful test is to soak a piece of muslin in a solution of the syntan and dry it out. Free sulphuric acid will rot the muslin, whilst a stable syntan will not affect its strength.—D. W.

Chrome tannage; One-bath —— with chrome alum. P. Chambard and L. Meunier. Chim. et Ind., 1922, 8, 325—329.

Experiments with basic chrome alum liquors show that for a given basicity the amount of chromic oxide fixed in the skin when it is saturated is independent of the concentration provided that the liquor is renewed several times and sufficient time is allowed. With normal chromium compounds the amount of chromic oxide fixed by the skin when it is saturated diminishes with the concentration. —D. W.

Vegetable-tanned leathers; Determination of water-soluble matter in ——. W. J. Chater and D. Woodroffe. J. Soc. Leather Trades' Chem., 1922, 6, 247—255.

Experiments with the official method of determining water-soluble matter in vegetable-tanned leathers show that it is in error to the extent of 10—30%. An additional litre of percolate should be collected, the water-soluble matter determined in an aliquot portion thereof and added to that determined in the official method. The yield of soluble matter from leathers plotted against time of extraction gives curves of the same type for different leathers, all of which appear to follow closely laws of an exponential type.—D. W.

Gelatin and glue; Evaluation of ——. R. H. Bogue. J. Ind. Eng. Chem., 1922, 14, 435—441.

Commercial gelatin and glue should be evaluated in terms of proportion of pure and unhydrolysed gelatin which is contained in the material. Glue as an adhesive should be evaluated in terms of the strength of the joint made with the material. The glue with the largest amount of unhydrolysed gelatin produces the strongest joint. If the viscosity is kept constant the jelly content and joint strength vary as the jelly consistency, whilst if the latter is constant these properties vary as the viscosity. The jelly consistency and the viscosity bear the same relation to the melting point, and the latter appears to indicate the gelatin content and the joint strength. Most melting point determinations are inexact, but a value for the melting point may be obtained by plotting the curve of viscosity at decreasing temperatures and extrapolating to the temperature where the viscous flow would be zero. The same order of differentiation may, however, be obtained by a single determination of the viscosity at 35° C., using the equivalent of 18 g. of dry glue made up to 100 g. with water. The hydrogen ion concentration of a 1% solution should be measured. The viscosity at 60° C., the jelly consistency, the foam test, the grease test, appearance, and odour should also be determined. The grade designation of the product may be expressed by consecutive numbers, 1 being the lowest, and corresponding to a viscosity of the 18% solution (dry basis) at 35° C. of less than 20 centipoises and each succeeding numerical increase in the designation corresponding to an increase of 10 centipoises.—D. W.

Patents.

Tanning of hides and skins. P. J. C. Margotton. E.P. 184,955, 30.6.21.

Hides and skins which have been worked in a stream and tawed and have been fleshed and pressed, especially hides intended for use in the manufacture of gloves, are worked in a solution containing, *e.g.*, 2 g. of chromic acid and 2 c.c. of sulphuric acid per 50 g. of hides, in 3 l. of water. The solution is contained in a "fulling prism" consisting of a prismatic box of polygonal section rotating about a vertical shaft parallel to its axis. The box is separated into two compartments by a grating inclined to the axis of the prism at an angle of about 60°. Another grating parallel to and near the base of the prism prevents the hides from blocking the end of an aerating pipe leading into the space between the base and the grating. When the hides are completely impregnated with the solution, they are allowed to drain, treated successively with sulphur dioxide and ammonia, washed to remove ammonia and ammonium salts, treated with hot air charged with alcohol vapour, impregnated with oil, heated to 45°—50° C., degreased and dried. Means are provided for recovering sulphur dioxide, ammonia, and alcohol vapour.—L. A. C.

Tanning hides and skins. E. W. Merry, Assr. to Pyrotan Leather Corp. U.S.P. 1,427,221, 29.8.22. Appl., 11.2.19. Renewed 16.5.22.

Hides are agitated in contact with a solution containing a soluble aluminium salt and a soluble pyrophosphate. The temperature is not allowed to exceed 107° F. (42° C.).—D. W.

Leather grease. G.P. 353,222. *See* XII.

XVI.—SOILS; FERTILISERS.

Soil-reaction; Change of —— by manuring. I. S. Osugi and N. Soyama. Ber. Ohara Inst. Landw. Forsch., 1921, **2**, 79—93.

A number of plots were treated with different fertiliser mixtures, and periodic observations of the H-ion concentration of the soil were made by means of 1:10 water-extracts. No regularity was observed in the changes of p_H values due to the fertilisers used, nor was there any correlation between p_H values and crop yields. The only distinct effects were those due to the alkalinity of lime, lime-nitrogen (crude calcium cyanamide), and potassium carbonate. Continuous application of the same fertiliser mixture to the same soil does not cause an accumulation of reaction changes due to the fertiliser. The reaction of irrigation water may modify or obliterate that produced by added fertilisers.—A. G. P.

Colloidal clay [in soils]; Quantitative determination of ——. R. Sokol. Internat. Mitt. Bodenkunde, 1921, **11**, 184—211. Chem. Zentr., 1922, **93**, IV., 704.

The clay, suspended in water, is flocculated with *M*/10 sodium chloride, and the volume of the sediment is measured, immediately, and also after 24 hrs. The ratio of the two values gives the "colloid number." The addition of the salt produces a flocculent precipitate, which contains in addition to colloidal matter all the dust and other coarse suspended matter; the volume of the latter may be determined in a similar manner without the use of salt. Clays were graded by Atterberg's method, and the proportions of coarse and fine particles in grade A (less than 0·002 mm. diam.) estimated from the amount of deposit after 3 and 17 days respectively. Microscopical examination showed that the former had an average diameter of 0·0007 mm., and the latter 0·0003 mm., which values agree well with Stokes' formula. The flocculation method enables the diameters of the various particles to be estimated, whilst the determination of the hygroscopicity, as recommended by Mitscherlich, only gives a rough idea as to whether few or many small particles are present, and gives no evidence as to their dimensions.—A. B. S.

Lime-sulphur mixture. Harukawa. *See* XIXb.

Patents.

Acid phosphate or superphosphate; Apparatus for manufacturing ——. T. J. Sturtevant, Assr. to Sturtevant Mill Co. U.S.P. (a) 1,428,920, (b) 1,428,921, and (c) 1,428,922, 12.9.22. Appl., (a) 19.4.21, (b) 26.4.21, (c) 24.5.21.

(a) A semi-liquid mixture of ground phosphate rock and acid is delivered to a series of containers which are advanced continuously for a sufficient distance to allow the mixture to solidify, the solidified mixture being discharged from the container during transit. (b) A mixture of ground phosphate rock and acid is delivered into the upper end of a den, and passes, on becoming spongy, into a disintegrator disposed below. Means are provided for supporting the materials above the disintegrator. (c) An apparatus for manufacturing superphosphate comprises a den having a fixed floor and rear walls, and roof and side walls which may be moved so as to expose the block of superphosphate formed in the den. The phosphate is fed toward the rear wall of the den to a disintegrator.—J. S. G. T.

Nitrogenous manures; Manufacture of ——. D. Lo Monaco. E.P. 184,833, 7.4.21.

See U.S.P. 1,402,638 of 1922; J., 1922, 151 a. In addition to humus, organic refuse of all kinds (manure, oil-seed cakes, lemon refuse, ground horns and nails, dried blood, chrysalides, bones, leather scrap, cloth refuse) may be treated by the process described. [Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 2662 of 1873 and 4103 of 1875.]

Nitrolim; Process for making granular —— from nitrolim and sulphite-cellulose pitch. A. Mann. G.P. 313,129, 24.1.18.

Pulverised nitrolim and pulverised sulphite-cellulose pitch are mixed and cellulose waste lye is added, in one or more operations, until a plastic mass is obtained, which is then heated on rippling rolls or plates until dry. The product is free from dust. Short-fibred refuse from cellulose and paper manufacture may be added and increase the fertilising value of the mass.—H. C. R.

Liquid manure; Process for making an artificial ——. G. Cyliax. G.P. 355,038, 25.7.19.

Natural liquid manure or a pure culture of the bacteria contained in it is mixed with water, meal from leguminous plants, especially lupins, straw-meal, earth and sodium bicarbonate, and kept for about 48 hrs. at 44°—48° C. This manure encourages the development of useful soil-bacteria. An application of 3 cubic metres per quarter hectare every four or five years is specified.—H. C. R.

Artificial liquid manure; Production of an ——. G. Cyliax. G.P. 355,991, 3.7.21. Addn. to 355,038 (*cf. supra*).

Instead of using natural liquid manure, the product obtained as described in the chief patent is employed to inoculate fresh material.—A. B. S.

Phosphatic fertiliser; Process for making a ——. A.-G. für Anilin-Fabrikation. G.P. 355,180, 12.10.20.

Low-grade phosphate rock is decomposed with nitric acid, and the solution and residue are worked up separately and afterwards united. Whereas phosphate rocks rich in iron and aluminium when decomposed with nitric acid in the usual manner and neutralised, only contain 30—40% of the total phosphate soluble in citric acid, a product is obtained by this process containing 85—90% of its phosphate soluble in citric acid.—H. C. R.

Seeds; Treatment of ——. A. W. Beer. G.P. 354,658, 18.4.20.

A solution of the complex salt, acetamide-mercury chloride, containing 0·05% Hg, renders spores of mildew etc. inactive. The solution is less harmful to the germ centre of the seed than mercury chloride itself and can be applied to oil-seeds not easily treated by other means.—A. C.

Fungicide and insecticide. G.P. 355,829. *See* XIXb.

XVII.—SUGARS; STARCHES; GUMS.

Extraction of sugar from beet molasses by a modification of the baryta process. H. Manoury. Bull. Assoc. Chim. Sucr., 1922, **39**, 413—421.

Barium sulphide (obtained by the reduction of the sulphate by heating with charcoal to 1000°—1200°

C.) is treated with hot water, and the resulting liquor, after filtration, mixed with zinc oxide and heated, the solution of barium hydroxide thus obtained being used for the preparation of barium monosaccharate, which is filtered off in presses. In order to decompose this saccharate cake, it is heated with a solution of zinc sulphate, the solution of pure sugar obtained being worked up as "refined." Regarding the by-products resulting from this method of operating, the zinc sulphide is treated with sulphuric acid to produce the zinc sulphate used for the decomposition of the saccharate cake; while the mixture of barium sulphate and zinc hydroxide resulting from the decomposition of the saccharate cake is mixed with the wash-waters from the process of leaching out the barium sulphide, the barium hydroxide filtered off, and the residue (consisting of zinc sulphide and barium sulphate) treated with sulphuric acid for the recovery of more zinc sulphate. It is stated that this process is in routine operation in a sugar factory in Spain.
—J. P. O.

Explosion of sugar dust, its causes, and prevention. P. Beyersdorfer. Z. Ver. deuts. Zuckerind., 1922, 475—533.

Experiments are described showing that the temperature necessary for the ignition of sugar dust is 410° C. in air, and 371° C. in oxygen, and that these results are influenced considerably by the presence of relatively inert gases, carbon dioxide having a considerably stronger depressing effect than nitrogen. Dust clouds having a concentration less than 17·5 g. or more than 13·5 kg. of sugar per cub. m. of air will not explode. The ignition of sugar dust in air may also be due to an electrical cause, experiments being described demonstrating that when sugar dust is whirled with rapidity through air it gives rise to electrical charges upon both dust and air to the extent of several thousand volts. An "aerosol" is then formed, and when the maximum capacity is reached a discharge with flashing occurs, the stages concerned being the formation of ozone and nitrogen pentoxide, reaction of these gases with the extremely fine dust, and lastly the explosion. Triboluminescence may arise during the disintegration of the sugar in the crushing machines, but the occurrence of this phenomenon cannot give rise to dust explosions. As precautionary measures to be observed in practice, it is advised that dust formation should be reduced to the minimum by effecting disintegration in three stages, the machines recommended being jaw crushers for the preliminary reduction, roller mills for the coarse grinding, and stamping mills for the finest comminution. Bucket elevators, steel (not balata) belts, and dust-tight screw elevators are the most suitable means for the removal of the ground material from the disintegrating machines; while for the withdrawal of the dust a system of wet separation combined with a "cyclone" is the only permissible one, this portion of the plant being decentralised. Wires should be run to earth from all parts of the machines where static electricity is likely to be generated. A certain means of protection against any danger of explosion, whether from thermal or electrical causes, is the gas-tight enclosure of the disintegrating and conveying machines and the displacement of the air within by a relatively inert gas, preferably carbon dioxide, or possibly washed and filtered flue gases.—J. P. O.

Sucrose; Inversion of —— by alkaline copper solution. L. Maquenne. Bull. Soc. Chim., 1922, 31, 799—806.

The author has previously pointed out that the reducing power of sucrose towards alkaline copper solution is not constant but is dependent on the quantity of invert sugar present and on the concentration of the solution (*cf.* J., 1915, 1263; 1916, 268). Canals' results (J., 1922, 608 A) are criticised on the ground that necessary precautions were omitted. Details of the author's method for the determination of reducing sugars in presence of sucrose (J., 1916, 320, 373) are repeated with examples, and tables for calculating the results are given.—H. J. E.

Patent.

Dextrin; Method and apparatus for manufacturing ——. J. J. Merrill, Assr. to Corn Products Refining Co. U.S.P. 1,428,604, 12.9.22. Appl., 23.4.17.

In the preparation of dextrin, heating is carried out in a cylindrical vessel having a door in its side wall and heated by steam pipes arranged adjacent to the side wall, surrounding the major part of the vessel and connected to the source of heat supply by means of headers arranged on opposite sides of the door.—W. H. G.

XVIII.—FERMENTATION INDUSTRIES.

Malt; Speckled ——. F. A. Mason and F. Brown. Bull. Bur. Bio-Tech., 1922, No. 6, 188—191.

A sample of high-dried malt containing 10% of speckled grains or "magpies" has been examined. Contrary to the view expressed by Frew (J., 1898, 330), the speckling of the corns appears to be due to the production of one or more melanoidins in the outer cells of the husks, owing to certain conditions of moisture content and to the nature of the kiln gases, these being determined by the ventilation and temperature. The yields of extract and the specific rotations of the wort obtained from the speckled and from normal grains agree so closely that differences between the endosperm contents in the two cases seem unlikely; the only variable feature is the deeper colour of the wort given by the speckled malt. Except for this increase in tint, the brewing value of a malt is not impaired by the presence of speckled corns.—T. H. P.

Malt; Proteolytic enzymes of ——. H. Lundin. Biochem. Zeits., 1922, 131, 193—218.

The optimum p_H for malt peptase in malt is 3·7—4·3 and in green malt 3·2. There is no malt peptase in malt germ. The malt tryptase of green malt and of malt germ acts best at p_H 6·3. At the optimum p_H neutral salts have little action. The autolytic process in malt is conditioned by the various enzymes present, each having an optimum p_H; the optimum value however for autolysis is 4·3—5·0 in malt, 4·4 in green malt, and 6·3 in malt germ.
—H. K.

Yeast; Influence of mineral spring water on the carbohydrate interchange in ——. P. Mayer. Biochem. Zeits, 1922, 131, 1—5.

The use of Karlsbad water as a solvent for the sucrose in yeast fermentation leads to an increased production of glycerol and a diminished production of alcohol. Solutions made up from Karlsbad salts (powdered form) show this action to a greater degree.—H. K.

Carboligase. V. Union of carbon to carbon biosynthetically in the aliphatic series. J. Hirsch. Biochem. Zeits., 1922, 131, 178—187.

Yeast fermentation in the presence of pyruvic acid leads to the production of optically active methylacetylcarbinol. This "acyloin" condensation is brought about by the carboligase present in yeast.
—H. K.

Fer[illegible]tation; Production of the second and third forms of —— with Saccharomyces Saké, Zygosaccharomyces major, and Zygosaccharomyces salsus. H. Kumagawa. Biochem. Zeits., 1922, **131**, 148—156.

The Japanese yeasts named can decompose sugar according to the second and third modes of fermentation. *Saccharomyces Saké* can withstand a greater proportion of sodium bisulphite than German yeasts, thus giving rise to increased yields, 19·6% of acetaldehyde and 39·2% of glycerol, the alcohol production being only 10%.—H. K.

"Ropiness" in worts and beers; Causation of ——. P. Hampshire. Bull. Bur. Bio-Tech., 1922, No. 6, 179—187.

Application of the method previously described for the isolation of bacteria from beer deposits (J., 1922, 340 A) to a pitching yeast found to produce a ropy and highly acid wort after incubation for five days has resulted in the separation of an organism termed *Bacterium R*, which differs in cultural and physiological behaviour from that described by previous workers for organisms connected with ropiness. The character of the mucilage formed by *Bacterium R* in sterile beer is influenced greatly by the amount of oxygen available. In flasks from which the air had been expelled by means of either hydrogen or carbon dioxide, no surface film was formed on the beer, which retained its original slight turbidity but became permanently ropy. On the other hand, in presence of air a dense film appeared at the surface and a heavy slime at the bottom of the liquid, which also developed pronounced turbidity. A condition essential to the production of a typical clear ropiness is the presence of only a very limited amount of oxygen, the fact that the organism is able to induce this phenomenon when grown together with a yeast in the ordinary way being explained by the displacement of the air by the carbon dioxide resulting from the fermentation. A description is given of the morphological and physiological features of *Bacterium R*, which is compared with the members of the acetic acid group of bacteria or *Acetobacter*. The author is unable to confirm the obligate aerobic character of the latter organisms, which grow well in absence of oxygen, although the production of film is essentially an aerobic process.—T. H. P.

Citric and oxalic acids; Formation of —— in Citromyces cultures on sugar and a process for the quantitative estimation of these acids. W. Butkewitsch. Biochem. Zeits., 1922, **131**, 327—337.

Various kinds of citromyces were cultivated in 10% sucrose solutions deficient in nitrogen content, and calcium carbonate added. The citric and oxalic acids formed were estimated. In each case a large yield of citric acid was accompanied by a low yield of oxalic acid and *vice versâ*. This is attributed to the formation of oxalic acid at the expense of the citric acid. These two acids may be estimated in the presence of each other in an approximately quantitative manner either by extraction of the mixed calcium salts with dilute hydrochloric acid or by dissolving the salts in hydrochloric acid and precipitation of the calcium oxalate alone by addition of sodium acetate solution. The main error falls on the citrate.—H. K.

Citric acid; Utilisation and formation of —— in cultures of Citromyces glaber on sugar. W. Butkewitsch. Biochem. Zeits., 1922, **131**, 338—350.

Citric acid is formed by *Citromyces glaber* when grown either on normal or abnormal media. If citric acid be added to the nutrient media, oxalic acid appears directly. In dilute solutions the "economic coefficient" of the use of citric acid approaches that of dextrose, but in concentrated solutions it falls off. The combination of dextrose with citric acid is stimulative of the productive metabolism.—H. K.

Beer casks; American oak wood used in the construction of ——. P. Groom. J. Inst. Brewing, 1922, **28**, 645—677.

Beer casks made from American oak are classified as satisfactory or unsatisfactory according as they do not, or do, cause rapid deterioration, as regards taste and odour, of the beer contained in them. With casks of both classes investigations have been made, dealing with fungi and bacteria in the wood and beer, the presence or absence of sapwood, the mode in which the staves and end-pieces were cut, and the structure of the wood: its identification, porosity, and chemical constituents in so far as these are identifiable microchemically. The wood used was that described commercially as heartwood, although in many instances it was wood transitional between typical heartwood and sapwood, as it contained a considerable proportion of starch. All the wood used belonged to the most suitable class, that of the "white oaks." Three types agreeing largely with the wood of *Quercus alba* occurred regularly in both satisfactory and unsatisfactory casks; the latter contained a higher percentage of one of the three types and low percentage of doubtful pieces which could not be referred to any type. Tannin was always present in the walls of the constituents of the wood, which thus agreed with the heartwood of the two common European oaks. Starch was generally more abundant in unsatisfactory casks, but did not aid in the identification of the species and did not lead to deterioration of the beer by providing food material for fungi and bacteria in the wood, as such organisms were not found in staves or end-pieces. It is possible that wood may be unsatisfactory because it is from either an inappropriate species, or a tree felled at the wrong season, or heartwood that is too young. Generally the amount of calcium oxalate in the wood varied inversely as that of the starch. The bacteria found, termed tentatively *Clostridium*, *Streptothrix* and *Bacillus aceti*, occurred in the good and the bad beer in approximately equal numbers. Differences either in the artificial or natural seasoning in the country of origin, or in the pickling in this country, may possibly play a part in determining the satisfactory or unsatisfactory nature of the wood or cask.
—T. H. P.

Beer casks; Chemical examination of oaks used in the construction of ——. S. B. Schryver. J. Inst. Brewing, 1922, **28**, 678—696.

The proportions of extractives yielded to benzene, alcohol, and water by various timbers differ widely, but no correlation with the suitability of the timber for making beer casks is apparent. Beer is able to remove appreciable quantities of these extractives from the wood, especially during the first fortnight of contact; this removal occurs more readily with timbers satisfactory for making beer casks, than with those unsatisfactory. The various oaks examined showed wide variations (17 to 30%) in the amounts of matter removable by treatment with 4% sodium hydroxide solution, and there are distinct indications that the more satisfactory timbers yield more to this reagent than the unsatisfactory ones do. The differences between the various timbers as regards their value for cask-making appear to be due, not to any specific extractive imparting a deleterious flavour to the beer, but rather to fundamental differences in the physical and chemical properties of the timbers. The chief product extracted by alkali from American white oak is soluble in hot water to a solution which gelatinises on cooling, and has the properties of the hemicelluloses.—T. H. P.

Fusel oil from sweet-potato brandy. I. E. Yoshitomi, R. Soejima, and M. Imoto. Yakugakuzasshi (J. Pharm. Soc. Japan), 1922, No. 486, 661—666.

A SAMPLE of fusel oil from sweet-potato brandy, light brownish-yellow in colour, was fractionally distilled. The part distilling below 145° C. was composed of 46·5% of alcohol (or 10·5% of the original oil), 19·7% of water (4·45%), and 33·4% of amyl alcohol (7·79%). The residue boiling above 145° C. (10·6%) was saponified, and the presence of palmitic acid (5% of the oil) and lower fatty acids (1·77%) was detected. The acids are present as amyl esters in the oil.—K. K.

PATENTS.

Aeration of brewers' wort and other liquors; Process and apparatus for the ——. F. Bryant. E.P. 184,860, 18.5.21.

IN the normal methods of aeration, air is introduced at the bottom of the fermenting liquor and bubbles through and escapes freely at the top, resulting in considerable losses of the spirit produced. The modified process consists in introducing the air in the form of extremely minute bubbles, which are practically completely absorbed during their passage through the liquid. The apparatus consists of channels or chambers of porous stone or other foraminous material situated at the bottom of the fermenting vessel and into which air is led at a pressure above atmospheric, passing through the porous material into the surrounding liquor.
—W. H. G.

Butyl alcohol and acetone; Process for producing —— *by fermentation.* G. D. Horton, Assr. to E. I. du Pont de Nemours and Co. U.S.P. 1,427,595, 29.8.22. Appl., 6.9.19.

ACETONE and butyl alcohol are produced by fermenting a sterilised grain mash with *Bacillus acetobutylicum* without positively excluding sterilised air from the mash.—L. A. C.

Distilling process. Distilling apparatus. Apparatus for distilling. Process for distilling. E. J. Winter, Assr. to U.S. Industrial Alcohol Co. U.S.P. (A) 1,427,885, (B) 1,427,886, (C) 1,427,887, and (D) 1,427,888, 5.9.22. Appl., 13.6.18.

(A) AQUEOUS alcohol is distilled, the vapours being passed through a rectifier maintained under reduced pressure and at a temperature lower than the boiling point of absolute alcohol corresponding to the pressure used. The alcohol issuing from the top of the rectifying column is condensed. (B) Apparatus for working the above process, consisting of a still, and a long tubular rectifier with means for maintaining it at a predetermined temperature and under reduced pressure. (D) Aqueous alcohol of strength 20% or lower is distilled, the vapours being caused to come into contact with relatively moving bodies of mixed alcohol and aqueous condensate. The products from this separation are treated in a column rectifier. (C) A reduced pressure separator, in which vapours are constrained to follow a tortuous path, an unobstructed passage being provided for condensate. External means for refractionating the products in interconnected regions of a column rectifier maintained under reduced pressure are provided.—W. H. G.

Yeast; Process for making pressed —— *from beet juice.* F. Sailer. G.P. 355,596, 4.9.19.

THE juice is obtained by extracting the sliced beets in a diffusion battery. The juice coming from the first battery is passed through a second battery also filled with sliced beets. This has the effect of further enriching it with nutritive material which still remains in the raw material after the first diffusion and is of value for the preparation of yeast. The juice obtained is only slightly coloured. It contains, in addition to the sugar, the proteins and nutritive salts of the beet. The juice is subjected to the usual lactic fermentation after the addition of malt or malt-germs and is then sterilised. In addition to alcohol a pressed yeast of good quality can be obtained from it.—H. C. R.

[Fermentable] sugars from substances containing cellulose; Process for obtaining ——. A. Classen, Assr. to The Chemical Foundation, Inc. U.S.P. 1,428,217, 5.9.22. Appl., 21.6.19.

SEE E.P. 142,480 of 1920; J., 1921, 405 A.

Alcohol fuel. E.P. 184,607. *See* IIA.

XIXA.—FOODS.

Flour; Decomposition of hydrogen peroxide as a means of determining the degree of extraction of ——. D. Marotta and R. Kaminka. Giorn. Chim. Ind. Appl., 1922, 4, 249—251.

THE hydrogen peroxide test (*cf.* Marion, J., 1920, 796 A) has been applied to a number of flours of different origins and of 100, 90, 80, 70, and 60% extractions. The results show that, taken alone, this test gives no indication of the degree of extraction of a flour. Such an indication is, however, obtainable when the original grain is also available, since flours of various percentage extractions may then be prepared and the test applied to these also. In contact with hydrogen peroxide, flour from old or damaged grain yields little, if any, oxygen. Since such flour is also unsuitable for panification, it is possible that the catalase of flour exerts some function during this process.—T. H. P.

Flour; Determination of the acidity of ——. M. Arpin and M. T. Pecaud. Ann. Chim. Analyt., 1922, 4, 262—266.

MACERATION of the flour with 90% alcohol gives more regular results than maceration with water, as the alcohol prevents any further fermentation and gives the actual acidity at the time of sampling. The only two indicators found suitable were turmeric and phenolphthalein, of which the former gave the best results. Three series of experiments were carried out with three different kinds of flour to compare the results obtained. In each case both aqueous and alcoholic extraction were employed and the two indicators mentioned. The titrations were made with $N/50$ aqueous-alcoholic potassium hydroxide in the case of the alcoholic extract and aqueous potassium hydroxide in the case of the aqueous extracts. The maceration was continued for 19 days and tests carried out at intervals during this period. When alcoholic extraction was employed with turmeric as indicator, the acidity remained almost constant over the whole period. With phenolphthalein a slight increase in the values occurred. With aqueous extraction a very marked increase of acidity with the period of maceration occurred in all cases and the results obtained were much higher than in the case of alcoholic extraction. Carbon dioxide was evolved during the course of maceration with water.—H. C. R.

Corn [maize]; Characteristic proteins in high- and low-protein ——. M. F. Showalter and R. H. Carr. J. Amer. Chem. Soc., 1922, 44, 2019—2023.

A CONSIDERABLY larger part of the protein is present as zein and globulins in maize of high nitrogen content than in that of low nitrogen content;

the zein and globulins have been formed at the expense of the amides, albumin, and glutelin. The embryo constitutes about 15% of the total weight of maize corns of high nitrogen content, whereas Yellow Dent maize (low in nitrogen) of the usual composition has only about 11% of embryo. Zein is the protein present in most variable amount, averaging 50·28% in maize of high nitrogen content and only 31·85% in that of low nitrogen content. The protein of popcorn of high nitrogen content is particularly rich in zein, averaging 57·24%. The total nitrogen content appears to determine the amounts of the various proteins. The amino-nitrogen in the filtrate from the bases is higher in the maize of high nitrogen content than in that of low nitrogen content. The diamino acids constitute approximately twice as great a percentage of the total nitrogen in maize of high nitrogen content as in that of low nitrogen content.—H. W.

Milk; Physical and chemical changes of —— during pasteurisation. A. F. Weinlig. Forsch. Geb. Milchwirtsch. u. Molkereiwes., 1922, **2**, 127—169, 175—205. Chem. Zentr., 1922, **93**, IV., 593—594.

Equal quantities of milk were heated in round-bottomed flasks of 3 l. capacity, so that 800 c.c. of milk finally remained. The heating was carried out on the water-bath with occasional careful shaking. The time taken to warm up and cool down was not reckoned in the time of pasteurisation. The temperatures used were between 60° and 80° C. Careful pasteurisation accelerates the separation of cream, but if a certain temperature is exceeded the separation is delayed. This critical temperature depends on duration of heating. If the milk is only heated for a few seconds the critical temperature may be above 75° C., but if the duration of heating is ½ hr. the critical temperature is 63°—64° C. In judging the rate of separation, in addition to the amount of cream separating in 24 hrs., the fat content of the cream should also be determined. The fat content of the cream separating in 24 hrs. is at first decreased by increasing the temperature of pasteurisation, but does not usually fall as low as the value for raw milk. By further increase in the temperature of pasteurisation it is again markedly increased. These changes in the creaming of the milk are primarily caused by changes in the composition of the skin of albuminous colloid around the fat globules; the concentration and tenacity of this skin are increased by careful pasteurisation, but considerably diminished at higher temperatures. The viscosity of milk is decreased by pasteurisation at 60°—65° C., but less so by treatment at higher temperatures, and after treatment at 80° C. the viscosity usually exceeds the value for raw milk. The decrease is probably caused by changes in the casein, and the increase at higher temperatures by vaporisation of water, coupled perhaps with changes in the albumin. A definite influence on the sp. gr. of milk could not be ascribed to pasteurisation. The acidity of milk is reduced by pasteurisation, but to different degrees in different samples. The albumin content of the milk is strongly influenced by the temperature and duration of pasteurisation. By treatment at 60° C. for ½ hr. on an average 8·5% of the soluble albumin becomes insoluble, but the amount varies greatly from sample to sample. By treatment at 80° C. for 1 min. 40% of the soluble albumin became insoluble. The decomposition of the casein is illustrated by the altered behaviour of milk on the addition of rennet. Milk treated at 60° C. for ½ hr. has its coagulation by rennet delayed by 10·2%, while the time of coagulation of milk treated at 80° C. for 1 min. is increased by 32·6%. The changes in the casein are partly due to the precipitation of calcium and magnesium salts.—H. C. R.

Rennet; Chemical action of ——. G. S. Inichoff. Biochem. Zeits., 1922, **131**, 97—108.

On addition of rennet to milk or casein solutions under various conditions, there is no appreciable increase of acidity. Peptonisation does not therefore occur. The action of rennet is purely physical, the formation of paracasein being due to a change in the degree of dispersity of the solution under the influence of the enzyme and in presence of divalent ions and hydrogen ions.—H. K.

Margarine; Water-content of ——. K. Brauer. Chem.-Zeit., 1922, **46**, 834.

The determination of the water-content of samples of margarine taken from different parts of the same packets shows that enormous variations occur. Samples taken from the outside of the packet often contain as much as 7% less water than samples taken from the middle of the same packet. It follows that only analyses based on average samples taken from a whole packet can be of any value. The low water-content of the outer layers is ascribed to evaporation and absorption of water by the paper wrappings.—H. C. R.

Antineuritic vitamin; Further experiments on the isolation of the ——. A. Seidell. J. Amer. Chem. Soc., 1922, **44**, 2042—2051. (*Cf.* Seidell, J., 1922, 191 a.)

The preparation of the vitamin solution is modified in that, instead of subjecting the fresh yeast to autolysis and filtering the thick, slimy liquid thus obtained, the yeast is treated for a few minutes with boiling water and the mixture is then centrifuged. The aqueous solution thus obtained contains a greater proportion of the total vitamin than is present in the filtrate from autolysed yeast and, in addition, is free from adenine and other products of autolytic decomposition. The vitamin is adsorbed from its acid solution by fuller's earth (*cf.* Seidell, U.S. Pub. Health Repts., 1922, **37**, 801) thus giving an activated solid which is extracted with barium hydroxide solution and the barium eliminated by addition of sulphuric acid. The extract is treated with saturated lead acetate solution and filtered. The filtrate is freed from excess of lead by means of hydrogen sulphide and concentrated by distillation under diminished pressure (the treatment with lead acetate prevents the otherwise excessive foaming during distillation). The residue is precipitated successively with silver nitrate and ammoniacal silver nitrate. Approximately one-third of the solids of the extract is precipitated as silver compounds and these contain somewhat more than one-half of the antineuritic vitamin. The incomplete precipitation of the vitamin is attributed to the considerable solubility of its silver compound. The vitamin fractions are quite stable both in solution and in the dried condition. They dialyse almost completely through a collodion membrane and physiological tests show that all of the vitamin is in the diffusate, thus indicating that the vitamin molecule is of relatively simple constitution. Using nitrogen estimations as a criterion of purity, the conclusion is drawn that the highly active fractions contain vitamin and one or more analogous nitrogenous bases and that these cannot be separated advantageously from one another by silver precipitation.—H. W.

Vitamin B; Preparation and properties of ——. S. Tsukiye. Biochem. Zeits., 1922, **131**, 124—139.

The author has prepared an active vitamin B preparation from an 80% alcoholic extract of 30 kg. of rice polishings and from an aqueous extract of 4 kg. After purifying with basic lead acetate, the vitamin is precipitated by phosphotungstic acid, the precipitate decomposed by baryta, and the silver precipitate obtained in acid solution removed. Baryta is added till the solution is weakly alkaline and the precipitate containing the vitamin collected and freed from silver. The vitamin is precipitated by tannin and picric acid and the picrate is soluble in alcohol and hot water. The vitamin is not soluble in the neutral state in alcohol above 80% strength, but is easily soluble in acidified alcohol or water.—H. K.

Amino-acid nitrogen. Riffart. *See* XXIII.

Patents.

Fat-containing granular products; Process for rendering —— impalpable. J. Eppenberger. E.P. 176,305, 14.4.21. Conv., 1.3.21.

Granular products containing fat, such as almonds, coffee beans, cocoa beans, and the like, are fed from a hopper into a disintegrator consisting of two rotating rollers of which one can move away resiliently from the other to allow large pieces of material to be drawn between. The material then falls by gravity through a series of smooth rollers in pairs so driven that the two rollers in each pair rotate at different velocities. To reduce the number of rollers required, these may be vertically staggered and so arranged that each roller, except the highest and lowest, by contact with the rollers immediately above and below it, provides two grinding passes. The rollers have a surface which is either fluted or sufficiently porous to grip the material and draw it between them. The temperature of the rollers is raised by the friction between their surfaces, and can be adjusted as desired by admitting steam or water into the rollers through the hollow axes. Adhering particles are removed from the rollers by scrapers, and means are provided for adjusting the pressure between each pair of rollers.—L. A. C.

Milling flour; Method for use in ——. A. W. Woolcott. E.P. 184,837, 18.4.21.

The stock during its reduction from wheat to flour is subjected to moistened air supplied in separate streams to individual machines used in the milling operation, the moisture content of the air being independently regulated in the various streams. The air may be first purified and its temperature may be regulated. Nitrogen peroxide, chlorine, or the like may be added to the air.—H. C. R.

Whey; Process for the extraction of proteids and lactose from ——. D. Thomson. U.S.P. 1,428,820, 12.9.22. Appl., 12.12.21.

See E.P. 173,831 of 1920; J., 1922, 192 A. After neutralising the whey as described, more alkali is added till an alkalinity corresponding to p_H 10·5 is attained, after which the solution is evaporated, the remaining protein coagulated and separated, and lactose recovered by crystallisation.

Vegetable proteid substances; Process of manufacturing ——. S. Satow. U.S.P. 1,427,645, 29.8.22. Appl., 20.8.18.

See E.P. 121,141 of 1917; J., 1919, 263 A.

Sterilising and filling of receptacles with substances such as milk or alimentary liquids; Method of and apparatus for ——. Sterilising milk. N. J. Nielsen. E.P. 185,185, 26.5.21, and 185,221, 31.5.21.

Margarine; Manufacture [consolidating and blending] of ——. Maypole Margarine Works, Ltd., and O. Michelsen. E.P. 185,241, 8.6.21 and 7.1.22.

XIXb.—WATER PURIFICATION; SANITATION.

Lime-sulphur [insecticidal] mixture; Studies on ——. C. Harukawa. Ber. Ohara Inst. Landw. Forsch., 1921, 2, 1—20.

Mixtures containing lime and sulphur in the proportions of 1:1 and 1:2 respectively were compared. Spraying experiments against scale insects showed no difference in effectiveness where quantities of the sprays containing equal amounts of sulphur were used. The reducing power towards permanganate solutions was the same with both sprays. It was noted that in all cases the amount of permanganate reduced at ordinary temperature was one half that reduced in boiling solutions. Lime-sulphur mixture does not possess the power of dissolving the wax of the scale insect. After death of the insect the activity of the oxidase and catalase of the tissue gradually decreases. Living as well as dead scale insects fall from infected trees after spraying with lime-sulphur. The death of the insect may be judged by the change of colour of the insect within a definite time after spraying.
—A. G. P.

Pyrethrum [insecticide] powder. D. Costa. Giorn. Chim. Ind. Appl., 1922, 4, 251—253.

For the determination of the water-soluble extract in finely ground commercial insecticide powder from *Chrysanthemum cinerariaefolium*, the author uses a cylindrical separating funnel, in which are placed, in order, layers of cotton-wool, powdered pumice, powdered pumice mixed with the insecticide, pumice, and cotton-wool. Two hundred c.c. of water is poured slowly into the funnel, 100 c.c. of extract being drawn off and replaced by water after 12 hours; the extraction is complete after two repetitions of this treatment. The percentage of water-soluble extract, calculated on material dried at 100° C., is 22—25, 12—14, and 9—11 for closed flowers, open flowers and stems of pyrethrum respectively.—T. H. P.

Patents.

Sewage; Treatment of —— in underdrained settling basins. K. Imhoff. E.P. 184,742, 19.12.21.

Sewage sediment deposited in basins with an underdrained bottom is dried rapidly and without odour by using only a shallow depth of liquid, *e.g.*, about the same as the thickness of the final layer of the sludge, *i.e.*, 4—12 ins. Preferably a number of basins are so arranged that sewage can be run into one at a time, the one in use being baffled to hold back the sediment. Sufficient sewage to deposit the desired depth of sludge is run through the basin with the drain pipe closed, and the overflow passes through another basin. As soon as sufficient sludge is deposited in the first basin, the drain pipe is opened and the sludge is allowed to drain and dry, the supply of water being diverted to the basin which previously received the overflow.
—L. A. C.

Removing oxygen from liquids; Process and apparatus for ——. Union Thermique. E.P. 181,309, 7.9.21. Conv., 8.6.21.

A tank is provided with a horizontal perforated diaphragm on which is placed deoxidising material (*e.g.*, iron filings) and is also provided with vertical non-perforated diaphragms which extend from the horizontal diaphragm alternately to the bottom and top of the tank, so that when water is admitted to one side of the tank and exhausted at the other, it will pass through the deoxidant several times. The spaces above the horizontal diaphragm are left quite large so as to form storage chambers for a reserve of partly treated water, and the top of the tank is covered and provided with removable water-sealed caps for access to the interior. Cleaning jets may be provided within the tank for cleaning the deoxidant and removing sediment.—B. M. V.

Fungicide and insecticide. Farbenfabr. vorm. F. Bayer und Co. G.P. 355,829, 16.4.15. Addn. to 349,870 (J., 1922, 516 A).

Ethers of hydroaromatic alcohols, such as cyclohexyl methyl ether, with or without other additions (*cf.* G.P. 349,871; J., 1922, 516 A) are used. These ethers can be used either in the liquid state or in the form of vapour, or in the same way as the hydroaromatic ketones, such as cyclohexanone, specified in the main patent.—H. C. R.

Sterilising air; Method of ——. A. Wolff. U.S.P. 1,423,704, 25.7.22. Appl., 3.11.20.

See G.P. 346,201 of 1921; J., 1922, 230 A.

Refuse destructor furnaces. J. S. Atkinson, and Stein and Atkinson, Ltd. E.P. 185,492, 2.6.21, 20.7.21, 2.3.22.

Base-exchanging bodies. E.P. 159,196. *See* VII.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Meconic acid; Estimation of —— *in opium.* H. E. Annett and M. N. Bose. Analyst, 1922, 47, 387—391.

Five grms. of opium is triturated with 50 c.c. of water, and after standing overnight, 40—45 c.c. of the filtered liquid is treated with 6 c.c. of 50% calcium chloride solution and allowed to stand for a further 24 hours. The precipitate, consisting of calcium meconate and sulphate, is filtered off, washed till the washings are colourless, and dissolved in 15 c.c. of 1·25 *N* hydrochloric acid. After standing for 24 hours pure meconic acid will have separated in white scales. It is filtered off, washed twice with 0·5 c.c. of distilled water, dried over sulphuric acid, and weighed as $C_7H_4O_7,3H_2O$. To the weight found 0·0213 g. is added to correct for the solubility of meconic acid in 15 c.c. of 1·25 *N* hydrochloric acid, and the figure obtained is multiplied by the factor depending on the amount of the aliquot portion of the solution taken for analysis, and then by the factor 10/9, to correct for the amount of meconic acid unprecipitated by calcium chloride. —G. F. M.

Cevadine. I. A. K. Macbeth and R. Robinson. Chem. Soc. Trans., 1922, 121, 1571—1577.

Cevadine, $C_{32}H_{49}O_9N$, has already been shown to be the tiglate of an alcohol, cevine, $C_{27}H_{43}O_8N$. The presence of a second hydroxyl group in cevine has now been demonstrated by the preparation of *o*-nitrobenzoylcevadine and di-*o*-nitrobenzoylcevine. In the hydrolysis of cevadine with potassium hydroxide the cevine is obtained as a potassium salt, from which cevine was isolated by passing carbon dioxide through the aqueous solution. The formation of this salt probably points to the presence of a lactone ring in cevine, as this substance exhibits no phenolic character. Cevine is lævo-rotatory $[\alpha]_D^{17} = -15·36$ (in methyl alcohol). By distillation with soda-lime in a stream of hydrogen a small yield of a base which appeared to be identical with *l*-coniine was obtained.—G. F. M.

Elsholtzic acid; Constitution of ——. Y. Asahina and S. Kuwada. Yakugakuzasshi (J. Pharm. Soc. Japan), 1922, No. 485, 565—579.

Furane-2-methyl-3-carboxylic acid, prepared by the method of Benary (Ber., 1911, 44, 493), was oxidised by the method of Hill and Sawyer (Ber., 1894, 27, 1569) to furane-2.3-dicarboxylic acid, colourless prisms, m.p. 221° C. The latter gave a dimethyl ester, white crystals, m.p. 34° C., and a monoanilide, light yellowish-brown needles, m.p. 169°—170° C., and was identical with the acid obtained from elsholtzic acid, the constitution of which is therefore furane-3-methyl-2-carboxylic acid.—K. K.

Heliotropin; Preparation of —— *from isosafrol by means of ozone.* S. Nagai. Kôgyô-Kwagaku Zasshi (J. Chem. Ind. Japan), 1922, 25, 631—652.

The author has studied the ozonisation of isosafrol by ozonised air containing 2—3·5% of ozone, the decomposition of isosafrolozonide, and the preparation of heliotropin. The ozonide is easily prepared by passing ozonised air into a solution of isosafrol (10 g.) in a perfectly dry solvent (100—150 g.), such as carbon tetrachloride, tetrachloroethane, chloroform, glacial acetic acid, toluene, or xylene. The product is separated by distilling off the solvent *in vacuo*, or by diluting with 2—3 vols. of petroleum ether having nearly the same boiling point as the solvent. When a mixture of 1 vol. of the solvent and 2—3 vols, of petroleum ether is used, the ozonide produced is precipitated and the process may be made nearly continuous by adding isosafrol from time to time. The ozonide, a deep reddish-brown, viscous oily substance having a characteristic odour, is easily decomposed at the ordinary temperature and by warming its solution at 40°—50° C., or stirring it with water, the products being acetaldehyde, heliotropin, piperonylic acid, and a dark brown resinous substance. When the ozonide solution is stirred with excess of 35—36% sodium bisulphite solution, the ozonide is decomposed by water, the freed oxygen is reduced by the reagent, and the heliotropin produced separates as a crystalline addition product, the yield being 85%. —K. K.

Silver-albumose; Estimation of silver in ——. G. Maue. Pharm. Zeit., 1922, 67, 751—752.

The method previously given (J., 1918, 782 A) is not always applicable owing to variations in the quality of commercial silver-albumose preparations. The following process is now recommended. 1 g. of silver-albumose is dissolved in 5 c.c. of water and 5 c.c. of nitric acid (sp. gr. 1·4) and heated to boiling until a clear solution is obtained. After cooling 35 c.c. of potassium permanganate solution (1:20) is added in small portions and the solution again boiled over a small flame. After boiling for 15 mins. the solution is decolorised by sufficient powdered oxalic acid, diluted with 50—100 c.c. of water and titrated with *N*/10 ammonium thiocyanate solution, using ferric ammonium sulphate solution as indicator.—H. K.

Silver-albumose; Estimation of silver in ——. J. Herzog. Pharm. Zeit., 1922, 67, 802—803. (*Cf. supra.*)

One grm. of the silver-protein complex is dissolved in 10 c.c. of water and 10 c.c. of strong sulphuric acid added in a thin stream. 2 g. of finely divided potassium permanganate is then added gradually with vigorous shaking. After keeping for 15 mins., the solution is diluted with 50 c.c. of water and the excess of permanganate or peroxides of manganese removed by addition of small portions of ferrous sulphate. Ferric ion is thus formed which acts as indicator in the subsequent titration with *N*/10 ammonium thiocyanate solution.—H. K.

Hexamethylenetetramine; Catalytic synthesis of ——. L. E. Rombaut and J. A. Nieuwland. J. Amer. Chem. Soc., 1922, 44, 2061.

Hexamethylenetetramine is formed in small amount when a mixture of carbon monoxide,

hydrogen, and ammonia at atmospheric pressure is passed over a mixture of equal parts of reduced, finely-divided nickel and very pure diatomaceous earth heated to 250°—280° C. A trace of ammonium cyanide and a relatively large quantity of ammonium carbonate are also produced, the latter resulting from the reaction, $2CO \rightarrow C + CO_2$, since a deposition of carbon is noticed in the reaction chamber. The effectiveness of a catalyst in this synthesis depends on its ability to form an unstable carbonyl, for reaction does not occur when the nickel catalyst is replaced by platinised asbestos.
—H. W.

Butadiene; Formation of —— from ethylene. J. E. Zanetti, J. R. Suydam, jun., and M. Offner. J. Amer. Chem. Soc., 1922, **44**, 2036—2041.

The formation of butadiene from ethylene has been studied at temperatures varying from 550° C. to 850° C. The temperature of maximum formation is 750° C., above which the decomposition of ethylene into methane, hydrogen, and carbon occurs very rapidly. The maximum quantity of ethylene transformed into butadiene is 0·0096 litre per litre of ethylene. It is suggested that the formation of aromatic hydrocarbons from ethylene takes place, in part at least, through the intermediate production of butadiene. Attention is directed to the formation of an aliphatic hydrocarbon of higher boiling point from one of a lower boiling point and to the possible rôle of similar reactions in the cracking of oils.—H. W.

Alcohols; Electrolytic oxidation of ——. I. Isoamyl alcohol. S. Koizumi. Mem. Coll. Sci. Kyoto Imp. Univ., 1922, **5**, 359—382.

The material used in the investigation had b.p. 130°—132° C., sp. gr. 0·811, and was obtained by the fractional distillation of technical isoamyl alcohol; it possibly contained a small quantity of optically active amyl alcohol. The experiments were made in a divided cell, the cathode being of nickel gauze or sheet lead and the cathode solution being sulphuric acid or dilute aqueous sodium hydroxide. Lead peroxide acted most effectively as anode material. The products of the oxidation were isovaleric acid, isovaleraldehyde, and carbon dioxide. In alkaline solution the acid formed was always accompanied by the aldehyde; the current efficiency increased with decreasing current density. In sulphuric acid solution, aldehyde was produced only when the current density fell below 1 amp. per 100 sq. cm. For the electrolytic preparation of isovaleric acid the most suitable current density was 1—1·4 amp. per sq. dcm. if the solution remained stationary and about 2 amp. per sq. dcm. when it was stirred. The most favourable concentration of sulphuric acid was 10—20%. The temperature should be maintained below 30° C. Vanadium pentoxide, cerium sulphate, potassium bichromate, and ferrous sulphate were found to be effective oxygen carriers. A convenient and rapid electrolytic method for preparing isovaleric acid without involving the use of a diaphragm is described in detail.
—H. W.

Formic acid; Catalytic decomposition of ——. E. Müller. Z. Elektrochem., 1922, **28**, 307—310.

The catalytic decomposition of formic acid in solution into carbon dioxide and hydrogen by finely-divided rhodium as observed by Deville and Debray in 1874 was found to be due to impurities in the rhodium, most probably osmium. The decomposition takes place rapidly with osmium reduced from the hydrated dioxide by hydrogen at 150° C.; thus, 0·3 g. of the metal in 10% formic acid solution containing 3·4% of sodium formate causes the evolution of 2 c.c. of gas per second, the liquid eventually becoming alkaline due to the decomposition of the sodium formate into sodium carbonate and hydrogen. Any conditions that tend to cause the osmium to become colloidal increase its activity, while the higher the metal has been heated the less active it becomes. Neither pure rhodium nor pure platinum have any action, but the addition of very small quantities of osmium to either metal imparts a considerable catalytic activity.—A. R. P.

Piperitone; Position of the double linkage in ——. II. A. R. Penfold. Perf. Essent. Oil Rec., 1922, **13**, 322—323.

From the products of the oxidation of piperitone with neutral potassium permanganate, in addition to diosphenol, the following acids were isolated: α-hydroxy-α-methyl-α-isopropyladipic acid, m.p. 143·5° C., α-isopropyl-γ-acetylbutyric acid, identified by its semicarbazone, m.p. 158° C., and α-isopropylglutaric acid, m.p. 94°—95° C. The formation of these substances confirms the constitution of piperitone previously put forward, viz., Δ_1-menthenone-3. The best method for the preparation of piperitone hydroxylamino-oxime consists in treating a cold alcoholic solution of the ketone with hydroxylamine hydrochloride in presence of potassium hydroxide. After keeping for a few hours the whole solidifies to a crystalline mass of the oxime in quantitative yield.—G. F. M.

Geraniol content of citronella oil; Determination of the so-called total ——. A. W. K. de Jong and A. Reclaire. Perf. Essent. Oil Rec., 1922, **13**, 319—321.

Numerous samples of citronella oil were analysed by slightly varying methods in order to ascertain the reason for the different results often obtained by different operators. The maximum difference observed was 2·8%, the average difference 0·7%. The influence of acetic anhydride of higher concentration than usual (80%) was negligible, and sodium acetate dried over sulphuric acid did not give better results than the usual re-fused material. The method recommended is to heat 10 g. of the oil, 10 c.c. of 80% acetic anhydride, and 2 g. of sodium acetate for 2 hrs. After cooling, 50 c.c. of water is added, and the excess of anhydride is decomposed by warming and shaking. The acetylated oil is separated, washed with brine until neutral, and dried. About 1·5 g. is then saponified with *N*/2 alcoholic potassium hydroxide, after neutralising any residual acidity. After boiling for 2 hrs. under a reflux condenser the excess of alkali is titrated back with *N*/2 sulphuric acid.—G. F. M.

Sandalwood oil; Properties and preparation of Dutch East Indies ——. A. Rojdestwensky. Perf. Essent. Oil Rec., 1922, **13**, 331—332.

The amount of oil obtainable from Dutch East Indian sandalwood varies from 3·8 to 5·8%. The oil has the following characters:—Sp. gr. at 15° 0·9745—0·9842, $\alpha_D^{28} = -16·4°—18·4°$, santalol content 93·7—98%, soluble in 3—4 vols. of 70% alcohol, $n_D^{28} = 1·5000—1·5013$. The quantity of oil obtainable from a sample of the wood may be ascertained by distilling not more than 0·5 kg. of shavings with water after soaking for 48 hours. After 10—15 hrs. the colour of the oil begins to darken, and after 20 hrs. the distillation is finished. The earlier and later runnings of oil do not differ greatly in properties. For the distillation of larger quantities the wood is cut into pieces about the size of oats, and a steam-jacketed stirring apparatus is employed, saturated steam being blown slowly through the wood.—G. F. M.

Essential oil from Cinnamomum glanduliferum. V. Massera. Riv. It. Essenze e Profumi., 1922, **4**, 41—42. Chem. Zentr., 1922, **93**, III., 502.

From 30 kg. of leaves and twigs there was obtained

180 g. of oil, which was yellow in colour and had a camphor-like odour. The oil had sp. gr. at 15° C., 0·9024; $\alpha_D^{20} = -23° 20'$; $n_D^{20} = 1·4685$; saponif. value, 11·16; acetyl value, 39·76; soluble in 4·5 times its weight of 80% alcohol. Its constituents are pinene and camphene (which, however, could not be confirmed by the preparation of derivatives), cineol (34·2%), and *l*-α-terpineol (about 10%).—H. C. R.

Preparation of oil emulsions, and relationship to tuberculosis. Kramer. *See* XII.

Citric and oxalic acids. Butkewitsch. *See* XVIII.

Citric acid. Butkewitsch. *See* XVIII.

Patents.

Acetaldehyde; Production of —— from acetylene. Soc. Anon. de Prod. Chim. Etabl. Maletra. E.P. 165,085, 19.5.21. Conv., 15.6.20. Addn. to 140,784 (J., 1921, 716 A).

In the synthetic production of acetaldehyde from acetylene in the presence of a mercury catalyst in an acid medium, and of a ferric salt to maintain the catalytic action of the mercury as described in the main patent, the exhausted reaction liquid is regenerated by anodic oxidation after the removal of dissolved acetaldehyde and mercury salts, which would otherwise cause inconvenience owing to amalgamation and disintegration of the lead anodes. The mercury salts are removed from the reaction liquor by means of iron filings, preferably at a temperature not exceeding 70° C. The mercury is deposited at the bottom of the receptacle and the liquid is decanted. The aldehyde is removed by distillation in a vacuum at a temperature not exceeding 50° C., in order to avoid polymerisation to tarry products.—G. F. M.

Compositions of oils or other organic substances; Manufacture of ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 184,534, 11.4.21.

Transparent, colloidal dispersions of essential oils in non-solvents, such as water or glycerin, for use, *e.g.*, as perfumes or flavouring essences, are prepared by treating a mixture of an oil and a large quantity of the non-solvent for several minutes in a colloid mill, such as that described in E.P. 155,836 (J., 1922, 357 A), in the presence of a substance capable of accelerating dispersion. Suitable substances are oil solvents which are wholly or partially miscible with water, such as ketones, alcohols, or esters (*e.g.*, acetin), or substances containing one or more sulphonic groups, such as Turkey-red oil, sulphonaphthenic acids, or purified sulphite-cellulose waste liquor. In preparing perfumes, the odour is improved by the addition of a small quantity of ambergris before treatment in the mill. The dispersions may be converted into concentrated emulsions or gels by ultra-filtration by the process described in E.P. 155,834 (J., 1922, 619 A), or similar concentrated products can be obtained by treating a relatively large quantity of oil with the non-solvent.—L. A. C.

Oxalic acid; Manufacture of ——. J. Y. Johnson. From Badische Anilin- und Soda-Fabr. E.P. 184,627, 7.6.21.

Oxalic acid is prepared by treating wood or other cellulosic material with nitric acid, or nitrous gases and water, in the presence of compounds, *e.g.*, nitrates, of iron, or of the rare earths, or of magnesium. For example, wood is steeped in nitric acid of up to about 65% strength containing, *e.g.*, 2 to 4% of iron as iron nitrate, or didymium or didymium-lanthanum salts, and is treated below 70° C. with a stream of nitrous gases such as those obtained by the catalytic oxidation of ammonia. The product is filtered and cooled, crystals of oxalic acid are separated, and the mother liquor is used for treating a fresh quantity of wood. If magnesium compounds are employed, the reaction is effected at a higher temperature, *e.g.*, finely divided wood is added gradually with vigorous agitation to fused crystalline magnesium nitrate at 160°—170° C., the nitric acid liberated from the magnesium nitrate effecting oxidation of the wood. Alternatively, the wood may be added to other fused magnesium salts, such as the chloride, maintained at about 170°—190° C., sufficient nitric acid to oxidise the wood being added subsequently. The melt is dissolved in dilute nitric acid, and the solution is either cooled to effect crystallisation of the oxalic acid, or the oxalic acid is precipitated as its calcium salt.—L. A. C.

Pharmaceutical compounds. H. Weyland, H. Hahl, and R. Berendes, Assrs. to Farbenfabr. vorm. F. Bayer und Co. U.S.P. 1,427,182, 29.8.22. Appl., 8.8.21. (*Cf.* J., 1922, 786 A.)

A pharmaceutical product, useful as a remedy against scabies, is obtained by the interaction of toluene, sulphur, and aluminium chloride. It is a yellowish oil, b.p. 150°—230° C. at 3 mm. pressure, and it contains 23—25% of sulphur.—G. F. M.

Salicylaldehyde; Process of producing ——. C. C. Loomis, Assr. to Semet-Solvay Co. U.S.P. 1,427,400, 29.8.22. Appl., 23.6.21.

Salicylaldehyde is formed in presence of an alkali sulphite or bisulphite in such excess as to convert the aldehyde, as it is formed, into a bisulphite addition product, from which, after completion of the reaction, it is regenerated by distillation.—G. F. M.

Hydrocarbons of the terpene series; Process for preparing polycyclic ——. Chem. Fabr. auf Actien (vorm. E. Schering). G.P. 353,933, 12.8.20.

Hydrazones of terpene ketones are heated with mercuric oxide in indifferent solvents. Alternatively the double salts of the hydrazones with mercuric chloride are heated in indifferent solvents after the addition of the equivalent quantity of alkali hydroxide. The action of mercuric oxide on the hydrazones produces basic mercury compounds, soluble in water, which on heating in indifferent solvents decompose according to the equation

$$C_{10}H_{16}:N.NH.Hg.OH = C_{10}H_{16} + N_2 + Hg + H_2O.$$

Tricyclene, obtained from camphor-hydrazone and mercuric oxide in alcohol by boiling for 8 hrs., distilling off the alcohol and precipitating with water, has b.p. 153·5° C., m.p. 63·5° C. *d*-Cyclofenchene, from α-fenchone-hydrazone, has b.p. 142·5°—143·5° C., sp, gr. at 20°/4° C. 0·8588, $n_D^{20} = 1·45134$, $[\alpha]_D^{20} = +0·45°$. Apocyclene, from camphenilone-hydrazone, has b.p. (17 mm.) 120·5° C., b.p. 138°—139° C., m.p. 40·1° C., sp. gr. at 45°/4° C. 0·8694, $n_D^{20} = 1·44914$.—H. C. R.

Hydrocoumarins and their derivatives; Process for preparing ——. Tetralin Ges.m.b.H. G.P. 355,650, 9.5.20.

o-Coumaric acid or a substitution product, salt, ester or lactone thereof is treated with hydrogen under pressure and at temperatures not exceeding 200° C. in the presence of nickel catalysts. The usual nickel catalysts activated with small quantities of copper are suitable, or combinations of nickel catalysts with another metal or metallic oxide of the iron group in conjunction with a heavy metal or metallic oxide not belonging to this group, may be used. Examples are given of the hydrogenation of 1.2-coumarin to *o*-hydrocoumarin, of *o*-coumaric acid to *o*-hydrocoumaric acid, which can be converted by distillation into hydrocoumarin, and of the hydrogenation of *o*-methoxycinnamic methyl ester to *o*-methoxyhydrocinnamic methyl ester. The products can be utilised as perfumes and as intermediates in the manufacture of dyestuffs and medicines.—H. C. R.

Nitroamines; Preparation of aromatic ——. L. Haas, Assr. to Soc. Chim. de la Grande Paroisse. U.S.P. 1,423,494, 18.7.22. Appl., 2.9.21.

See E.P. 169,688 of 1921; J., 1922, 647 A.

Dialkyl sulphates; Process of manufacture of ——. L. Lilienfeld. U.S.P. 1,427,215, 29.8.22. Appl., 10.1.21.

See E.P. 143,260 of 1920; J., 1921, 322 A.

Acetaldehyde; Production of —— *from acetylene.* L. E. M. Trevoux, Assr. to Soc. Anon. Prod. Chim. Etabl. Maletra. U.S.P. 1,428,668, 12.9.22. Appl., 31.5.21.

See E.P. 165,085 of 1921; preceding.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Colouring matters; Formation of —— *by oxidation with exposed silver halides.* R. Fischer and H. Siegrist. Phot. Korr., Jan., 1914. Bull. Soc. Franç. Phot. 1922, 9, 247—249.

By employing paraphenylenediamine and its derivatives as developers in the presence of phenols as combining substances, colour images are obtained on dissolving away the reduced silver. With dichloronaphthol the colours obtained are:—On development with paraphenylenediamine—bluish-pink; with paratoluylenediamine—blue; with dimethylparaphenylenediamine—bluish-green. Phenol itself and its halogen derivatives give colours varying from blue to green, but which are not fast. Combinations of aromatic nitroso compounds with substances containing an acid methyl group give a large variety of tones by forming azomethines. Non-cyclic organic compounds containing the double carbon linkage, such as allyl alcohol and cinnamic acid, give with sulphite very rapid coloration. Essential oils of lavender, bergamot, geranium, orange, etc. act similarly. On the other hand, some substances, such as phenol, catechol, tannic acid, picric acid, naphthol, etc., containing hydroxyl groups in the benzene nucleus, act by diminishing the sensitiveness.—W. C.

Colouring matters; Reduction of —— *by light.* R. Ihran. Phot. Korr., Dec., 1913. Bull. Soc. Franç. Phot., 1922, 9, 249—250.

A résumé of work on the action of light on colouring matters in presence of sodium sulphite and an organic compound such as thiosinamine or anethol. The action of sulphite is variable. Some colours like Fuchsin, Malachite Green, Alkaline Blue, etc. are immediately decolorised; others, like Methylene Blue, are very slowly decolorised and exposure to light has no marked effect. The presence of organic materials modifies the action, and contact with paper is sufficient to render the treated colour very slowly sensitive to light. Colouring matters like Erythrosine and Rose Bengal do not change in the dark in the presence of sulphite, but are decolorised in light in the presence of organic compounds. A fourth group of colours, such as nitro- and azo-dyes, are not changed by sulphite in the dark nor in the light. Colours which bleach rapidly in light under the action of an organic-sulphite compound belong to two groups, *i.e.*, thiazines, such as Methylene Blue, and Toluidine Blue, and Eosines, such as Eosine, Erythrosin, Rose Bengal, and Fluorescein. The colours obtained with *p*-nitrobenzyl cyanide with various developers are: With *p*-phenylenediamine—yellowish; with dimethyl-*p*-phenylenediamine—reddish-blue; with diethyl-*p*-phenylenediamine—bluish-red. The colours obtained are not very fast to light, but are fairly stable in diffused light if the reduced silver is not removed.—W. C.

Isocyanines; Brominated ——. K. L. Moudgill. Chem. Soc. Trans., 1922, 121, 1509—1511.

Comparison by the photographic method of Pinacyanol (1.1′-diethylazurine iodide) and its 6.6′- and 5.5′ (or 7.7′)-dibromo-derivatives shows that the introduction of the halogen into the quinaldine nucleus considerably depresses the sensitiveness, which at the same time is shifted towards the red end of the spectrum.—G. F. M.

Cyanine dyes. Mills and Braunholtz. *See* IV.

Patents.

Cinematograph films; Process for coating the surface of ——. A. F. M. Ott. E.P. 184,495, 10.3.21.

The film surface is coated with a mixture of collodion, ether, methylated spirit, and formic acid, and then dried. A suitable proportion for the ingredients is 100 c.c. of collodion (4% in ether-alcohol), 500 c.c. of ether (sp. gr. 0·72), 500 c.c. of methylated spirit (90—96%), and 30 c.c. of formic acid (80%). Formic acid may be replaced by glacial acetic acid or ethyl acetate. This treatment increases the life of the film and protects the surface from scratching. It also increases the pliability of the film and strengthens it against wear at the sprocket holes.—W. C.

X-ray photography; Sensitive film supports for ——. N. E. Luboshey. E.P. 184,519, 2.3.21.

The sensitive emulsion is coated on one or both sides of a support prepared by incorporating a material such as gelatin, glue, gum, celluloid, or collodion with substances such as calcium tungstate, barium platinocyanide, etc., which are used in making intensifying screens for X-rays.—W. C.

Photographic emulsions; Process for intensifying the action of X-rays on ——. C. Schleussner. G.P. 356,378, 28.12.20.

Secondary rays are produced by using salts of those organic or inorganic residues which are capable of dyeing silver bromide either by bathing or addition to the emulsion in the silver bromide complex, their "atomic weights" depending on the object to be attained. For example, an emulsion can be treated with a 1% solution of the strontium salt of Tetrabromofluerescein, or the finished plates may be bathed in a 0·2% solution of this salt.—W. C.

Photographic print-out images; Toning process for ——. Graphikus-Ges. m.b.H. G.P. 356,380, 29.5.19.

Sulphide toning baths are used after previous use of two fixing baths. Selenium toning baths may be applied after the sulphide toning. By using the selenium toning baths, platinum tones are obtained. —W. C.

XXII.—EXPLOSIVES; MATCHES.

Patents.

Smoke; Production of coloured ——. V. M. L. Experimental, Ltd., and O. D. Lucas. E.P. 185,339, 6.10.21.

A smoke-producing unit comprises a mass of self-combustible composition, stable at normal temperatures, and containing volatilisable colouring matter. The composition is packed in a container having orifices so arranged that on ignition the temperature produced is sufficient to volatilise the colouring matter but not high enough substantially to decompose it. The composition is in the form of pellets which may be ignited by quickmatch and gunpowder. The colouring matter comprises about half the composition, the remainder consisting of sugar or flour as a fuel and potassium chlorate.—H. C. R.

Explosive compositions; Process for increasing the sensitiveness and power of ——. W. M. Dehn. U.S.P. 1,428,011, 5.9.22. Appl., 20.8.20.

Diazodinitrophenol is mixed with other explosive matter under water and the mixture is subsequently dried.—H. C. R.

Priming compositions; Manufacture of —— for percussion and friction fuses, detonators, cartridges and the like. E. R. von Herz. G.P. 289,016, 25.7.13.

Complex compounds of metallic hypophosphites with the metallic salts of inorganic acids yielding oxygen are used. For example, a mixture of 95% of lead nitrate-hypophosphite and 5% of antimony sulphide can be used, or 60% of lead nitrate-hypophosphite, 25% of barium nitrate, and 15% of antimony sulphide, with or without the addition of glass powder. These compounds may be used as substitutes for mercury fulminate.—A. G.

Priming compositions; Manufacture of —— for the percussion caps of small arms, ordnance and projectiles, and similar percussion and friction fuses. E. R. von Herz. G.P. 289,017, 30.7.13.

The normal lead compound of trinitroresorcinol is used as the primer, to which, as damping medium, paraffin, vaseline oil, ceresin, etc. may be added and if necessary other explosives which are not detonators. Primers are thus obtained which are safe against dangers from handling, proof against moisture, and which do not attack metals.—A. G.

Incendiary and explosive compositions. B. Benedix. G.P. 300,020, 16.10.15.

An explosive or incendiary composition consists of a combustible organic substance and a sodium peroxide compound out of direct contact with the organic substance. The fuse consists of an inflammable alcohol of low b.p., particularly methyl alcohol and mixtures containing it, and methyl salicylate is employed as the organic substance.
—A. J. H.

Explosives; Production of gelatinous —— proof against firedamp. Dynamit-A.-G. vorm. A. Nobel u. Co., and P. Naoûm. G.P. 353,200, 15.10.20.

Concentrated sulphite-cellulose waste liquor is added to the explosive in moderate quantity. The plasticity and flexibility of the explosive are increased and in consequence the ease with which it can be incorporated in cartridges, and its stability and ease of detonation are unimpaired.—A. G.

XXIII.—ANALYSIS.

Extraction of liquids by immiscible liquids; Apparatus for ——. Fayolle and C. Lormand. Chim. et Ind., 1922, **8**, 273—274.

Two robust forms of extraction apparatus, for use respectively according as the extracting liquid is heavier or lighter than the liquid to be extracted, and in which the former liquid passes through the latter in a succession of drops, are described. A comparatively small volume, from 50 to 100 c.c., of extracting liquid is required. The apparatus is suitable for the extraction of aqueous solutions of caffeine, digitalin, and morphine by chloroform, extraction of fats from soap solutions by ether etc.
—J. S. G. T.

Turbidity standard. H. Bechhold and F. Hebler. Kolloid-Zeits., 1922, **31**, 132—137.

A turbidity standard, for use in nephelometric work, may be prepared by mixing 1/500 g.-mol. of hydroxylamine sulphate in glycerol with 1/500 g.-mol. of barium chloride also in glycerol. The product contains 1/1000 g.-mol. of barium sulphate consisting of particles 2·5 μ diam. and is stable for eight days. A standard sol is prepared by mixing barium nitrate and magnesium sulphate both dissolved in a mixture of glycerol (85 pts.) and isobutyl alcohol (15 pts.). The sol contains 1/200 g.-mol. of barium sulphate and on mixing with glycerol containing 15% of isobutyl alcohol can be brought to the same turbidity as the first-mentioned standard. It is normally three times as turbid as the standard turbidity and its particles have a diameter not greater than 90 $\mu\mu$. It is stable for at least six months.—J. F. S.

Coagulation of colloids; Apparatus for measuring the rate of ——. Wo. Ostwald and F. V. von Hahn. Kolloid Zeits., 1922, **30**, 62—70.

Two forms of apparatus for determining the rate of coagulation of colloidal suspensions are described. In the one, the colloid is contained in one limb of a U-tube about 130 cm. long and 6 mm. diameter, and is balanced hydrostatically against a liquid, such as distilled water, contained in the other limb, which is about 3·7 mm. in diameter. The rate of coagulation is determined by observing the respective heights of the two liquids in the two limbs. In the second form, the colloid is sucked up into a vertical tube about 2 m. long, connected at the upper end with a closed vessel containing gas and immersed in a bath at constant temperature. The rate of coagulation is determined by observing the rise of level of the top of the column of liquid. The use of the instruments is illustrated in the cases of the coagulation of suspensions of silver sulphide, mercury sulphide, gum mastic, and colloidal gold.
—J. S. G. T.

Sedimentation analysis; Technical ——. F. V. and D. von Hahn. Kolloid-Zeits., 1922, **31**, 96—101.

A slightly enlarged form of the Ostwald and Hahn U-tube coagulation measurer (*cf. supra*) may be used to determine the relative size of the particles of commercial preparations. A description of the use of the instrument to differentiate varieties of lampblack is given.—J. F. S.

Potassium binoxalate and the standardisation of alkali solutions. Y. Osaka and K. Ando. Mem. Coll. Sci. Kyōtō, 1921, **4**, 371—375.

The use of anhydrous potassium binoxalate for the standardisation of alkali solutions is recommended, and a method of preparation of the salt from oxalic acid and potassium oxalate described.—J. S. G. T.

Qualitative chemical analysis. V. Macri. Boll. Chim. Farm., 1922, **61**, 417—418.

The following scheme dispenses with the use of sulphur compounds. The hydrochloric acid solution of the substance to be analysed is placed, together with a stick of zinc, in a flask fitted with a gas-delivery tube, which is heated at one part as with a Marsh apparatus; the flask also is eventually heated. The precipitate thus formed may contain silver, mercury, lead, bismuth, copper, cadmium, platinum, gold, tin, antimony, and arsenic, and is separated by filtration, the filtrate being heated to boiling with zinc acetate. The precipitate thus obtained may contain aluminium, iron, and chromium, and the filtrate from this is heated with hydrogen peroxide, which precipitates manganese. The latter is filtered off and the filtrate heated, and treated with zinc oxide in presence of chlorine, nickel and cobalt being thus precipitated. This subdivision into groups does not hold exactly. Antimony and arsenic may be volatilised, at least partially, as hydrides. Chromium may remain in solution if aluminium and iron are not also present, and in such case may be detected by the yellow coloration obtained when the liquid from the manganese precipitate is rendered alkaline. The last two groups may be combined, since treatment with zinc oxide and chlorine precipitates also the manganese. The separations of the metals in the different groups is not described, but it is pointed out that the first group precipitate is best treated successively with hydrochloric acid, nitric acid, and *aqua regia*; the nitric acid may give a residue of antimonic anhydride, which is readily dissolved by hydrochloric or tartaric acid. The presence of mercury may lead to difficulty as the mercury may be deposited on the zinc and thus prevent its further attack. If oxalates, fluorides, silicofluorides, phosphates, borates, or silicates are present together with alkaline-earth metals, the latter may be precipitated completely or partially as oxalates, fluorides, or silicofluorides; the borates and phosphates remain in solution in an acid medium, whilst the silicates are decomposed. The precipitate should be separated, dried, calcined in presence of a few drops of sulphuric acid, redissolved, and again treated with zinc oxide.—T. H. P.

Barium; Approximate volumetric estimation of ——. M. Polonovski. Bull. Soc. Chim., 1922, **31**, 810—813.

To a measured volume of the solution containing barium an equal volume of 80% alcohol is added, followed by excess of a standardised solution of sodium thiosulphate in 30% alcohol. The separation of barium thiosulphate is facilitated by shaking and is complete in about 24—36 hrs. The temperature and alcoholic content of the solution are then noted, the precipitate filtered off, and the excess of sodium thiosulphate in the filtrate determined, the barium being thus estimated by difference. A correction is necessary on account of the small solubility of barium thiosulphate; the author gives a formula for applying the correction in which temperature and alcoholic content of the solution are factors. The method is applicable in presence of other alkaline-earth metals and may be used for estimation of sulphates; in this case excess of barium is added and the amount remaining in solution is determined.—H. J. E.

Alkaline-earth metals; Method of qualitative separation of ——. M. Polonovski. Bull. Soc. Chim., 1922, **31**, 806—810.

The precipitate of alkaline-earth carbonates is dissolved in a few c.c. of dilute acetic acid, the solution boiled to eliminate all traces of carbon dioxide and neutralised with ammonia. An equal volume of 60% alcohol and the same volume of a saturated solution of sodium thiosulphate in 30% alcohol are added; barium thiosulphate is at once precipitated and the solution should be well shaken and allowed to stand for 10 mins. After filtering, the filtrate is freed from traces of barium by addition of 1/10 of its volume of a solution of potassium sulphate (7 g. per litre). A second filtration removes the barium sulphate, and strontium is detected by adding to the filtrate half its volume of a solution of 1 pt. of sodium sulphite in 300 pts. of 30% alcohol. Complete precipitation of strontium is effected by excess of concentrated solution of sodium sulphite or of potassium sulphate. The filtrate containing calcium is acidified with very dilute acetic acid and the metal precipitated with ammonium oxalate.
—H. J. E.

Arsenite; Effect of iron on the iodine titration of ——. F. L. Melvill. J. S. Afr. Chem. Inst., 1922, **5**, 3—5.

The slightly acid arsenite solution, containing not more than 0·1% of iron, is treated with about one-half the volume of standardised iodine solution required to oxidise all the arsenite, and 10 c.c. of saturated sodium bicarbonate solution is then added. The iron is thus precipitated completely as ferric arsenate and no longer interferes when the titration with the iodine solution is continued to completion.—W. P. S.

Lead nitrate; Electrometric titrations with ——. I. M. Kolthoff, Z. anal. Chem., 1922, **61**, 369—377.

Iodides in solutions of not too low concentration may be titrated with lead nitrate solution, and chlorides and bromides do not interfere if the end-point is determined electrometrically. The method is also suitable for the determination of ferrocyanides, oxalates, tartrates, and succinates, and of sulphates, but in the latter case mineral acids, ferric salts, and aluminium salts must not be present. Electrometric titration of pyrophosphates with lead nitrate solution is, however, untrustworthy.—W. P. S.

Ferrocyanides; Electrometric titration of ——. E. Müller and H. Lauterbach. Z. anal. Chem., 1922, **61**, 398—403.

The end-point of the titration of ferrocyanides in sulphuric acid solution by potassium permanganate solution may be determined electrometrically.
—W. P. S.

Aluminium; Experiments on the oxide method of determining ——. J. E. Clennell. Inst. of Metals, Sept., 1922. [Advance copy.] 16 pages.

Results of experiments show that for the hydrolysis of aluminium salts to hydroxide alkali thiosulphate is more satisfactory than phenylhydrazine or iodide-iodate mixture (*cf.* Ibbotson and Aitchison, "Analysis of Non-Ferrous Alloys," 137, 1915). An acid solution of the aluminium alloy or salt (containing about 100 mg. of aluminium) is made faintly ammoniacal after the usual elimination of silica and metals of the copper group, then diluted to 300 c.c., cooled somewhat, and sulphur dioxide passed through until the precipitate is dissolved and the solution colourless. Dilute ammonia in slight excess is added and 5 g. of sodium thiosulphate (if iron or manganese be present, 10—20 c.c. of 1:3 acetic acid is also added), and the solution is boiled for 30 mins., diluted to 500 c.c. with hot 1% ammonium chloride solution, and, after settling, decanted, similar decantations being repeated twice. The precipitate is then collected in the usual way. Re-treatment of the filtrate by thiosulphate usually yields further small amounts of alumina. For large amounts of iron or zinc, double precipitation is necessary; magnesium does not affect the process. Results are generally high, due to adsorbed salts, undissociated aluminium sulphate, and the hygroscopic nature of the ignited alumina, but with suitable blank assays an accuracy, for small amounts of impurities, within ±0·2% is claimed in the case of alums and of about ±0·5% for alloys. The precipitated hydroxide is flocculent and easily filtered, and the method is applicable to basic corrosion products of aluminium oxidation, *e.g.*, those from the action of water on aluminium amalgam, for which the older methods had proved unsatisfactory.—J. R. P.

Carbon dioxide in air; New apparatus for determination of ——. H. Lundegardh. Biochem. Zeits., 1922, **131**, 109—115.

The author has modified Pettenkofer's method by replacing the flask by an open zinc vessel in the form of a beaker with a detachable cover and fitted with three tubes to facilitate withdrawal and introduction of solutions. A larger apparatus on similar lines, suitable for use in the open, is described and illustrated.—H. K.

Nitrogen; A new accelerator for the destruction of organic matter in the Kjeldahl method for the determination of ——. M. and I. Sborowsky. Ann. Chim. Analyt., 1922, **4**, 266—267.

Mercurous iodide accelerates the destruction of organic matter in the digestion with sulphuric acid much more effectively than metallic mercury or other mercury salts. In two experiments carried out with 10 c.c. of sulphuric acid with mercurous iodide 0·7 g. of sugar was destroyed in the time required for the destruction of only 0·1 g. with metallic mercury. A digestion was completed in 50—60 min., which with metallic mercury took 4—8 hrs.—H. C. R.

Incineration by Kjeldahl's method; Apparatus for —— *on the micro scale.* H. Winkler. Chem.-Zeit., 1922, **46**, 785.

The incineration mixture consists of 300 c.c. of phosphoric acid and 100 c.c. of concentrated sulphuric acid, and to each 100 c.c. of this mixture are added 10 c.c. of a 6% solution of copper sulphate and 10 c.c. of water. 2 c.c. of the mixture is used for an incineration, which is carried out in a Jena glass test-tube of special shape, in the upper part of which is a tube, ending underneath in a funnel and above in a bulb, by which arrangement the ejection of liquid at the moment of reaction is avoided. The test-tube is heated by a strong flame, and the process only requires a few minutes for its completion. The resulting small quantities of ammonia are best distilled in a current of steam. —H. M.

Amino-acid nitrogen; Triketohydrindene (ninhydrin) reaction as a quantitative colorimetric method for estimation of ——. H. Riffart. Bio-Chem. Zeits., 1922, **131**, 78—96.

The ninhydrin reaction is suitable for the quantitative estimation of amino-acid nitrogen if certain precautions are taken. All the amino-acids examined, with free amino-groups, with the exception of histidine, give at p_H 6·976 the same standard colour if the solutions be equal in amino-acid nitrogen content, say 10 mg. or less of amino-acid nitrogen per litre. This result is obtained by taking 2 c.c. of such a solution, neutralising with $N/400$ alkali to p_H 6·976 by comparison with phosphate standards and methyl red, adding 2 c.c. of phosphate solution of the same p_H and 1 c.c. of 1% ninhydrin solution, and heating for half an hour in the water bath. The solutions are then diluted to 100 c.c. and compared colorimetrically. Histidine gives the standard colour at p_H 6·24, thus involving a small error where mixtures of amino-acids containing histidine are estimated. Some amines and ammonium salts also give the colour reaction but only in much higher concentrations than 15 mg. per litre.—H. K.

See also pages (A) 797, *Volatile matter in coal* (McLachlan). 798, *Specific gravity of coke* (Schmolke); *Hydrocarbons in gases* (Wollers); *Hydrogen and methane* (Rischbieth). 800, *Paraffin wax and vaseline* (Pyhälä); *Boring and cooling oils* (Kaleta). 803, *Benzol in gas* (Bähr). 806, *Mechanical wood pulp in paper* (Krull and Mandelkow). 810, *Boric acid* (Stocker and Kannappel); *Fluorides* (Smitt). 811, *Nitrites and nitrates* (Miyamoto). 825, *Total fat in soaps* (Jakes). 828, *Tannin analysis* (Kubelka and Köhler); *Water-soluble matter in leather* (Chater and Woodroffe); *Gelatin and glue* (Bogue). 829, *Colloidal clay in soils* (Sokol). 830, *Inversion of sucrose* (Maquenne). 831, *Citric and oxalic acids* (Butkewitsch). 832, *Flour* (Marotta and Kaminka); *Acidity of flour* (Arpin and Pecaud). 832, *Water content of margarine* (Brauer). 834, *Pyrethrum powder* (Costa). 835, *Meconic acid in opium* (Annett and Bose); *Silver-albumose* (Maue, also Herzog). 836, *Geraniol in citronella oil* (De Jong and Reclaire).

PATENTS.

Photometric devices. E.P. 184,853, 17.5.21.

Metal; Means for testing the physical properties [elasticity or hardness] of ——. F. S. J. Pile. E.P. 185,253, 18.6.21.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given; they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court Chancery Lane, London, W.C. 2, 15 days after the date given.

1.—GENERAL; PLANT; MACHINERY.

APPLICATIONS.

Benoit. 26,652. *See* XIX.

Blow, and Renshaw Engineering Works. Extracting and segregating soft penetrable substances from an aggregation of such substances and hard impenetrable substances. 26,117. Sep. 27.

Bowater and Lymn. Preventing formation of scale in boilers, evaporators, etc. 26,867. Oct. 4.

Drey and Hammersley. Refrigeration. 26,623. Oct. 3.

Dried Milk Dairy Products, Ltd., Lampitt, and Palmer. Apparatus for separating and collecting solid particles from air. 26,712. Oct. 3.

Hargraves, Minchin, and Werpe. Means for filtering liquids. 25,899. Sep. 25.

Kemp, and Wellman Seaver Morgan Co. Reversible regenerative furnaces. 27,104. Oct. 6.

Kennedy. Crushing apparatus. 26,533. Oct. 3.

Plausons (Parent Co.), Ltd. (Plauson). Disintegrators. 26,650. Oct. 3.

Rigby. Drying process and apparatus. 26,378. Sep. 30.

Rushen (Fitch). Continuous heating furnaces. 25,974. Sep. 26.

Sharples Specialty Co. Continuously separating substances. 27,184. Oct. 7.

Smidth & Co. Apparatus for separating solid particles from fluids. 26,583. Oct. 2. (Denmark, 3.10.21.)

Stone. Process and apparatus for subliming. 26,881. Oct. 5.

Thornton. 26,052. *See* XIX.

COMPLETE SPECIFICATIONS ACCEPTED.

12,497, 13,303 and 16,186 (1921). Buxton. Drying-apparatus. (186,370.) Oct. 11.

17,520 (1921). Adler. Absorption and purification of gases and vapours. (165,451.) Oct. 11.

18,028 (1921). Adler. Method and apparatus for lixiviation. (166,525.) Oct. 11.

19,299 (1921), 5322 and 10,607 (1922). Spensley. Grinding or disintegrating and mixing machines. (188,462.) Oct. 11.

19,742 (1921). Marks (National Air Dryers, Inc.). Drying apparatus. (186,207.) Oct. 4.

34,874 (1921). Scrive. Drying apparatus. (186,548.) Oct. 11.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Ardern and Sheppard. Fuel briquettes. 26,607. Oct. 2.

Barrs. Production of coke from small coal. 26,948. Oct. 5.

Etorre. Preventing fusion etc. of ash from combustion of powdered fuel. 26,330. Sep. 29. (Fr., 29.12.21.)

Fonblanque and Moeller. Drying and use of peat etc. 26,897. Oct. 5.

Grieve, Livens, and Ruston and Hornsby. Gas-producer plants. 26,783. Oct. 4.

Jackson (Koppers Co.). Removal of hydrogen sulphide from gases. 26,715. Oct. 3.

Koppers Co. Removing hydrogen sulphide from gases etc. 26,701—2. Oct. 3. (U.S., 8.12.21.)

Koppers Co. Purifying gases. 26,708 and 26,730. Oct. 3. (U.S., 8.12.21.)

Lewis. Molecular conversion of hydrocarbons and separation of resultant products. 26,114. Sep. 27.

Masson. 27,170. *See* XII.

Pickard. Production of combustible gases. 25,835—7. Sep. 25.

Plausons (Parent Co.), Ltd. (Plauson). Manufacture of lubricants. 26,276. Sep. 29.

Plausons (Parent Co.), Ltd. (Plauson). 26,189. *See* IX.

Powers and Umpleby. Gas generators. 26,016. Sep. 26.

Robinson. Treatment of asphaltic base oils, bituminous products, and tar. 25,870. Sep. 25.

Schauerman. Candles. 26,455. Sep. 30.

Schauerman. Substitute for petrol. 26,456. Sep. 30.

Smallwood. 26,805. *See* XIX.

Soc. Lyonnaise des Eaux et de l'Eclairage. Gasifying and carbonising coal etc. 26,833. Oct. 4. (Fr., 7.10.21.)

Ward. Desulphurisation of oils. 26,861. Oct. 4.

Complete Specifications Accepted.

9129 (1921). Illingworth. Production of smokeless fuels and coke. (186,085.) Oct. 4.

14,472 (1921). Marshall. Retorts for treating carbonaceous and other materials. (186,375.) Oct. 11.

14,676 (1921). Illingworth. Coking of coal. (186,384.) Oct. 11.

16,874 (1921). Testrup, and Techno Chemical Laboratories, Ltd. Utilising surplus power from hydro-electric plant for preparing peat or similar fuel. (186,137.) Oct. 4.

16,913. (1921). Price, and Minerals Separation, Ltd. Treatment of coal. (186,143.) Oct. 4.

27,625 (1921). Climie. Gas producers. (186,202.) Oct. 4.

III.—TAR AND TAR PRODUCTS.

Applications.

Dodd, Sprent, and United Alkali Co. Manufacture of *p*-dichlorobenzene and chloroanthraquinone. 26,343. Sep. 29.

Masters. Manufacture of *β*-naphthol 2.3.6- and 2.6.8-disulphonic acids. 26,021. Sep. 27.

Masters. Separation of isomeric naphthylamine sulpho acids. 26,022. Sep. 27.

Masters. Manufacture of *α*- and *β*-naphthols. 26,023. Sep. 27.

Robinson. 25,870. *See* II.

Complete Specification Accepted.

24,139 (1921). British Dyestuffs Corp., Baddiley, Payman, and Bainbridge. Manufacture of 1.4-naphtholsulphonic acid. (186,515.) Oct. 11.

IV.—COLOURING MATTERS AND DYES.

Applications.

Bloxam (Akt.-Ges. f. Anilinfabr.). Manufacture of tetrakisazo dyestuffs. 26,116. Sep. 27.

British Dyestuffs Corp., Green, and Saunders. Manufacture of azo dyestuffs. 25,989. Sep. 26.

Complete Specifications Accepted.

18,732 (1921). Durand et Huguenin Soc. Anon. Manufacture of mordant dyeing colouring matters. (166,530.) Oct. 4.

21,454 (1921). Soc. Chim. de la Grande Paroisse. Brown dyestuffs. (169,687.) Oct. 4.

24,456 (1921). British Dyestuffs Corp., Baddiley, Rodd, and Stocks. Manufacture of basic dyestuffs possessing affinity for unmordanted vegetable fibres. (186,517.) Oct. 11.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Dreyfus. Manufacture of products from cellulose derivatives. 27,083. Oct. 6.

Ironside. Treatment of jute. 27,163. Oct. 7.

Marshall. Manufacture of fabrics containing artificial silk. 26,880. Oct. 5.

Milne. Manufacture of paper. 27,017. Oct. 6.

Ros. Treatment of fibrous materials. 26,953. Oct. 5.

Complete Specifications Accepted.

8492 (1921). Acree. Converting wood into sugar and other products. (160,776.) Oct. 4.

8493 (1921). Acree. Converting wood into mucic acid and other products. (160,777.) Oct. 4.

13,850 (1921). Eyrich and Schreiber. Removal of ink from print-paper. (186,372.) Oct. 11.

16,886 (1921). Terrisse and Levy. Obtaining glucose and dextrin from wood. (186,139.) Oct. 4.

16,975 (1921). Steinhilber. Production of cellulose from reeds and similar plants. (179,885.) Oct. 4.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Beck. Colouring cotton. 26,158. Sept. 28.

Schauerman. Composition for fireproofing and waterproofing materials. 26,457. Sept. 30.

Complete Specifications Accepted.

9192 (1921). Aris. Fixing colours on textile fibres. (186,086.) Oct. 4.

3272 (1922). Imray (Gebr. Schmid). Dyeing silk black. (174,947.) Oct. 11.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Applications.

Coke and Gas Ovens, Ltd., and Smith. Production of white commercial pure ammonium chloride. 26,967. Oct. 5.

Dreyfus. Production of products from alkali compounds. 26,959. Oct. 5.

Hovey and Hovey. Nitrate of lime. 26,883. Oct. 5.

Howard. Production of hydrogen sulphide. 26,739. Oct. 3. (U.S., 20.10.21.)

Jackson (Koppers Co.). 26,715. *See* II.

Jackson (Koppers Co.). Manufacture of hydrogen sulphide. 26,722. Oct. 3.

Koppers Co. 26,701—2. *See* II.

Koppers Co. Manufacture of hydrogen sulphide. 26,721. Oct. 3. (U.S., 8.12.21.)

Nitrogen Corp. Synthesising ammonia. 26,000. Sep. 26. (U.S., 5.10.21.)

Rawson. Treatment of hydromagnesite. 25,983. Sep. 26.

COMPLETE SPECIFICATION ACCEPTED.

19,113 (1921). Plausons (Parent Co.), Ltd. (Plauson). Extraction of alkali from felspar and other minerals. (186,199.) Oct. 4.

VIII.—GLASS; CERAMICS.

COMPLETE SPECIFICATION ACCEPTED.

17,049 and 30,326 (1921). Hilger, Ltd., and Twyman. Annealing and apparatus used therein. (186,160.) Oct. 4.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Avis and Jennings. Material for structural purposes. 25,877. Sep. 25.

Dunstan. Cementitious composition. 26,869. Oct. 4.

Plausons (Parent Co.), Ltd. (Plauson). Production of cement from oil shale and simultaneous recovery of shale oil. 26,189. Sep. 28.

COMPLETE SPECIFICATIONS ACCEPTED.

35,073 (1920). Hamon. Compositions for making building blocks, slabs, tiles, etc. (186,355.) Oct. 11.

14,234 (1921). Rowse. Manufacture of roofing and building material. (186,105.) Oct. 4.

17,026 (1921). Imperial Trust, and Schryver. Manufacture of plastic material for flooring etc. (186,157.) Oct. 4.

20,006 and 20,198 (1921). Soc. de Recherches et de Perfect. Industriels. Impregnation of wood. (168,048 and 179,129.) Oct. 4.

21,843 (1921). Arquint. Insulating material against loss or gain of heat. (186,492.) Oct. 11.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Brewer (Krupp A.-G.). Electrolytic separation of pure chromium in thick layers. 26,206. Sep. 28.

Campbell. Reduction of metallic oxides and ores in melting furnaces. 26,470. Sep. 30.

Classen. Production of glossy metallic coatings on metals. 26,014. Sep. 26.

Fréson. Siemens etc. furnaces. 26,962. Oct. 5. (Belg., 11.10.21.)

Green and Hatfield. Alloy steels. 26,296—9. Sep. 29.

Jones. Distillation of zinc etc. by electrical means. 27,006. Oct. 6.

Meehan. Manufacture of grey iron. 25,973. Sep. 26.

Miles. Froth flotation machines etc. 27,086. Oct. 6.

Smallwood. Process for making ore or fuel briquettes. 26,805. Oct. 4.

Smidth & Co. Agglomeration of ore. 27,191. Oct. 7. (Sweden, 11.10.21.)

Ward. Melting metals. 27,156. Oct. 7.

COMPLETE SPECIFICATIONS ACCEPTED.

14,603 (1921). Jones, and Sylvette, Ltd. Nickel alloys. (186,381.) Oct. 11.

16,456 (1921). Thompson (Thoumyre Fils). Lead alloys. (186,118.) Oct. 4.

17,049 and 30,326 (1921). Hilger and Twyman. *See* VIII.

19,074–5 (1921). Fierz and Prager. Manufacture of nickel from nickel carbonyl. (186,457—8.) Oct. 11.

19,090 (1921). Classen. Production of glossy metallic coatings on metals. (186,459.) Oct. 11.

22,381 (1921). General Electric Co., and Smithells. Manufacture of tungsten. (186,497.) Oct. 11.

24,843 (1921). Boehm. Manufacture of magnesium foil. (186,253.) Oct. 4.

25,480 (1921). Hibbard. Art of puddling. (179,888.) Oct. 4.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Brewer (Krupp A.-G.). 26,206. *See* X.

Dutt. Electric primary batteries. 26,927. Oct. 5.

Dutt and Godfrey. Storage batteries. 26,928. Oct. 5.

Dutt and Godfrey. Electric batteries. 26,929. Oct. 5.

Dutt and Godfrey. Leclanché batteries. 27,106. Oct. 6.

Fischer and Pörscke. Galvanic cells and batteries. 26,843—4. Oct. 4.

Hancock and Hancock. Electric furnaces. 27,068. Oct. 6.

Jones. 27,006. *See* X.

McMullen and Rickets. Electrical systems and apparatus for chemical treatment of non-conducting liquids. 26,692. Oct. 3.

Metropolitan-Vickers Electrical Co., and North. Insulating materials. 26,838. Oct. 4.

Reynolds. Composition for screening X-ray emanations and for electrical insulation. 26,254. Sep. 28.

Stobie. Electric arc furnaces. 26,905. Oct. 5.

XII.—FATS; OILS; WAXES.

APPLICATIONS.

Ashwell. 26,621. *See* XIII.

Bannister. 26,319. *See* XIII.

Masson. Purification of oils. 27,170. Oct 7.

COMPLETE SPECIFICATIONS ACCEPTED.

8040 and 25,857 (1921). Macpherson and Heys. *See* XIX.

16,749 (1921). MacIlwaine. Preservation and preparation for transportation of oil-bearing raw material, such as nuts, seeds, and copra. (186,133.) Oct. 4.

17,239 (1921). Goslings. Purification of oils and fats. (172,923.) Oct. 11.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

APPLICATIONS.

Ashwell. Apparatus for drawing off, condensing, and collecting vapours and fumes from gums, oils, etc. 26,621. Oct. 3.

Bain, and Barry, Ostlere, and Shepherd. Manufacture of linoleum etc. 26,493. Oct. 2.

Bannister and Bannister. Manufacture of French-polishing oil. 26,319. Sep. 29.

Calwell. Writing inks. 25,826. Sep. 25.

New Jersey Zinc Co. Manufacture of lithopone. 25,909. Sep. 25. (U.S., 2.11.21.)

Peters. Paint or coating composition. 26,608. Oct. 2.

Plausons (Parent Co.), Ltd. (Plauson). Paints. 25,813. Sep. 25.

Complete Specifications Accepted.

15,942 (1921). Imray (Soc. Chem. Industry in Basle). Manufacture of resins. (186,107.) Oct. 4.

16,404 (1921). White (National Lead Co.). Manufacture of white lead. (186,114.) Oct. 4.

17,025 (1921). Imperial Trust, and Schryver. Manufacture of coating compositions. (186,156.) Oct. 4.

17,151 (1921). Pummerer. Production of artificial resins. (165,408.) Oct. 4.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Bourne and Whitehead. Rubber compositions. 26,443. Sep. 30.

Clarke, Roberts, and Skellon. Vulcanisation of rubber. 27,114. Oct. 6.

Rushen (Naugatuck Chemical Co.). Vulcanisation of rubber. 25,972. Sep. 26.

Schauerman. Substitute for rubber, vulcanite, etc. 26,458. Sep. 30.

XV.—LEATHER; BONE; HORN; GLUE.

Applications.

Aström. Manufacture of waterproof leather. 26,099. Sep. 27.

Comp. Gén. d'Electricité. Moulding casein into plates having polished surface. 25,908. Sep. 25. (Ger., 26.9.21.)

Hoare. 26,340. *See* XIX.

XVI.—SOILS; FERTILISERS.

Complete Specifications Accepted.

21,170 (1921). James (Eisenwerkges. Maximilianshütte). Treatment of phosphorus compounds suitable for manurial purposes. (186,223.) Oct. 4.

22,272 (1921). Stockholms Superfosfat Fabriks Aktiebolag. Granulation of calcium cyanamide. (168,070.) Oct. 11.

XVII.—SUGARS; STARCHES; GUMS.

Application.

Harding and Whetham. Manufacture of lactose and/or lactalbumen. 26,879. Oct. 5.

Complete Specifications Accepted.

8492 (1921). Acree. *See* V.

16,886 (1921). Terrisse and Levy. *See* V.

XVIII.—FERMENTATION INDUSTRIES.

Application.

Sobotka and Willstätter. Production of yeast preparations for food. 25,895. Sep. 25.

Complete Specification Accepted.

17,077 (1921). Hyde. Brewing malt liquors. (186,161.) Oct. 4.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Adams. Sewage purification tanks etc. 27,015. Oct. 6.

Benoit. Purification of liquids. 26,652. Oct. 3.

Comp. Indus. de Travaux d'Edilite. Furnace for incinerating refuse. 25,891. Sep. 25. (Fr., 24.8.22.)

Dried Milk Dairy Products, Ltd., and others. 26,712. *See* I.

Hampshire, Hobbs, and Co., and Jones. Drying fish and vegetable substances etc. 26,644. Oct. 3.

Harding and Whetham. 26,879. *See* XVII.

Harrington. Deodorisers or disinfectants. 26,801. Oct. 4.

Hoare. Manufacture of vegetable casein or albumin. 26,340. Sep. 29.

Linley. Treatment and storage of meat. 26,589. Oct. 2.

Seligman. Sterilising and preserving liquids. 26,974—6. Oct. 5.

Sobotka and Willstätter. 25,895. *See* XVIII.

Thornton. Composition for preventing rust etc. in containers for water and for keeping water fluid below freezing point. 26,052. Sep. 27.

Ward Baking Co. Manufacture of bread. 26,616, 26,749, and 26,750. Oct. 2 and 3. (US., 1. and 3.10.21.)

Ward Baking Co. Production of food products. 26,617. Oct. 2. (U.S., 1.10.21.)

Ward Baking Co. Production of enzymes for manufacture of bread. 26,751. Oct. 3. (U.S., 3.10.21.)

Ward Baking Co. Coagulating and curdling milk. 26,752. Oct. 3. (U.S., 3.10.21.)

Complete Specification Accepted.

8040 (1921). Macpherson and Heys. Antiseptic and insecticidal soap or compound. (186,078.) Oct. 4.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Engelhardt, and Farbenfabr. vorm. F. Bayer u. Co. Separating or isolating organic gases or vapours of organic products. 26,841. Oct. 4.

Holzverkohlungs-Industrie A.-G. Chlorination of methane. 27,107. Oct. 6. (Ger., 27.3.22.)

Lewis. 26,114. *See* II.

Complete Specifications Accepted.

8493 (1921). Acree. *See* V.

17,527 (1921). Elektrizitätswerk Lonza. Production of crotonic acid from crotonaldehyde. (165,728.) Oct. 4.

19,376 (1921). Johnson (Badische Anilin u. Soda Fabrik). Manufacture of thymol. (186,202.) Oct. 4.

31,276 (1921). Holzverkohlungs-Industrie A.-G., and Roka. Chlorination of methane. (186,270.) Oct. 4.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Application.

Marks (Daylight Film Corp.). Photographic developers. 27,200. Oct. 7.

Complete Specification Accepted.

11,556 (1921). Wolff. Negative material for colour photography. (168,035.) Oct. 11.

XXII.—EXPLOSIVES; MATCHES.

Applications.

De Wendel et Cie. Explosive. 26,989. Oct. 5. (Fr., 21.1.22.)

Friederich. Process for making charges for fuse cords etc. 26,577. Oct. 2.

XXIII.—ANALYSIS.

Application.

Bellingham and Stanley. Polarimeters etc. 26,725. Oct. 3.

I.—GENERAL; PLANT; MACHINERY.

Patents.

Boilers and the like; Compositions for preventing corrosion and removing incrustation in ——. The Zynkara Co., Ltd., and W. A. Cross. E.P. 185,035, 7.10.21.

Alkaline solid material of the kind usual in boiler compositions, *e.g.*, powdered caustic soda, is mixed with finely-divided zinc or other metal electro-positive to the metal of the boiler; the mixture is incorporated with a melted wax or other material of comparatively low melting-point not attacked by alkalis, and allowed to solidify.—H. H.

Electrolytic corrosion in surface condensers and like heat exchange apparatus; Prevention of ——. F. von Wurstemberger. E.P. 185,436, 8.3.21.

When iron parts (such as longitudinal stays) are used in conjunction with copper or copper alloys in condensers, precautions are taken to prevent contact of the iron parts with the copper (or alloy) tube-plates, the iron parts being provided with copper ends. In the case of intermediate copper tube-supporting plates, holes with a large clearance, and preferably bevelled to prevent water settling in them, may be used where the stays pass through. —B. M. V.

Pulverising, mixing, and grading; Apparatus for ——. W. Clark, G. and W. A. Dawson. E.P. 185,037, 10.10.21.

In an apparatus for pulverising wet or dry materials, with or without mixing, and for grading, assisted by induction of hot or cold fluids, a rotor or a travelling member co-acts with a casing. Wire or wire carding is used to form the grinding surfaces or parts thereof on the casing and on the rotor or travelling member. Other grinding parts may be formed as blades on the rotor etc. or as rotor arms, or as adjustable segmental blocks on the inner face of the casing. The grinding parts are arranged to be not actually in contact. Air or other fluids are inducted or injected through inlets provided in the casing and in some cases also in the revolving members. A grading attachment may be provided in which an intermittent blast co-operates with a duct, the cross-section of which increases abruptly.—H. H.

Tube mill. J. Ferencz. U.S.P. 1,428,687, 12.9.22. Appl., 30.4.21.

Hollow trunnions at the ends of a drum are supported in journal bearings on a pair of pedestals. From a standard secured to one pedestal an arm extends through the adjacent trunnion and carries a bar disposed longitudinally within the drum. Grinding rollers suspended from the bar co-operate with the inner surface of the drum to grind material fed into the drum.—H. H.

Baking or drying substances at high temperatures; Apparatus for —— *and subsequently cooling same.* B. Greenwood, and Carr and Co., Ltd. E.P. 185,460, 3.5.21.

The goods (*e.g.*, biscuits) are caused to ascend through a tower divided into a number of sections, each of which can be independently heated, preferably by means of hot air. On arrival at the top of the tower the goods pass through an air lock and descend another tower in which they meet a current of cool air, which leaves the tower at a point below the air lock for transfer of the goods. The speed of descent may be slower than the speed of ascent. —B. M. V.

Pulveriser; Rotary ——. W. H. Fulcher. U.S.P. 1,429,333, 19.9.22. Appl., 14.11.21.

A conical shell rotates about a fixed conical body, the material being crushed in the space between the two. As the shell rotates it is lifted and allowed to drop by means of cams, fixed to the shell, which engage with rollers running on a circular track below the shell, the rollers being mounted on a spider to keep them a fixed distance apart from each other.—B. M. V.

Heater and heat insulation. W. S. Hadaway, jun. U.S.P. 1,389,192, 30.8.21. Appl., 26.7.17.

A heated vessel or chamber is insulated by means of a porous body through which a fluid is caused to flow in opposition to the flow which the heat losses tend to produce. For example, a furnace chamber may be made with walls composed of a large number of capillary tubes, the ends of the tubes on the bottom extending downwards into water contained in a tank enclosed by an outer insulating wall. The spaces above the water and surrounding the tubes of the side walls of the furnace chamber are filled with asbestos wool or like material constituting a wick. The flow of heat outwards from the furnace chamber is counteracted by water flowing inwards through the wick and tubes, the water being gradually converted into steam, with absorption of heat. Various other forms of apparatus based on the same principle are described.

Tunnel-kiln air-heater. L. Wilputte, Assr. to American Dressler Tunnel Kilns, Inc. U.S.P. 1,389,408, 30.8.21. Appl., 20.11.19.

A tunnel kiln for delivering large volumes of hot air for drying or the like comprises a housing of refractory material provided with a number of parallel combustion chambers, similar to those of Dressler tunnel kilns, and with spaced pipes extending longitudinally and forming extensions of the combustion chambers. A mixture of preheated air and fuel is burnt in the combustion chambers and the air to be heated flows in a tortuous path between and in contact with the pipes and in a general direction opposite to the flow of products of combustion through the combustion chambers and pipes.

Drying apparatus; Process of heating —— *by means of furnace gases.* C. Loeser. G.P. 355,845, 8.12.16.

Hot furnace gases are delivered to a tube, disposed within the drying chamber and surrounded by a jacket through which a regulated supply of air flows, the hot gases imparting heat to the air, which then passes through orifices in the furnace gas tube into a mixing header. The mixture is then immediately used for drying purposes. The plant can be operated with just the amount of air required for the combustion of the combustible constituents of the furnace gases, and the material to be dried treated at the highest permissible temperature. —J. S. G. T.

Condensation of steam or other vapours. [Evaporative condenser.] D. McN. Ramsey. E.P. 185,462, 3.5.21.

The evaporating surface of an evaporative condenser with a rotating cage of tubes is smooth and clean and is dipped periodically into a liquid of which the surface tension is less than that of water (*e.g.*, dilute caustic soda solution). The liquid is also maintained cooler at the steam outlet end than at the inlet, for example, by hindering circulation in the dipping trough by one or more intermediate baffles and by sloping the tube towards the outlet, so that drops of liquid cooled by evaporation fall back into the cold end. Steam may be cut off from the tubes that are actually being dipped in the cooling liquid.—B. M. V.

Refrigeration; Process and machine for ——. W. Stewart. E.P. 185,607, 11.8.21.

A liquid (*e.g.*, water) to be solidified by refrigeration is sprayed upwards into a container (or set of containers) the walls of which are cooled and in which a vacuum may be maintained, ice being built up on the walls until a sufficiently thick block is formed; any uncongealed liquid falls into the source of supply and the vapour is removed by an exhauster and condensed and the condensed product used for cooling the external refrigerant. The rate of refrigeration is adjusted so that solid ice and not snow is formed, and when the blocks are thick enough heat instead of cold may be applied to the outside of the container and the blocks allowed to drop upon a rising and falling platform. The latter may be constituted by the supply tank or tanks, and air-tight joints are formed by means of inflatable tubular rubber rings between it and the bottoms of the ice containers. The apparatus is suitable also for the recovery of paraffin wax from oils.—B. M. V.

Emulsions; Method and apparatus for making ——. G. B. Hutchings. E.P. 185,618, 22.8.21.

The apparatus consists of a hollow truncated cone with ducts in the walls. The ducts extend from the base to the top and are also connected with the interior of the cone. When the cone is rotated at high speed in the material to be emulsified, liquid is drawn up into the interior of the cone and passes out by the ducts, an emulsion being formed. The vortex formed in the liquid causes the top of the cone to be always uncovered and by this means a certain amount of air is drawn in. If this is undesirable, the operation is carried out in a vacuum. —T. A. S.

Filters or strainers and sifting surfaces. G. C. Hurrell. E.P. 185,638, 13.9.21. Addn. to 174,116 (*cf.* U.S.P. 1,414,132; J., 1922, 449 A).

The wire for the filtering or straining surface described in the earlier patent (convolutions of wire wound on a squirrel cage) is of cruciform, oblong, oval, or other non-circular cross-section, and is twisted. A similar effect may be produced by cutting a spiral on the wire or by winding a finer wire in an open spiral on the main wire. Either form of the special wire may be used alone or alternating with plain wire.—B. M. V.

Filter-presses; Process for removing solid residues from ——. H. Jung. G.P. 355,483, 2.4.19. Addn. to 339,005 (J., 1921, 800 A).

Solid press-cake contained in the apparatus described in the chief patent is loosened by contact with a stationary bar, and blown by air out of the chambers.—L. A. C.

Vacuum [evaporating] apparatus. T. and J. R. Ray, Assrs. to Ray Bros. Corp. U.S.P. 1,428,557, 12.9.22. Appl., 3.12.17.

The heating drum of a vacuum evaporator is provided with end plates each formed with a series of openings. The peripheral outer edge of each opening is inclined, and tubes connecting the plates terminate within the openings below the inclined portions. The outer ends of the tubes are bevelled to fit these inclined portions.—H. H.

Liquids; Process for evaporating ——. A.-G. Kummler und Matter. G.P. 355,602, 14.4.20. Addn. to 347,070 (*cf.* E.P. 123,716; J., 1920, 287 A).

In the process described in the chief patent, the vapour introduced directly into the apparatus is only compressed to such a degree that it is able to overcome the pressure prevailing at the exit. —L. A. C.

Cleaning air and other gases; Apparatus for ——. H. N. Edens. U.S.P. 1,428,950, 12.9.22. Appl., 20.10.19.

A closed casing contains a liquid reservoir, and the space above the liquid is connected with a device for creating a vacuum. The gas is drawn through a passageway provided with a return bend below the liquid level, and a liquid inlet port is disposed in the outer wall of the bend. The discharge end of the passageway is disposed above the liquid level. —H. H.

Lye solution; Means for regulating and controlling the strength of ——. S. J. Dunkley, Assr. to Dunkley Co. U.S.P. 1,429,129, 12.9.22. Appl., 8.8.21.

The apparatus consists of a main tank connected by delivery and return pipes with a mixing tank. The delivery pipe is provided with a regulating valve, controlled electrically by a hydrometer which responds to changes in density of the liquid in the main tank.—D. J. N.

Contact material; Process for cleaning ——. T. L. Briggs, Assr. to General Chemical Co. U.S.P. 1,429,222, 19.9.22. Appl., 15.9.20.

A catalyst mounted on fibrous material is washed with water without disarranging it.—B. M. V.

Gaseous mixtures; Separation of —— [*by liquefaction*]. P. E. Haynes, Assr. to The Linde Air Products Co. U.S.P. 1,429,242, 19.9.22. Appl., 12.4.19.

In a process in which a compressed gas mixture is expanded with partial liquefaction, the mixture, before expansion, is cooled by heat interchange with the liquefied portion and with gases which have passed through the expansion stage.—B. M. V.

Adsorption apparatus for solvent recovery etc. R. R. Etter, Assr. to General Electric Co. U.S.P. 1,429,856, 19.9.22. Appl., 7.1.21.

An annular chamber with both concentric walls perforated is filled with solid adsorbent material, and the vapour-laden gases together with a heating medium are passed through radially in either direction.—B. M. V.

Washing salts; Apparatus for ——. F. Hornung. G.P. 357,594, 22.8.20.

An inclined drum is divided by partitions into compartments to which salt and washing fluid are delivered, and in which an agitator, comprising mixing and conveying vanes, is arranged. The latter are so shaped that the whole of the salt is not withdrawn from the first compartment, a little remaining behind and serving as a filter for the finer particles of salt. Washed salt is delivered to a bucket conveyor, provided with a partition, so that the washing fluid can be supplied to the washing plant in counter current to the solution of salt delivered from the apparatus. A heating device arranged below the drum enables the apparatus to be employed also for dissolving the crude salt. —J. S. G. T.

Filter. A. M. Capro. U.S.P. 1,429,488, 19.9.22. Appl., 19.6.20.

See E.P. 172,491 of 1920; J., 1922, 116 A.

Filtering apparatus. E. W. W. Keene. U.S.P. 1,429,913, 19.9.22. Appl., 20.4.22.

See E.P. 179,494 of 1921; J., 1922, 490 A.

Fluids; Apparatus for measuring, mixing or separating ——. H. Liese. E.P. 163,015, 6.5.21. Conv., 6.5.20.

Separating or sorting fragmentary materials by electric conductivity; Apparatus for ——. H. L. A. Schweitzer. E.P. 165,098, 20.6.21. Conv., 18.6.20.

Furnaces; Sealing device for travelling grate ——. Zellstoff-fabrik Waldhof, and A. Schneider. E.P. 185,974, 8.10.21.

Ore crusher. B. A. Mitchell. E.P. 186,162, 22.6.21.

Separating constituents of gaseous mixtures. E.P. 184,454. *See* VII.

Separating mixed gases. G.P. 347,601 and 354,630. *See* VII.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coals; Origin of ——. E. Donath and A. Lissner. Brennstoff-Chem., 1922, 3, 231—237.

The current chemical and geological theories of coal formation are critically reviewed. The theory of the transformation of wood and peat through lignites to coal and anthracite is being modified. Coal is not to be regarded as necessarily derived from peat as found in recent deposits and from brown coals such as exist now. That the brown coals and coal result from different kinds of vegetable matter is a view supported by the authors. They accept the Fischer-Schrader theory of the formation of coal from lignin (J., 1921, 172 a; 1922, 207a, 317 a), the cellulose being destroyed by bacterial action, but the theory is regarded as incomplete in ignoring the vegetable and animal proteins. The proportion of nitrogen in coal is such as to imply the existence of considerable quantities of these. There is some evidence of the possibility of union of protein with cellulosic matter, which would then be preserved. The true coals and harder lignites have probably passed through a pressure distillation process as imitated by Bergius (*cf.* J., 1913, 462).—H. J. H.

Peat; Artificial drying of ——. G. Keppeler. Brennstoff-Chem., 1922, 3, 237—239, 249—254, 262—269.

Evaporation of the water from peat by artificial heat is impracticable, because the fuel requirement exceeds the calorific value of the product. It is conceivable that the evaporation might be effected in closed vessels with the production of steam from which an equivalent of power might be obtained, but this has not proved feasible in practice. The expression of the water is extremely difficult owing to the colloidal character of the peat, and the difficulty seems to increase as the peat ages owing to the breaking down of the cell structure which provided channels of egress for the water. The author and Raapke have shown that, given time, which is the dominating factor, most of the water can be removed from the newer raw peat by pressure, but with an older specimen not even by prolonged application of the highest pressure could the water content be reduced below 75%. It is improbable that mechanical expression or centrifuging of raw peat will prove effective. The removal of water is facilitated by admixture of dry, powdery materials. The further dewatering is rendered much easier by admixture of peat dried to 10—20% of water. By this means the bulk of the water can be removed from the peat by machines described in the paper. This "wet pressing" is regarded as the most promising process. Unsuccessful attempts have been made to facilitate the removal of water by addition of electrolytes or liquids which have a greater wetting power than water. Freezing is effective if moss litter is required but the product is insufficiently coherent for fuel purposes. Similarly the preliminary application of heat facilitates subsequent removal of water as in the "wet carbonising" process, though this has not established itself in practice. Electro-osmose is effective, but owing to the small output per unit, has not proved commercially feasible. After surveying the whole field of artificial methods the author concludes that there is no immediate prospect that any will be successful and he concludes that the most promising field is the development of mechanical appliances to facilitate the winning of peat to be dried in the normal way.
—H. J. H.

Distillation gases of solid fuels; Composition of ——. M. Dolch and G. Gerstendörfer. Brennstoff-Chem., 1922, 3, 225—231.

An attempt is made to correlate the composition of the gas obtained in carbonisation with the geological character and age of the coal taken. The authors have made a large number of carbonisation tests on coals from Ostrau (German Austria). The results are shown graphically. The oxides of carbon, hydrogen, heavy hydrocarbons and tar yields fall off as the geological age increases, whilst the methane yield increases. The hydrogen content of the gas varies inversely with methane content, the sum of the two being practically constant. It is inferred that the former is a secondary product.
—H. J. H.

Carbon monoxide; Catalytic reduction of ——. G. Fester. Brennstoff-Chem., 1922, 3, 244—245.

An observation by Orlow has been confirmed (*cf.* J., 1909, 301), viz., that carbon monoxide when reduced at 100° C. by hydrogen in presence of a catalyst of nickel and palladium asbestos yields unsaturated hydrocarbons and not methane. The catalyst rapidly loses its activity.—H. J. H.

Petrols for road vehicles and aircraft. Effect of fuel composition upon engine performance. O. Thornycroft. J. Inst. Petrol. Tech., 1922, 8, 376—396.

In internal combustion engines operating on the constant-volume cycle, when the air: fuel ratio is that giving complete combustion, with a 5:1 compression, the maximum temperature is about 2600° C., instead of 3000° C. as calculated, on account of dissociation and the increase in the specific heat of the gases at high temperatures. This loss may be reduced by working with a weaker mixture of fuel to air. An infinitely weak mixture would give theoretical efficiency. The mixture strength cannot be reduced below 80% of normal because of difficulties in attaining combustion. Maximum efficiency is attained with 85% of normal, with benzene vapour as fuel. The ratio between experimental efficiency and the air cycle efficiency is increased with increased compression ratio, because the extent of dissociation is lessened. The efficiency of the cycle is practically independent of the variation in carbon and hydrogen contents of hydrocarbons, for while for carbon dioxide the dissociation is great at high temperatures, the increase in specific heat is small, and for water the dissociation is small but the increase in specific heat great. These effects balance each other. There is steady increase in efficiency with increased compression. The rate of increase of efficiency with increased compression is actually greater than that of the air cycle efficiency. All hydrocarbon fuels give the same efficiency at the same compression. Power output increases with compression ratio, but less rapidly than fuel efficiency and slightly less rapidly than the air cycle efficiency. All hydrocarbons give practically the same mean effective pressure or maximum power at the same compression. Detonation and pre-ignition, however, prevent the increase of the compression ratio. The detonation point of heptane corresponds to a compression of 3·75:1, and that of benzol to a compression of 7·1:1. The facility of starting with a given petrol is a function of the volatility of the first 10 to 20% of distillate. To avoid troubles in lubrication the final boiling point of the petrol should not be above 220° C.—H. M.

Ozonides from petroleum. R. Koetschau. Z. angew. Chem., 1922, 35, 509—513.

EXPERIMENTS were made on the action of ozone on American petroleum oils. A transformer oil of sp. gr. 0·915 and molecular weight (by the freezing point method in benzene) 293, yielded 25% of an ozonide having a molecular weight of 663. When a solution of the ozonide in benzene was left for a few hours the molecular weight fell to 606, and after two days, to 479. The value 663 corresponds closely to the calculated molecular weight of a dimeric diozonide, $(C_{19}H_{20}O_6)_2$, viz., 688. Many American crude oils and lubricating oils contain hydrocarbons very rich in carbon, possessing high sp. gr. and high refractive indices, probably saturated polycyclic paraffins. The molecular weights of mineral oils determined by the freezing point method in camphor are generally lower than those determined in benzene. The ozonides from Texas and Pennsylvanian spindle oils have a characteristic pungent odour. When these oils are ozonised the ozonides separate as a flocculent whitish precipitate, which gradually changes to a red resin at a temperature of 20° C. or over. Oils poor in sulphur give more stable ozonides of a lighter colour. The curves of ozone absorption are very steep at their commencement. The maximum increase in weight by absorption of ozone is 16—17%. The "white oils" show no separation of ozonides, but a considerable increase in viscosity when ozonised. On ozonising a Russian petroleum jelly a strong odour of vanilla was developed. Tables are given showing the properties of several ozonised oils and the distillation tests *in vacuo*, and graphs show the relation of quantity of ozone absorbed to time of reaction. A "splitting number" determined by measuring the acidity of an ozonised oil after boiling for half-an-hour with water, has been found of utility for the examination of transformer oils. Sludge values may be determined more rapidly and conveniently with ozone than with oxygen. The value is four to five times greater than with the old method. A table is given showing the amount of ozone absorbed, the sludge value, and the "splitting number" for a transformer oil for periods of reaction from 40 mins. to 5 hrs. A standard method of determination of sludge value is proposed, and details of the cost of ozone production are given.—H. M.

Acetylene and nitrogen. Garner and Matsuno. *See* VII.

Ichthyol. Pépin and Reaubourg. *See* XX.

PATENTS.

Fuel for briquetting purposes; Method of treating ——. G. Komarek, Assr. to Malcolmson Engineering and Machine Corp. U.S.P. 1,430,386, 26.9.22. Appl., 31.12.20.

COAL dust is mixed with a binder, heated in a vertical column, and kneaded in the lower part of the column.—H. Hg.

Peat; Process and apparatus for dewatering ——. Nederlandsche Veenverwerking Maatschappij. G.P. 356,823, 20.1.21. Conv., 10.1.21.

PEAT is passed continually downwards through a vertical shaft furnace so that the hot gases and vapours evolved in the lower zone, where the combined water is liberated, pass upwards through the still wet peat and assist in drying it in the upper zone of the furnace, thus economising fuel.
—A. R. P.

Pulverulent fuels; Method of and means for burning ——. R. S. Walker, Assee. of E. B. Worthington. E.P. 166,124, 24.6.21. Conv., 9.7.20.

A STREAM of pulverised fuel with a partial supply of air is directed downwards at a low velocity into a combustion chamber. Additional air is admitted to the lower part of the chamber, and the flame reverts in an upward direction over an inclined surface on which fused ash is deposited. If slag accumulates on the lower part of the surface, the flame is temporarily deflected in a downward direction by a jet of steam or air, so that the slag flows off the surface. The slag is then washed away by a stream of water and escapes from the bottom of the furnace under a pivoted door provided with fixed side wings for the exclusion of air and sealed with water along its bottom edge.—H. Hg.

Furnaces for fuel in dust or powdered form. F. Oertel. E.P. 171,118, 7.11.21. Conv., 6.11.20.

A JET of pulverised fuel and air enters a combustion chamber in a vertical direction and tangentially to the curved roof of the chamber. Due to the curvature of the roof and wall of the chamber the flame is reverted in a backward direction, and ash is separated by centrifugal force. There is an opening for the reception of ash at the base of the chamber, and the burning gases are directed over this opening and then across the stream of fuel and air issuing from the jet.—H. Hg.

Coke ovens; Recuperative ——. E. Piron. E.P. 185,811, 2.6.21.

GAS is admitted in a downward direction to each vertical heating flue of a coke oven through a carborundum nozzle at a point below the air inlet. Alternating with the heating flues are vertical flues up which air passes from the recuperators. The tops of all the adjacent heating and air flues are interconnected by a horizontal passage. The gas nozzles and all the passages for air and products of combustion are of large cross-sectional area so that increased supplies of gas and air may be drawn automatically into any relatively cold flue. The recuperator is composed of vertical flues arranged in blocks separated by continuous vertical joints. Each block is constructed of L-shaped bricks laid in opposite directions in alternate courses.—H. Hg.

Carbonising fuel in vertical retorts. Woodall, Duckham and Jones (1920), Ltd., and A. McD. Duckham. E.P. 185,461, 3.5.21.

THE temperature of the coke in the lower part of a vertical retort to which steam is admitted is maintained by the admission of oxygen together or alternately with the steam. The oxygen may be diluted with a proportion of nitrogen determined by the quality of the gas required.—H. Hg.

Retort for gas furnaces. G. Horn. U.S.P. 1,429,346, 19.9.22. Appl., 1.9.21.

A RETORT for manufacturing gas comprises stepped overlapping trough-shaped floor pieces of the breadth of the whole retort in combination with narrow ceiling pieces, each provided at each lateral surface with a groove and placed side by side, above the floor, so as to form an arched ceiling. The groups of the ceiling pieces are placed end to end, the ends of the individual pieces being displaced to the extent to which the floor pieces overlap. The grooves in the lateral surfaces register with each other, and the channel so formed is filled with refractory mortar.—A. R. M.

Gas producers [*and retorts*]. J. Healy. E.P. 185,685, 8.12.21.

Tar is eliminated from the gas produced in generators or retorts by withdrawing the gas through conduits which are subjected to the highest temperature of the fuel. Gas produced in a generator enters the open end of a vertical conduit just above the fuel level, passes into a horizontal conduit which encircles the hot zone of the fuel bed, and then into an off-take. The conduits are constructed of refractory material, provided with cleaning doors and sealed pipes for the removal of carbon, and so arranged as not to interfere with the passage of the fuel.—H. Hg.

Water gas; Apparatus and process primarily intended for manufacture of carburetted —— but which may be used for manufacture of other gases such as "blue" water gas, methane-hydrogen, and producer-gas. E. F. Murray. E.P. 185,887, 1.7.21.

In a gas producer of the type in which a retort is mounted above a water-gas generator, operated on the usual "blow" and "run" system, the gases produced during the blow are burnt in flues around the retort, and those produced during the run are passed through the fuel contained in the retort. A space is formed at the top of the retort for the purpose of drying the fuel and distilling off the lighter volatile constituents by means of the sensible heat of the "run" gas. Such volatile portions are passed into carburetting chambers situated so as to receive heat from the generator, which serves to crack them into permanent gases. If desired, additional carburetting material may be introduced into the vaporising space at the top of the retort. The gases thus fixed pass up through the retort together with the "run" gases and thence into an annular space around the retort, which is exposed to the heat of combustion of the "blow" gas. In this manner all the hydrocarbon vapours of the "run" gas are converted into permanent gases. Provision is made for alternate up-runs and down-runs.—A. R. M.

Gas producer. A. L. Galusha. U.S.P. 1,429,578, 19.9.22. Appl., 28.5.20.

The fuel is deposited on the end of a travelling conveyor which traverses an elongated combustion chamber from end to end. The gases which are driven off by the heat of combustion of a portion of the fuel at the delivery end are led off through an outlet.—A. R. M.

Gas purification; Process and apparatus for ——. K. Cox, R. P. Kerr, and E. J. Baty. E.P. 185,780, 7.4.21.

In a modification of the Klaus process for removing hydrogen sulphide from gases with recovery of sulphur, the temperature of the reaction in the contact material is controlled by suitable heat-exchanging devices, *e.g.*, zigzag pipes or members of cellular or honeycomb form through which steam or other fluid at suitable temperature is passed. The mass of contact material is divided by the heat-exchanging devices into comparatively small sections, but the aggregate cross-sectional area of the material normal to the direction of the flow of the gas is considerable. Thus, the transfer of heat, in conjunction with the heat of reaction, maintains a uniform temperature throughout, sufficiently high to ensure that the free sulphur is carried forward to condensers or receptacles. The gas outlet passage may be kept at such a temperature as to prevent the deposition of sulphur therein by jacketing it with the fluid used to maintain the temperature of the reaction. A great reduction in the size of plant required for purification of a given volume of gas as compared with the usual method is claimed.—A. R. M.

Natural gas; Process of treating —— and product thereof. H. E. Thompson, Assr. to Carbide and Carbon Chemicals Corp. U.S.P. 1,429,175, 12.9.22. Appl., 29.8.21.

A liquid of predetermined vapour pressure is obtained from a mixture of natural gas hydrocarbons by first separating from the mixture a fraction having a higher vapour pressure than that desired and then rectifying this fraction to produce vaporous and liquid portions, the rectification being so conducted that not more than one hydrocarbon of the fraction will occur in substantial quantity in both the liquid and the vaporous portions. Gasoline having a density not less than 87° B. (sp. gr. 0·645) and a vapour tension not substantially greater than 12 lb. at 100° F. (38° C.) can thus be recovered.—T. A. S.

Hydrocarbons or other oils; Apparatus for cracking ——. A. A. F. M. Seigle. E.P. 185,140, 24.2.21.

Hydrocarbon oil is vaporised at 650° C. and a pressure of 12 hectogrammes per sq. cm. (about 17 lb. per sq. in.) in a tube. This tube is packed with aluminium and iron turnings, the portions packed with aluminium being heated only to 450° C. The vapours are then expanded and cooled in chambers packed with metal turnings. Iron turnings are active at 650° C., aluminium at 450° C., copper at 300°—500° C., and ferronickel at 200°—350° C. The expansion chambers are maintained at the desired temperatures by jacketing with water boiling under the necessary pressure. Two expansion chambers are used, one working at 260° C. and the other at 160° C. Some heavy oil condenses in the expansion vessels and is withdrawn from the bottom. The vapours enter the first expansion chamber at the temperature and pressure at which they leave the vaporising tube and leave the chamber at about 260° C. and 4 hg. per sq. cm. (about 5·7 lb. per sq. in.). They are then again compressed and enter the second chamber at 300° C. and 9 hg. per sq. cm. (about 12·7 lb. per sq. in.), leaving at 160° C. and 2 or 3 hg. per sq. cm. (2·8—4·3 lb. per sq. in.). The products of the apparatus are rich gas, light hydrocarbons, and heavy oils suitable for use as lubricants. The quantity of light hydrocarbon can be increased by using suitable catalysts in the second expansion chamber and re-passing through it some of the rich gas along with hydrogen. The apparatus is designed to work on oil not boiling below 200°—250° C.—T. A. S.

Cracked petroleum oils and process and apparatus for producing same. L. W. Goold. From Universal Oil Products Co. E.P. 185,439, 11.3.21.

Oil is cracked at a temperature lower than 875° F. (470° C.) and a pressure of 135 lb. per sq. in. by being circulated in a system consisting of a heating coil about 400 ft. long, built up from 20-ft. sections of 4-in. pipe, and an expansion chamber made up of four 20-ft. sections of 10-in. pipe. Any deposition of carbon takes place in the expansion chamber, which is readily accessible for cleaning. The vapours from the expansion chamber are led off to a dephlegmator and any reflux condensate is taken back to the heating coil. Working on crude oil residues, a pressure distillate is obtained having a lower percentage of unsaturated hydrocarbons than the charging stock and containing not less than 15% each of gasoline and kerosene.—T. A. S.

Oil-cracking process and apparatus therefor. C. A. Jensen. From J. A. Stone. E.P. 185,624, 27.8.21.

The apparatus consists of two concentric cylinders packed with catalytic absorbent or spreading material. Oil is cracked in the inner cylinder, the outer cylinder being gas-fired for heating purposes. When the inner cylinder ceases to operate owing to deposition of carbon etc., the oil to be cracked is introduced into the outer cylinder and the inner cylinder is fired for heating purposes. The apparatus can be made to work with or without pressure. Suitable catalytic materials are cast-iron or nickel or porous fireclay or fuller's earth. Efficient double-phase cracking is claimed.—T. A. S.

Cracking hydrocarbons; Process of and apparatus for ——. F. G. Niece. E.P. 185,632, 7.9.21.

Heavy oil is cracked by passing it through molten metal under pressure. The metal, *e.g.*, lead, is contained in a long vertical tube, and preheated oil is introduced at the bottom. The vapours from the apparatus are condensed under pressure and any uncondensable gases are returned to the lower portion of the cracking apparatus and passed through the molten metal along with the oil under treatment. Distribution of the oil and vapours in the molten metal is brought about by means of baffles. —T. A. S.

Oil-topping plant. B. Gallsworthy. U.S.P. 1,428,159, 5.9.22. Appl., 14.7.19.

Hot flue gases are passed through coils arranged in a still. Oil is sprayed on to the upper coils and caused to drip on to the lower ones by means of baffles. The outlet for unvaporised oil is arranged so that the bottom coil is continually immersed. —T. A. S.

Dehydrator [; Electrical —— for oil emulsions]. W. Meredith, Assr. to Petroleum Rectifying Co. U.S.P. 1,428,178, 5.9.22. Appl., 28.10.20.

An emulsion is treated in a vessel divided into upper and lower compartments by a dielectric diaphragm through which an electrode passes. The electrode is insulated in the upper compartment by an ordinary insulator and also by dehydrated oil. The emulsion is dehydrated in the lower compartment by a high-potential discharge between the electrode and the walls of the vessel.—T. A. S.

Emulsions of petroleum; Apparatus for treating natural ——. W. S. Barnickel. U.S.P. 1,428,204, 5.9.22. Appl., 5.8.18.

The emulsion and a treating fluid are pumped together through a steam-heated conduit to a settling tank. The mixture is agitated during its passage through the conduit.—T. A. S.

Oils; Oil-converting process and apparatus for conversion and transformation of ——. J. H. Adams, Assr. to The Texas Co. U.S.P. 1,428,311-2, 5.9.22. Appl., 25.6.18.

(a) Hot high-boiling hydrocarbons are sprayed by means of superheated steam into a chamber, the steam being heated to a temperature sufficient to crack the oil. The heavy residues are collected in the bottom of the chamber and the evolved lighter vapours are withdrawn from the upper portion. (b) Hot oil is sprayed along with superheated steam into an expansion device consisting of spaced chambers with a communicating passage, the passage being heated. The cracked vapours are removed through a condenser. The apparatus is maintained at a pressure higher than atmospheric. —T. A. S.

Hydrocarbon oils; Apparatus for and method of cracking ——. F. T. Manley, Assr. to The Texas Co. U.S.P. 1,428,338-9, 5.9.22. Appl., 10.10.17.

(a) Oil is cracked by heating in a vertical still under pressure. Fresh oil is introduced into the bottom portion of the still, which is kept cold. The vapours evolved are passed through a dephlegmator, the heavy portions being returned to the bottom of the still with the fresh oil. (b) Hydrocarbon oils of comparatively low boiling point are brought in contact with a body of hydrocarbon oil of higher boiling point, of considerable length relative to its width and heated to a temperature sufficiently high to crack the lower-boiling oil. The vapours of the lower-boiling oil are caused to pass along the surface of the higher-boiling oil, and overheating is prevented.—T. A. S.

Hydrocarbons from oil shale; Process and apparatus for recovery of ——. C. W. Thompson. U.S.P. 1,428,458, 5.9.22. Appl., 15.9.19.

The shale is heated by external means to remove gasoline and light oils, which are collected separately. It is then further heated to vaporise the heavy hydrocarbons, and the vapours evolved are used to preheat cold shale prior to the first heat treatment.—T. A. S.

Compounds preferably of a hydrocarbon nature; Method and apparatus for treating or converting ——. W. J. Knox, Assr. to E. D. Warren. U.S.P. 1,428,641, 12.9.22. Appl., 24.3.19.

Hydrocarbon vapours are cracked by heating to a high temperature. The hot cracked gases before condensation are passed over the surface of oil to preheat it and remove low-boiling constituents. —T. A. S.

Liquid fuel; Method of forming a ——. A. Hayes, Assr. to U.S. Industrial Alcohol Co. U.S.P. 1,428,885, 12.9.22. Appl., 5.6.19.

A mixture consisting mainly of heavy hydrocarbon oil and alcohol and containing small proportions of light hydrocarbon and ether is converted into a fuel of a non-stratifying character by vaporising it and passing the vapours through a finely divided zinc or nickel catalyst maintained at a temperature below about 300° C.—T. A. S.

Hydrocarbons and their derivatives; Process for making —— by heating coal or hydrocarbons with hydrogen. S. Löffler. G.P. 303,332, 1.4.15.

Before being introduced into the reaction vessel the hydrogen and the substances to be hydrogenated are both heated in heat-interchangers to a temperature just below that required for the reaction, solid substances being finely powdered and mixed with liquid reagents. The overheating of the reacting substances and of the walls of the reaction vessel is in this way avoided.—H. C. R.

Naphthasulphonic acids; Extraction of —— produced in the refining of mineral oils with acids. Oelwerke Stern-Sonneborn A.-G. G.P. 310,701, 13.2.14.

Mineral oils or petroleum distillates, after purification by treatment with concentrated or fuming sulphuric acid and subsequent removal of the acid tar, are washed with a mixture of alcohol and aqueous sodium hydroxide. A volatile liquid soluble in water, such as methyl alcohol, ethyl alcohol, or acetone, is added to the lower layer of wash-liquor, and, after removing the mineral oil precipitated from the solution, the volatile liquid is separated by distillation, and naphthasulphonic acids are precipitated from the residue by the addition of acids.—L. A. C.

Sludge acids [from oil refining]; Method of treating ——. I. Hechenbleikner and T. C. Oliver, Assrs. to Chemical Construction Co. U.S.P. 1,429,140, 12.9.22. Appl., 7.1.22.

Sludge acids or separated sludge acids are preheated, without concentration, to drive off the volatile impurities and then concentrated by further heating.—T. A. S.

Coke; Plant for separating —— from waste fuel and residues. W. Weber, Assr. to Weber u. Co., Ges. für Bergbau, Industrie und Bahnbau. U.S.P. 1,429,987, 26.9.22. Appl., 27.12.20.

See E.P. 155,269 of 1920; J., 1921, 837 a.

Coke-oven; By-product —— with sole firing. Sole-heated coke oven. B. Zwillinger. U.S.P. 1,428,621–2, 12.9.22. Appl., 22.3.19, and 24.2.20.

See E.P. 172,739 of 1920; J., 1922, 130 a.

Coke-oven wall. O. Piette, Assr. to Belgian American Coke Ovens Corp. U.S.P. 1,429,252, 19.9.22. Appl., 6.11.18.

See E.P. 120,201 of 1918; J., 1919, 808 a.

Gas generator and retort apparatus; Combined ——. Combined vertical retort and gas-generator apparatus. G. P. Lewis. U.S.P. 1,430,452–3, 26.9.22. Appl., 13.2.22.

See E.P. 177,556 and 177,559 of 1920; J., 1922, 362 a.

Dehydrator [for petroleum emulsions]. F. W. Harris, Assr. to Petroleum Rectifying Co. U.S.P. 1,430,300, 26.9.22. Appl., 7.9.20.

See E.P. 175,352 of 1920; J., 1922, 244 a.

Gas producers [; Fuel rakes of ——]. W. Climie. E.P. 185,980, 15.6.21.

Refrigeration process and machine. E.P. 185,607. *See* I.

Sulphur from spent gas-purifying material. G.P. 357,033. *See* VII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Activated carbon; Suitability of different coals and vegetable matter for the preparation of ——. F. Fischer, H. Schrader, and K. Zerbe. Brennstoff-Chem., 1922, 3, 241—244.

The wash oil process in practice may still leave one-third of the benzol in the gas, but the use of activated carbon, though more effective, is too costly and the working life too short. Various raw materials have been examined to see if supplies can be obtained so cheaply as to permit the discarding of the carbon after the activity has been impaired, *e.g.*, by deposition of tar. A variety of vegetable substances and coals were examined but only the lignites yielded a product comparable with that obtained from cellulose. The activity of the lignite coke could be improved by pressure extraction of the raw material with benzene. Alexandria lignite carbonised at 800° C. in steam yielded a coke capable of absorbing from air saturated with benzene 22·1% of its weight as compared with 25·3% for charcoal from cellulose.
—H. J. H.

Patents.

Dissolution of wood and other cellulose-containing materials of vegetable origin; Process for the ——. Rütgerswerke A.-G., and H. Teichmann. E.P. 160,467, 4.3.21. Conv., 17.3.20.

Wood in the form of dust or shavings is mixed with about 5 times its weight of anthracene or similar coal tar oil and heated to about 300° C. An alkali may be added to combine with the acids produced, or a mineral acid may be used if the raw material contains nitrogen. The mixture is stirred and the volatile products are passed into a condenser. The insoluble residue is separated from the tar by filtration. Acetic acid, methyl alcohol, creosote, etc., are recovered from the filtrate, and there remains a pitch-like residue soluble in tar oils.
—H. Hg.

Retorts for the distillation of coal and other carbonaceous substances. Low Temperature Carbonisation, Ltd., Low Temperature Construction, Ltd., and T. M. Davidson. E.P. 185,778, 21.3.21.

The plates mounted centrally within a vertical retort as described in E.P. 161,608 (J., 1921, 380 a) are pivoted on a spindle at the top of the retort. There are transverse flanges on the inner faces of the plates which abut one against the other and keep the plates spaced apart during the carbonisation period. Upon rotation of the spindle through 90° the plates move away from the carbonised charge, one in an upward direction and one in a downward direction. The spindle may take the form of a pivoted beam so shaped as to prevent the entry of fuel to the space between the plates while the retort is being charged.—H. Hg.

Low temperature carbonisation; System of ——. J. A. Yeadon. E.P. 185,684, 5.12.21.

Powdered coal is fed into, and coke discharged from, a vertical retort through horizontal cylinders as described in E.P. 114,971 (J., 1918, 295 a). The charging cylinder is heated on its underside by steam or by waste heat from the retort setting, and at its outlet end a rotary distributor is fitted to cause the coal to descend the retort in a fine spray. The coal is heated to 400°—700° C. in the retort, which is of oblong cross-section and provided with internal corrugations as described in E.P. 127,986 (J., 1919, 565 a). The discharge cylinder is water-jacketed.—H. Hg.

Carbon for hardening steel and iron; Process for obtaining extracts and —— from nitrogenous organic matter. M. Lindner. G.P. 357,226, 11.9.20. Addn. to 287,665 (J., 1916, 258).

The process of heating the organic matter in an autoclave under pressure is carried out in the presence of oxygen and carbon dioxide. The yield of extract is in this way considerably increased, the ratio of extract to carbon being 60:40 instead of 20:80 as in the earlier process.—H. C. R.

Gas-tight seals or closures between metals and vitreous materials [quartz]; Production of ——. The Silica Syndicate, Ltd., and F. Reynolds. E.P. 185,952, 7.9.21.

Two or more wires are passed through separate holes in a cylinder or plug of vitreous material, such as quartz or silica glass, the cylinder or plug is fused into an enveloping tube of quartz or silica glass, and the seal completed with lead in accordance with E.P. 23,854 of 1913 (J., 1914, 571).
—J. S. G. T.

Incandescence bodies; Production of —— from tungsten. Bergmann-Elektrizitäts-Werke A.-G. G.P. 355,335, 14.11.12.

In manufacturing incandescence bodies by compressing and heating coarse tungsten powder, finely crystalline tungsten powder is added in place of the usual organic binders, thereby facilitating the sintering of the compressed mass.—L. A. C.

Retorts for distillation [*of bituminous materials*]. Deutsche Petroleum A.-G., S. Kacser, and E. Bauer. E.P. 165,724, 23.6.21. Conv., 3.7.20.

See G.P. 350,572 of 1920; J., 1922, 456 A.

III.—TAR AND TAR PRODUCTS.

Phenols of low-temperature tars. A. Weindel. Brennstoff-Chem., 1922, 3, 245—249. (*Cf.* J., 1920, 150 A, 151 A.)

The tar acids from low-temperature tar produced in the Dellwik-Fleischer "Trigas" process have been examined with a view to their identification. The tar acids were separated and fractionated within close limits. The carbon and hydrogen contents of these fractions were compared with the figures for known phenols. The low hydrogen contents point to the presence of unsaturated and polyhydric phenols. An alternative method was the determination of the molecular weights of the phenol acetic esters, which gave confirmatory results. β-Naphthol was identified.—H. J. H.

Pyridine; Test for ——. F. Lehner. Chem.-Zeit., 1922, 46, 877.

If a few drops of aniline are added to a solution of pyridine containing water and a trace of freshly prepared cyanogen bromide, a red colour is immediately obtained and crystals of α-anilidophenyldihydropyridine bromide separate. Pyridine can be thus detected at a dilution of 1:350,000.—H. C. R.

Active carbon. Fischer and others. *See* IIb.

Aniline arsenates. Paternò. *See* XX.

Pyridine. Spacu. *See* XXIII.

Patents.

Anthraquinone; Purification of ——. H. F. Lewis, Assr. to National Aniline and Chemical Co., Inc. U.S.P. 1,429,514, 19.9.22. Appl., 22.12.20.

Crude anthraquinone is purified by crystallisation from comercial *o*-dichlorobenzene.—L. A. C.

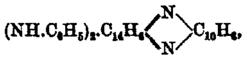
Phenols and the like; Method of manufacturing ——. R. Pocius. U.S.P. 1,430,184, 26.9.22. Appl., 17.7.20.

In the manufacture of compounds containing the hydroxyl group, *e.g.*, phenols, by fusing other compounds with a quantity of a hydroxide in excess of that required for the reaction, the liquor containing the excess hydroxide is concentrated for use in further fusions.—L. A. C.

IV.—COLOURING MATTERS AND DYES.

Phenanthraquinone; Dyes derived from ——. *I. Phenanthranaphthazines.* A. C. Sircar and S. Dutt. Trans. Chem. Soc., 1922, 121, 1944—1951.

Nitro- and bromo-substituted phenanthraquinones, condensed with 1.2-naphthylenediamine and its 5-sulphonic acid in glacial acetic acid solution, give a series of azine dyes which dye yellow shades on wool, light in the case of the bromo- and deeper in that of the nitro-derivatives. Condensation of 1.2-naphthylenediamine with amino- and hydroxy-substituted phenanthraquinones gives azines, insoluble in water, but soluble in organic solvents, which dye wool from acid baths in shades varying from light yellow to dark brown. They are characterised by high melting point, sparing solubility in organic solvents, well-developed tinctorial properties, and stability to oxidising agents. The dyeing properties of dihydroxydihydrophenanthranaphthazines are unsatisfactory. Ullmann's reaction for the replacement of bromine atoms by anilino groups (Ber., 1901, 34, 2174) can be applied in the phenanthraquinone series. The anilino derivatives so obtained in general dye blue shades, while the corresponding azines without the anilino group dye redder shades. 2.7-Dianilinophenanthranaphthazine,

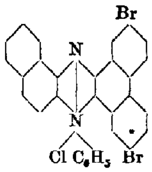


$$(NH.C_6H_5)_2.C_{14}H_6\langle N_2 \rangle C_{10}H_6,$$

and the 4-nitro-5-anilino-, dinitroanilino- and nitrodianilino-phenanthranaphthazines prepared in this way dye wool in full shades ranging from olive green to bottle green. They are insoluble in water and nearly so in organic solvents. The introduction of sulphonic groups into the azine molecule gives sodium salts, soluble in water, which dye wool from an alkaline bath in brown to maroon shades, the shade being deeper than is obtained with the unsulphonated compound.—P. V. M.

Phenanthraquinone; Dyes derived from ——. *II. Naphthaflavindulines.* S. Dutt. Trans. Chem. Soc., 1922, 121, 1951—1955.

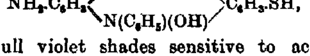
2.7-Dibromonaphthaflavinduline (see formula)



and the 2.7-dianilino-, 3-bromo-, 3-anilino-, 2.7-dinitro-, 4.5-dinitro-, 2-nitro-, 4-nitro-, 2.7-diamino-, 4.5-diamino-, 2-amino, 4-amino-, 2.7-dihydroxy-, 4.5-dihydroxy-, 2-hydroxy-, 4-hydroxy-, dibromonitro- and bromodinitro-naphthaflavindulines, prepared in most cases by condensing the corresponding phenanthraquinone derivatives in acetic acid and nitric acid solution with phenyl-1-amino-β-naphthylamine, exhibit dyeing properties in general much better than those of the corresponding phenanthranaphthazines (*cf. supra*). Freshly prepared, they dye wool evenly from an acid bath. They are difficultly crystalline, and are decomposed with difficulty by fuming nitric acid; they dissolve in concentrated sulphuric acid with a brown colour.
—P. V. M.

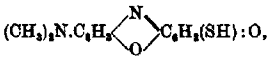
Red sulphide dyes; Attempts to prepare ——. E. R. Watson and S. Dutt. Trans. Chem. Soc., 1922, 121, 1939—1943.

Attempts to prepare red sulphide dyes of the azine, oxazine, phthalein, nitroso, and acridine series failed. 2-Amino-8-thiol-10-phenylphenazonium hydroxide,



$$NH_2.C_6H_3\langle N,\ N(C_6H_5)(OH) \rangle C_6H_3.SH,$$

gives dull violet shades sensitive to acids and alkalis; 9-dimethylamino-2-thiol-3-phenoxazone,

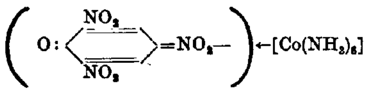


$$(CH_3)_2N.C_6H_3\langle N,\ O \rangle C_6H_2(SH):O,$$

gives light indigo-blue shades, and a product (2.8-diamino-3.7-dithiolacridine?), prepared by boiling 2.2′.4.4′-tetra-amino-5.5′-dithioldiphenylmethane, $CH_2[C_6H_2(NH_2)_2.SH]_2$, with ferric chloride and hydrochloric acid, gave light brown shades on cotton. Dithiolfluorescein, obtained by condensation of thiofluorescein and phthalic anhydride, and possibly identical with the compound previously prepared by Maki (J., 1921, 143 A) from fluorescein and sodium sulphide, and dinitrosothiolresorcinol are soluble in sodium sulphide but have no affinity for cotton.—P. V. M.

Cobaltammine salts of the nitro-dyes. Researches on residual affinity and co-ordination. IX. G. T. Morgan and H. J. S. King. Chem. Soc. Trans., 1922, **121**, 1723—1729.

Unlike the mordant dyestuffs of the quinoneoxime, alizarin, and hydroxyazo series, the substantive nitro-dyestuffs do not furnish chelate groups, each capable of reacting as two associating units in the co-ordination sphere of the cobaltic atom. This behaviour of the nitro-dyestuffs may be assigned to a lack of residual affinity in the nitro groups as regards cobalt, or it may be taken as corroborative evidence of the *p*-quinonoid configuration of these substances, hexammino-cobaltic picrate, for example, being formulated



A number of cobaltammine compounds of picric acid, dipicrylamine, 2.4-dinitro-α-naphthol (Naphthol Yellow N), and 2.4-dinitro-α-naphthol-7-sulphonic acid (Naphthol Yellow S) were prepared and are described. The cobaltammine picrates were crystalline compounds, sparingly soluble in cold water to yellow solutions, undergoing partial hydrolysis on warming. The dipicrylamine salts were red non-crystallisable solids, somewhat more soluble in water than the cobaltammine salts of other nitro-dyestuffs. The cobaltammine salts of Naphthol Yellow N were formed as pasty non-crystalline precipitates, brick red in colour when dry. Only dicobaltammine salts of Naphthol Yellow S could be obtained. They were orange, crystalline hydrated compounds, sparingly soluble in water.
—G. F. M.

Saffron. Guerbet. *See* XX.

Reductions with cadmium in analysis. Treadwell and others. *See* XXIII.

Patents.

2.3-Hydroxynaphthoic acid arylides; Manufacture of sulphonic acids of ——. Farbw. vorm. Meister, Lucius, und Brüning. E.P. 183,428, 23.5.22. Conv., 19.7.21.

By heating with sulphuric acid monohydrate for a short time to 90° C. the arylamides of 2.3-hydroxynaphthoic acid are converted into sulphonic acids which are valuable as dyestuff intermediates. The acids are light grey powders; the solutions in hot water sometimes solidify to a jelly on cooling. The alkali salts are soluble in water to a faint yellow solution.—G. F. M.

Triarylmethane colouring matters; Manufacture of new ——. British Dyestuffs Corp., Ltd., A. G. Green, K. H. Saunders, and S. C. Bate. E.P. 185,612, 17.8.21.

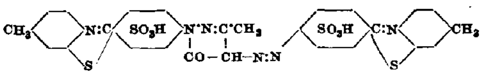
New triarylmethane dyestuffs containing an oxyalkyl group attached to nitrogen are obtained by condensing Michler's ketone or Michler's hydrol with a hydroxyalkylarylamine, a dihydroxyalkylarylamine, a hydroxyalkylalkylarylamine, or a hydroxyalkylaralkylarylamine, and in the case of the hydrol oxidising the leuco compound first produced to the dyestuff in the usual way. *Example.* The hydrochloride of hydroxyethyl-tetramethyl-triaminonaphthyldiphenylcarbinol,

$$[(CH_3)_2N.C_6H_4]_2:C:C_{10}H_6:NHClC_2H_4OH,$$

is obtained by adding 23 pts. of oxyethyl-α-naphthylamine to the product of the action of 20 pts. of phosphorus oxychloride on 30 pts. of tetramethyldiaminodiphenyl ketone (Michler's ketone) in presence of toluene as diluent. The dyestuff crystallises on cooling in green crystals which have the same properties as Victoria Blue R, except that the solubility is much greater. The hydrochloride of tetramethyl-dihydroxyethyltriaminotriphenylcarbinol, $[(CH_3)_2N.C_6H_4]_2C:C_6H_4:N(Cl)(C_2H_4.OH)_2$, prepared from Michler's hydrol and dihydroxyethylaniline, and oxidation of the leuco compound with lead peroxide, is a coppery powder which dyes tannin-mordanted cotton bright purple shades. Other shades of purple are obtained by substituting monohydroxyethylaniline, dihydroxyethyl-*o*-toluidine, etc., for the dihydroxyethylaniline above.
—G. F. M.

Direct cotton dyestuffs; Manufacture of ——. British Dyestuffs Corp., Ltd., J. Baddiley, J. B. Payman, and E. G. Bainbridge. E.P. 185,880, 28.6.21.

Pyrazolone dyestuffs containing two arylbenzothiazole residues and capable of dyeing unmordanted cotton in shades fast to light, washing, and ironing, are produced by interaction between 2 mols. of a thiazolehydrazine and 1 mol. of dioxytartaric acid or alternatively by reaction between 1 mol. of a thiazolehydrazine and 1 mol. of ethyl acetoacetate or oxalacetate, the pyrazolone thus formed being subsequently coupled with a diazotised thiazole. For example, a dyestuff of the formula



is formed by the following method. To 335 pts. of the hydrazine compound obtained from dehydrothiotoluidinemonosulphonic acid suspended in water and neutralised with soda ash are added 160 pts. of sodium acetate and 140 pts. of acetoacetic ester, the mixture is boiled under a reflux condenser for 8 hrs., and acidified; the pyrazolone thus obtained (401 pts.) is coupled with the diazo compound from 343 pts. of dehydrothiotoluidinesulphonic acid and the dye salted out.—A. J. H.

Safranines; Preparation of anthraquinonyl derivatives of ——. Akt.-Ges. für Aniln-Fabr. G.P. 355,491, 13.8.19.

Aposafranine derivatives are treated with aminoanthraquinones in the presence of alkalis, and, if necessary, the dyestuffs produced thereby are sulphonated, yielding acid dyestuffs which dye wool from a hydrosulphite vat. The condensation product obtained by heating dimethylisorosinduline chloride, prepared from nitrosodimethylaniline and 2-phenylaminonaphthalene, with 2-aminoanthraquinone and sodium hydroxide in the presence of nitrobenzene, is treated with fuming sulphuric acid, yielding a dyestuff which gives blue shades on wool from a vat. A similar dyestuff is obtained by condensing 2-aminoanthraquinone with isorosinduline, which is prepared from 2-phenylaminonaphthalene and 1-amino-4-diethylaminobenzene-2-sulphonic acid.—L. A. C.

Vat dyestuff of the anthraquinone series; Preparation of a blue ——. E. Kopetschni. G.P. 356,922, 1.5.14.

1-Mercapto-2-aminoanthraquinone or the corresponding disulphide is heated with a substance capable of removing sulphur, *e.g.*, with copper powder in the presence of naphthalene, yielding N-dihydro-1.2.2′.1′-anthraquinoneazine.—L. A. C.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Flax and kindred fibres. Method for distinguishing flax from hemp. C. R. Nodder. J. Textile Inst., 1922, **13**, 161—171.

The fibrillar structure of the fibres is brought into prominence by mounting in a strong solution of calcium chloride which has been slightly tinted with iodine. The fibre thus softened is then squeezed by pressing the cover glass carefully with a scalpel while under observation under the microscope. The various growth-layers of the cell wall thus become widely separated and distinctly visible. The fibrils of the outer layers of the flax and ramie fibres are observed to form a left-handed spiral, while the fibrils of the hemp and jute fibres are arranged in right-handed spirals. Based on this difference a method for distinguishing between flax and hemp fibres, at any stage of manufacture or purification, is proposed. The material is cut up into short pieces and steeped for some minutes in warm water. Single fibres are picked out with a pair of forceps and held over a hot-plate against a dark background. During the wetting the fibres have undergone a rapid twisting movement in accordance with their characteristic fibrillar arrangement, and when they are held at one end while drying this twisting movement is reversed. If the wet fibre be held with the free end pointing towards the observer, flax and ramie fibres describe a clockwise twisting movement when drying, whereas hemp and jute fibres always move in the anti-clockwise direction. This spiral structure of the component fibres may be assumed to have an important influence on the properties of twisted yarns in textile practice.—J. F. B.

Cellulose; Aerobic decomposition of —— by mould fungi. N. I. Kosin. Nachr. Phys.-Chem. Lomonossow-Ges. Moskau, 1921, **2**, 57—98. Chem. Zentr., 1922, **93**, III., 874.

Mould fungi, particularly *Cladosporium*, are capable of attacking cellulose in the presence of air and mineral nutrient salts, with the primary formation of a hexose which is subsequently converted into carbon dioxide. In the course of 256 days, 25% of the cellulose was thus destroyed. Saccharification takes place under the agency of an enzyme which has been isolated. A similar destruction of cellulose takes place in nature during the summer months and sugar is produced.—J. F. B.

Pine oil. Sandqvist. *See* XIII.

Patents.

Impregnation of textile fabric, paper, etc. L. Ubbelohde. G.P. 316,099, 11.8.17. Addn. to 303,324 (J., 1922, 704 A).

The fabric is soaked in solutions of humic acid and other substances extracted from peat or lignite by means of alkalis, and is then treated with a precipitating agent such as alum or ferric sulphate.

—H. C. R.

Mixed fibre textile goods; Production of ——. A. G. Bloxam. From Technochemia A.-G. E.P. 185,238, 4.6.21.

A mixed textile material which appears to contain one kind of fibre only, even when dyed, is made by spinning a mixture of animal fibres, *e.g.*, wool slivers, treated as described in E.P. 183,249 and 183,270 (*cf.* U.S.P. 1,389,274-5; J., 1921, 765 A) with combed artificial cellulose fibres of any degree of fineness in the ratio, for example, of 1:2.

—D. J. N.

Fur and wool; Process for protecting —— from moth and other insects. Vereinigte Chem. Fabr. J. Norden und Co. G.P. 357,063, 25.10.21.

Animal fibres are protected from moth etc. by treatment with the vapour of α-tetralon (α-tetrahydronaphthaleneketone) or mixtures of this with other suitable substances. The protective effect of α-tetralon is more lasting than that of chlorinated aromatic compounds, since it is less volatile. α-Tetralon is obtainable as an emulsion in soft soap or in the form of a powder, pellets or tablets. Paper and fabrics may be treated with solutions of α-tetralon in petroleum spirit of high boiling point.

—A. J. H.

Viscose; Preliminary treatment of cellulose intended for the manufacture of ——. W. Cross. From Technochemia A.-G. E.P. 185,433, 4.3.21.

Bleached or unbleached sulphite or soda wood pulp is treated with 0·5% hydrochloric acid at 100° C., or with 2% hydrochloric acid at 80° C., or 8% hydrochloric acid at 40°—50° C., or with 0·2% sulphuric acid in a closed vessel under a steam pressure of 0·5 atm. for several hours. The digested cellulose is washed free from acid and transformed into viscose by treatment with only 30—40% of the quantities of sodium hydroxide and carbon bisulphide usually required. Under the conditions specified, if no drying of the cellulose be permitted, there is no formation of hydrocellulose as measured by solubility of the treated cellulose in boiling barium hydroxide solution.—J. F. B.

Nitrocellulose composition [for films]. A. F. Sulzer, Assr. to Eastman Kodak Co. U.S.P. 1,429,174, 12.9.22. Appl., 23.2.21.

A liquid composition for forming film by flowing and drying consists of nitrocellulose 100 pts., a monohydric aliphatic alcohol having 4 to 5 carbon atoms 10 to 100 pts., ethyl butyrate 1 to 100 pts., and sufficient common solvent to make a viscous solution.—T. A. S.

[Cellulose ether] films; Process of treating ——. W. R. Webb, Assr. to Eastman Kodak Co. U.S.P. 1,429,179, 12.9.22. Appl., 4.11.21.

The curling tendency of a film containing cellulose ether is lessened by applying a solvent to the face of the film and stopping the application before the body of the film is attacked.—T. A. S.

Pyroxylin composition and process of making the same. W. G. Lindsay, Assr. to The Celluloid Co. U.S.P. 1,430,020, 26.9.22. Appl., 16.2.20.

A pyroxylin composition having a high degree of flexibility consists of 100 pts. of nitrocellulose and more than 60 pts. of an aromatic phosphate.

—A. J. H.

Ethers of carbohydrates; Production of ——. G. Young. E.P. 184,825, 12.9.21.

Alkyl ethers of carbohydrates of the general formula $(C_6H_{10}O_5)_n$, *e.g.*, cellulose, starch, and dextrin, are made by heating the carbohydrate (1 mol. $C_6H_{10}O_5$) in admixture with approximately 1—1½ times its weight of a metallic hydroxide, preferably sodium hydroxide, and 0·5—0·75 times its weight of water, with about 20 mols. of an alkyl chloride, *e.g.*, methyl, ethyl, propyl, or amyl chloride, in a revolving autoclave for 6—8 hrs. at 100°—150° C. (preferably not above 130° C.). A convenient method of mixing the carbohydrate with alkali is to soak the carbohydrate for 30 mins. in a 40% solution of alkali, and then gently squeeze out the excess of solution. When methyl or ethyl chloride is used as the alkylating agent, it is introduced into the autoclave by means of a pressure pump and the reaction proceeds sufficiently rapidly at 100° C. Inert diluents such as benzene, and catalysts, such as finely divided copper, may also be used. When etherification is complete, the unchanged alkyl chloride is removed by distillation, excess of alkali is removed by washing with water, and the product purified by solution in glacial acetic acid and precipitation by water. Good yields are obtained and the ethers produced are insoluble in benzene, methyl or ethyl alcohol, but soluble in glacial acetic acid; they may be used for the manufacture of artificial threads, films, plastic masses, etc.—D. J. N.

[Sulphite] pulp boilers; Recovery of sulphurous acid and heat from the waste gases from ——. Process of filling pulp boilers with heated sulphite lye. (A) Zellstoff-fabr. Waldhof, C. Hangleiter, and H. Clemm, (B) Zellstoff-fabr. Waldhof, and H. Clemm. E.P. (A) 167,171 and (B) 168,866, 25.7.21. Conv. (A) 2.8.20, (B) 4.9.20.

(A) Waste gases etc., from sulphite pulp boilers are passed without cooling into raw sulphite liquor contained in a closed lead-lined tank capable of withstanding pressure. The liquor, when sufficiently enriched with sulphurous acid and heated to a temperature of 90° C. or above, is transferred directly to a boiler, freshly charged with wood. (B) Wood pulp boilers are filled with hot sulphite liquor by means of a pressure pump or similar device, the digester being closed by an excess pressure valve which can be adjusted so that for any given temperature the desired quantity of sulphur dioxide is retained in the acid liquor.—D. J. N.

Sulphite pulp digesters; Blowing off of —— with recovery of sulphur dioxide and heat. Zellstoff-fabrik Waldhof. G.P. 350,471, 28.4.21.

The gases and steam discharged from the digesters are condensed in the immediate neighbourhood of the digesters by means of fresh liquor and are absorbed by this liquor.—J. F. B.

Printed papers; Recovery of paper fibres or pulp from ——. S. Kumagae and T. Chiba. G.P. 356,742, 5.10.21.

The waste paper is boiled with a mixture of the residual liquor from the manufacture of "Tofu," with soap and sodium thiosulphate, and the printers' ink is removed in the usual way by washing the pulp. "Tofu" is a Japanese foodstuff prepared from the soy bean.—J. F. B.

Animal and vegetable fibres; Method of rendering —— active. J. Korselt, Assrs. to The Chemical Foundation, Inc. U.S.P. 1,426,298, 15.8.22. Appl., 24.10.17.

See E.P. 108,489 of 1917; J., 1920, 482 A.

Textile materials; Degumming ——. G. Jenny and O. Jaeck, Assrs. to Swiss Ferment Co., Ltd. U.S.P. 1,430,523, 26.9.22. Appl., 16.6.20.

See E.P. 145,583 of 1920; J., 1921, 383 A.

Graphitised vulcanised fibre; Methods of preparing ——. E. G. Acheson, jun. E.P. 174,899, 7.7.21. Conv., 31.1.21.

See U.S.P. 1,379,156 of 1921; J., 1921, 540 A.

Cellulose esters; Production of ——. A. D. Little, Inc., Assees. of G. J. Esselen, jun., and H. S. Mork. E.P. 161,564, 9.3.21. Conv., 10.4.20.

See U.S.P. 1,425,580 of 1922; J., 1922, 748 A.

Cellulose ester compositions. E. I. Du Pont de Nemours and Co., Assees. of J. M. Kessler. E.P. 165,439, 2.3.21. Conv., 19.6.20.

See U.S.P. 1,360,759 of 1920; J., 1921, 42 A.

Cellulose esters; Manufacture of ——. J. Koetschet and M. Beudet, Assrs. to Soc. Chim. Usines du Rhône. U.S.P. 1,389,250, 30.8.21. Appl., 12.1.21.

See E.P. 146,092 of 1920; J., 1921, 765 A.

Cellulose; Process for the recuperation of the sulphurous acid and heat from waste gases coming from boilers for ——. H. Clemm and C. Hangleiter, Assrs. to Zellstoff-fabr. Waldhof. U.S.P. 1,429,128, 12.9.22. Appl., 2.3.21.

See E.P. 167,171 of 1921; preceding.

Cellulose; Process for producing —— from reeds and similar kinds of plants [by mechanical grinding]. H. Steinhilber. E.P. 179,885, 21.6.21. Conv., 13.5.21.

Regulating the strength of lye. U.S.P. 1,429,129. *See* I.

Friction facing. E.P. 185,809. *See* XIII.

Floor coverings. E.P. 185,816. *See* XIII.

Tanning preparation. U.S.P. 1,430,477. *See* XV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Patents.

Liquid washing blue and bleaching preparation and process for making the same. J. J. Reichelt. E.P. 176,747, 13.6.21. Conv., 8.3.21.

A liquid preparation containing ultramarine and which exerts simultaneously a purifying, bleaching, and disinfecting action is made by heating a mixture containing borax, turpentine oil, alcohol, water-glass, sodium tungstate, formaldehyde, and ultramarine. This preparation is not affected by hard water.—A. J. H.

Cleansing and sterilising textile fabrics and other materials; Preparations for ——. A. Maclennan. E.P. 185,828, 9.6.21.

A powder suitable for cleansing lace curtains, silks, tapestries, carpets, linoleum, etc., and also, in conjunction with a 5% solution of hydrogen peroxide, suitable for removing ink, iodine, and paint stains from fabrics, consists of 53½ pts. of a mixture of equal parts of palm and cokernut (coconut) oils, 31½ pts. of anhydrous sodium carbonate, and 15 pts. of water, together with a further addition of about 2% of ultramarine for the purpose of correcting yellow coloration. In the preparation of this powder, 60 pts. of the mixture of oils is saponified at 38°—45° C. with a strong solution containing 35 pts. of anhydrous sodium carbonate, and the product is allowed to cool and solidify.—A. J. H.

Bleaching and dyeing vegetable and animal fibres; Process of ——. A. S. Roberts, Assr. to Surpass Chemical Co., Inc. U.S.P. 1,429,775, 19.9.22. Appl., 30.3.21.

Textile material is bleached and dyed at the same time in a bath containing a dyestuff, an alkaline oxidising agent, and a neutralising agent. —A. J. H.

Printing; Multicolour ——. F. Kunert and E. Acker, Assrs. to The Chemical Foundation, Inc. U.S.P. 1,426,299, 15.8.22. Appl., 2.11.16.

See E.P. 104,108 of 1916; J., 1917, 384.

Cotton; Process for imparting transparent effects to ——. H. Forster, Assr. to C. Forster. U.S.P. 1,430,163, 26.9.22. Appl., 21.9.20.

See E.P. 162,627 of 1921; J., 1922, 291 A.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitrogen oxides; Reactions between gaseous —— and alkaline solutions. A. Sanfourche. Comptes rend., 1922, 175, 469—472.

In estimating gaseous oxides of nitrogen, sulphuric acid is to be preferred to alkali as an absorbent, as the latter, in presence of oxygen, gives too high a figure unless alkali is in excess at all points of contact. If this condition is not fulfilled the formation of nitrite and nitrate is affected by the reaction with water to form nitric acid and nitric oxide, the latter combining with more oxygen. Further, if absorption of the vapour in alkali is incomplete, volatilisation of water causes the reaction to take place in the gaseous phase and free nitric acid is formed as a mist even in presence of alkaline solution.—H. J. E.

Ammonia; Limits for the propagation of flame at various temperatures in mixtures of —— with air and oxygen. A. G. White. Trans. Chem. Soc., 1922, **121**, 1688—1695.

Propagation of flame downwards in mixtures of ammonia with air, determined in tubes of 5 cm. diam. at temperatures from 0° to 450° C., begins when the temperature approaches 70° C., the optimum mixture containing about 22·5% of ammonia by volume, while the mixture for complete combustion contains just under 22%. Up to 140° C. the interval between the upper and lower limits increases very rapidly. Above this point the upper limit increases at the same rate for downward propagation as for propagation in other directions, but the lower limit decreases more rapidly for downward—10% per 100° C.—than for upward or horizontal propagation; for the last-named the decrease appears to be 7% per 100° C. The limits with air determined in tubes of 7·5 cm. diam. are approximately the same for upward as for horizontal propagation. The upper and lower limits for mixtures of ammonium and air at any one temperature are nearly symmetrically situated about the mixture for complete combustion for all directions of propagation. The lower limit for horizontal propagation for ammonia-air mixtures at 18° C. in a tube of 7·5 cm. diam. is 17·4% and for ammonia-oxygen mixtures 15·6%. In determining the upper limit mixtures with oxygen great care had to be taken, as using slightly too little ammonia was apt to cause a violent explosion. Calculation shows that to ensure propagation at the lower limits the flame temperature must be approximately the same —about 1620° C.—whatever the initial temperature of the mixture. Undried air was used in the experiments, since moisture up to 2·5% is without effect on the limit values.—P. V. M.

Sulphurous acid; Autoreduction of ——. G. M. Bennett. Trans. Chem. Soc., 1922, **121**, 1794—1795.

Sulphurous acid, liberated in solution at 100°—120° C. and lower temperatures, by dropping powdered sodium sulphite or metabisulphite, or saturated solutions of these salts into hot aqueous 60—70% sulphuric acid, to which a small quantity of antimonious oxide has been added, undergoes instantaneous autoreduction with formation of hydrogen sulphide. Gaseous sulphur dioxide, the solid hydrate, or saturated solutions of sulphur dioxide gave negative results.—P. V. M.

Carbon dioxide; Rate of absorption of —— by ammoniacal solutions. P. Riou. Comptes rend., 1922, **175**, 472—474.

The author has investigated the rate of absorption of carbon dioxide by solutions of ammonium carbonate containing different proportions of bicarbonate, and expresses his results by diagrams showing velocity as a function of concentration and also of temperature. In the former, the rate of absorption reaches a maximum and then falls off; the presence of bicarbonate renders the action considerably slower. In the latter increasing concentration of bicarbonate in proportion to carbonate lowers the temperature at which the maximum is reached.—H. J. E.

Alkali metal bisulphites; Equilibria in aqueous solutions of ——. E. C. C. Baly and R. A. Bailey. Trans. Chem. Soc., 1922, **121**, 1813—1821.

The equilibrium mixtures of air-free solutions of metabisulphites or of bisulphites contain $K_2S_2O_5$, K, $KHSO_3$, HSO_3, and possibly S_2O_5, hence these solutions show the absorption band, $\lambda=257\mu\mu$ of metabisulphite. Such solutions are stable to light in absence of oxygen, but in the presence of oxygen, photo-oxidation of the HSO_3 ion occurs, followed by an ionic rearrangement whereby normal sulphate, sulphurous acid and hydrated sulphur dioxide are produced. The solution then shows the absorption band at $\lambda=276\mu\mu$ characteristic of hydrated sulphur dioxide. No isomerism of sulphite molecules has been detected.—P. V. M.

Nitrites; Detection of ——. P. Falciola. Gazz. Chim. Ital., 1922, **52**, II., 87—89.

The following reactions serve for the detection of nitrites. (1) Addition of sodium thiosulphate solution, of about 0·5 *N* concentration, drop by drop to an alkali nitrite solution acidified with sulphuric acid yields a transitory yellow coloration, more or less intense according to the proportion of nitrite present; this reaction is perceptible with 0·0001 *N* nitrite solution. With moderately concentrated nitrite solution, use may be made of sodium thiosulphate test-paper, which is dipped first into the nitrite solution and then into dilute sulphuric or acetic acid. (2) If a litre of water containing 0·0001% of sodium nitrite is treated with about 2 c.c. of sulphuric acid and then with excess of thiocyanate and about 0·1 g. of ferrous sulphate, an orange coloration is readily developed; if only 0·00001% of the nitrite is present, the colour appears more slowly. Should pure ferrous sulphate be unavailable, the water to be tested may be treated with a pinch of thiocyanate, and a small glass tube containing a small piece of iron, such as a nail and a little dilute sulphuric acid, added immediately afterwards; the characteristic coloration appears in the neighbourhood of the glass tube if nitrite is present (*cf.* Horst, J., 1921, 507 A). (3) Excess of aniline phosphate, either solid or in freshly prepared solution, gives a yellow coloration, turning to reddish, with a 0·1% sodium nitrite solution and a faint yellow coloration with a 0·01% solution; the reaction is not detectable with a nitrite solution of greater dilution than 0·001%. Benzene removes the colouring matter from the liquid, and the coloration may be distinguished from that given by hydrogen peroxide by means of sulphuric acid, which turns it red or pink. —T. H. P.

Perchlorates; Preparation of —— by heating chlorates. F. C. Mathers and J. W. H. Aldred. Trans. Amer. Electrochem. Soc., 1922, 57—63. [Advance copy.]

A yield of about 55% of potassium perchlorate is obtained by heating potassium chlorate at 480°—550° C., for from 30 min. to 4 hours. The actual period of heating necessary is determined by the temperature and the quantity of chlorate used. No catalytic agents have been found which will increase the yield of perchlorate; silver oxide, red lead, mercuric oxide, and glass materially reduce the yield. Sodium chlorate behaves similarly, but gives smaller yields throughout.—J. B. F.

Alkali iodides; Analysis of ——. L. W. Winkler. Pharm. Zentralh., 1922, **63**, 386—387.

Commercial samples of potassium iodide were found to contain 98·6—99·6% of the salt, whilst the purity of samples of sodium iodide was 97·0—99·9%. —W. P. S.

Alkali formates and acetates; Solubilities of —— in water. N V. Sidgwick and J. A. H. R. Gentle. Trans. Chem. Soc., 1922, 121, 1837—1843.

The solubility of the formates and acetates of the alkali metals, like that of most salts of weak acids, increases with the atomic weight of the alkali metal, though the lithium salt is more soluble than the sodium salt below 120° C. in the case of the formates, and at all temperatures in the case of the acetates. Both the sodium and lithium salts are markedly less soluble than are those of the other alkali metals. The solubilities of the anhydrous salts at 100° C. (that of potassium acetate is of the hydrated salt $C_2H_3OK,\frac{1}{2}H_2O$), in molecular percentages, are:—lithium formate 31·7, lithium acetate 34·9, sodium formate 29·8, sodium acetate 27·2, potassium formate 62·1, potassium acetate 43·0, rubidium formate 67·4, rubidium acetate 51·2, cæsium formate 67·7, cæsium acetate 58·3. Hydrates of the formates and acetates of lithium, sodium, rubidium and cæsium and of potassium acetate are described.—P. V. M.

Chromium trioxide—sulphur trioxide—water; The system ——. L. F. Gilbert, H. Buckley, and I. Masson. Trans. Chem. Soc., 1922, 121, 1934—1938.

By measurement of the solubilities of chromium trioxide at 25° and 45° C. in sulphuric acid of varying concentrations the isothermal diagram of the condensed ternary system, chromium trioxide, sulphur trioxide, water, is shown to have three distinct regions, each with a minimum of solubility. In the first region the solid phase is chromium trioxide, the minimum solubility 0·3% by weight, occurring in 70% aqueous sulphuric acid. In the second region, between 85 and 95% sulphuric acid, the solid phase is CrO_3,SO_3, which above 95% sulphuric acid passes into the compound, CrO_3,SO_3,H_2O characteristic of the third region. Both complex compounds have small solubilities, are very hygroscopic and liberate scarlet chromic oxide on exposure. They tend to become amorphous when deposited from sulphuric acid of high concentration or from fuming sulphuric acid. Equilibrium is attained slowly, at least several days being required.—P. V. M.

Chromate electrolysis with diaphragms. A. Lottermoser and K. Falk. Z. Elektrochem., 1922, 28, 366—376.

Extending the work of Müller and Sauer (J., 1912, 982) the authors have investigated the current yields obtainable in the electrolysis of sodium chromate in diaphragm cells of the following types: (1) With two compartments, (a) catholyte NaOH, anolyte Na_2CrO_4; (b) both electrolytes Na_2CrO_4; (2) with three compartments, (a) catholyte NaOH, in the other two compartments Na_2CrO_4, (b) in all compartments Na_2CrO_4. The yields obtained confirmed theoretical considerations. In the two-compartment cell, case (a). the yields of bichromate and of sodium hydroxide approximated to the theoretical 18%. To some extent the diaphragm acts as a third compartment, causing the yield of bichromate for the first half hour to be much higher. In case (b) the yields of both bichromate and sodium hydroxide are nearly 100% for a time, but soon fall off as the migration velocity of the OH ion comes more and more into play. With a three-compartment cell the best yield is obtained in case (b) and this is the most favourable type for the electrolysis. Technically, however, the difficulty would arise of working up the solution in the middle compartment, in which most of the sodium hydroxide accumulates and from which sodium chromate would have to be separated. The paper concludes with a mathematical investigation of the yields possible under different conditions.—E. H. R.

Potassium permanganate; Properties of ——. G. Fester and G. Brude. Z. angew. Chem., 1922, 35, 527.

Crystals of pure potassium permanganate prepared in the dark and in air free from carbon dioxide and organic matter are brown and have a bronze metallic lustre. The finely powdered crystals however show a dark violet colour. When exposed to subdued daylight and ordinary air, the surfaces of crystals develop a violet colour in a few hours and a steel-blue lustre after two days. This change is confined to the surface layer, which acts as a filter protecting the remainder of the crystal. The change is particularly rapid in an atmosphere containing mineral acid. Potassium permanganate oxidises paper and most other organic substances, so that the statement that it is without action on litmus paper is untrue.—H. C. R.

Hydrogen peroxide; Catalysis of —— by finely divided platinum. Influence of inhibitants. E. B. Maxted. Trans. Chem. Soc., 1922, 121, 1760—1765.

The activity of finely-divided platinum in the catalysis of the decomposition of hydrogen peroxide in the presence of the inhibitants, mercuric chloride, mercuric nitrate, and lead acetate, is, over a wide range, a linear function of the concentration of the poison; the curve is of the same type as that representing the inhibition of the activity of catalysts for the hydrogenation of an ethylene linkage. With higher concentrations of the poison the inhibition of activity is less abrupt, the deviation from the linear curve occuring when slightly less than 75% of the original activity has been suppressed; this corresponds to the presence of about 3% of mercuric chloride, 1% of mercuric nitrate, and 8—9% of lead acetate. With the materials employed the decomposition proceeds approximately according to the unimolecular reaction law.—P. V. M.

Arsenic trichloride; Solubility of —— in concentrated hydrochloric acid at 100° *C.* W. D. Treadwell and C. Mussler. Helv. Chim. Acta, 1922, 5, 818—821.

The solubility of arsenic trichloride in concentrated hydrochloric acid at 100° C. was determined by an indirect method consisting in measuring the rate of volatilisation of the trichloride in a current of gaseous hydrogen chloride from the solution at 100° C. The solubility found was 100·3 g. per litre. To volatilise 99% of the $AsCl_3$ present in 100 c.c. of saturated solution at 100° C. requires 19·8 litres of hydrogen chloride gas; to complete the volatilisation to 1 pt. in 1000 requires 29·7 litres of gas. (*Cf.* J.C.S., Nov.)—E. H. R.

Acetylene and nitrogen; Explosion of ——. II. W. E. Garner and K. Matsuno. Trans. Chem. Soc., 1922, 121, 1729—1736.

Explosion experiments on mixtures of acetylene and nitrogen with hydrogen and helium and of acetylene with cyanogen show that substitution of hydrogen or helium for nitrogen causes a marked increase in the rate of cooling, while the temperature of explosion is higher in the presence of helium than when equal amounts of either nitrogen or hydrogen are present. The yield of hydrocyanic acid is given by the relation

$$[HCN]=K_1''[C][N_2]^{0{\cdot}37}$$

where [C] represents the atomic concentration of carbon per litre of bomb volume. $K_1''=0{\cdot}079$ is found to hold for experiments previously reported (J., 1922, 90 A) and for mixtures containing hydrogen and helium. This indicates that the yield of hydrocyanic acid is practically independent of the partial pressure of the hydrogen, being a function only of the area of carbon surface and the concentration of nitrogen. The expression $[NH_3]=K_2[HCN][H_2]$ approximately represents the concentration of ammonia in the explosion mixture, K_2 being decreased by the addition of helium and increased by the addition of hydrogen to the mixture. Helium thus acts as a negative catalyst. The acetylene which escapes decomposition varies between 8% and 4% in the final gases. In the experiments with mixtures containing cyanogen larger amounts of hydrocyanic acid and ammonia were formed.—P. V. M.

Carbon bisulphide; Manufacture of ——. G. A. Richter. Trans. Amer. Electrochem. Soc., 1922, 219—232. [Advance copy.]

The furnace described consists of a cast iron shell lined with refractory material and fitted with water-cooled electrodes to which power is supplied by a 2-phase 440-volt A.C. line with transformers in 10-volt stages. The resistance bed consists of broken arc light carbons. The sulphur is melted externally by steam and fed into the hottest part of the furnace through a liquid seal. The charcoal (willow or birch) must be well burnt and as dry as possible. The carbon bisulphide is condensed and washed with water. This unit has a capacity of 1 ton of carbon bisulphide per 24 hrs. with a power consumption of 0·5—0·7 kw.-hr. per lb. of washed material recovered, and works with an 80% efficiency on sulphur. The thermal efficiency is discussed in detail. The thermal balances for some steps in the complicated transformation from solid rhombic sulphur to sulphur vapour at 1000° C. are unknown, but making approximations, Thomsen's value of −26,000 cals. for the heat of formation of gaseous carbon bisulphide appears to be about correct. Taking this figure the thermal efficiency of the furnace is about 31%, loss by radiation accounting for another 60%. This loss can be reduced by increasing the size of the unit, but such increase also raises the loss of sulphur by sublimation.—C. I.

Thiocyanates. Chlorides and bromides in presence of thiocyanates. Spacu. *See* XXIII.

Radioactive indicators. Paneth. *See* XXIII.

Patents.

Sulphuric acid; Process for producing the effect of the Glover tower in the manufacture of ——, *without the use of Glover towers.* T. Schmiedel. E.P. 184,966, 12.7.21.

In the lead chamber process, the Glover tower is replaced by a mechanical apparatus of the type described in E.P. 149,647 (J., 1921, 613 A). The gases are cooled and freed from dust, the nitrosylsulphuric acid is denitrated, the chamber acid introduced is concentrated, and a greater part of the sulphurous acid is converted into sulphuric acid by the direct action of nitrosylsulphuric acid (*cf.* E.P. 149,648; J., 1921, 693 A).—J. B. F.

Nitric acid purification; Apparatus for ——. G. H. Tozier, Assr. to Eastman Kodak Co. U.S.P. 1,429,177, 12.9.22. Appl., 24.5.21.

An apparatus for obtaining pure concentrated nitric acid consists of a still, a partially refluxing condenser resistant to the concentrated acid, and a complementary condenser connected in series.
—T. A. S.

Acids; Manufacture of ——. W. O. Snelling. U.S.P. 1,430,035, 26.9.22. Appl., 17.7.20.

A mixture of halogen gas or vapour and sulphur dioxide is exposed to actinic rays whilst being sprayed with an aqueous fluid.—D. F. T.

Sulphurous acid [sulphur dioxide]; Process for the manufacture of ——. Rhenania Verein Chem. Fabr. A.-G., formerly Verein Chem. Fabr in Mannheim. E.P. 161.581, 9.4.21. Conv., 14.4.20.

A mixture of ferric oxide (pyrites cinder etc.) with iron pyrites or similar sulphide in the proportion of 1·5—3·0 mols. of Fe_2O_3 to 1 atom of sulphide sulphur is calcined at 900°—950° C. with an alkaline-earth sulphate. The excess of ferric oxide prevents loss of sulphur by sublimation almost completely.—C. I.

Ammonium chloride [solution]; Treatment of ——. A. Riedel. E.P. 167,769, 10.8.21. Conv., 13.8.20.

Ammonium chloride solution is rendered exactly neutral by allowing it to trickle over lumps of calcium carbonate. It can then be handled in iron vessels without corrosion. If the solution contains iron the limestone treatment causes precipitation of this in a form capable of removal by filtration.
—C. I.

Sulphate furnaces; Mechanically operated stirring devices for ——. R. Moritz. E.P. 172,006, 21.11.21. Conv., 23.11.20.

The teeth of the stirring device are made of ferro-silicon containing 12—16% Si. Such material can be cast into any desired shape, is very hard, and is refractory to acids.—J. B. F.

Compound and method of producing same [by means of selenium oxychloride. V. Lenher. U.S.P. 1,385,081, 19.7.21. Appl., 4.8.20.

The patent covers the general application of selenium oxychloride, alone or mixed with a modifying agent, *e.g.*, sulphur trioxide, as a solvent. Examples mentioned are its use for dissolving oxides of molybdenum, selenium, arsenic, and vanadium; for attacking or dissolving metals and non-metals; for reacting with or dissolving unsaturated hydrocarbons and separating them from aliphatic saturated hydrocarbons; for dissolving rubber, plenol-aldehyde condensation products, etc. (*Cf.* J., 1922, 158 A, 159 A, 751 A).

Treating air and gases electrically; Method of and apparatus for ——. [*Oxidation of nitrogen.*] W. T. Hoofnagle, Assr. to Electro Chemical Products Co. U.S.P. 1,388,112, 16.8.21. Appl., 6.3.20.

Air is passed through a non-disruptive electric field and a catalyst, *e.g.*, water vapour, is introduced into the reaction chamber to facilitate combination of nitrogen and oxygen. The products are passed through an oxidising chamber, and the nitrogen oxides subsequently absorbed. In order to maintain a non-disruptive discharge at relatively high air pressures, the electrodes, which may be of nickel, are heated before supplying them with a high-tension current, or the discharge is first produced between the cold electrodes in a partially exhausted chamber, and the air pressure is gradually increased as the electrodes become heated.—J. S. G. T.

Calcium cyanamide; Preparation of ammonium sulphate from crude ——. Bambach und Co. G.P. 299,131, 7.2.13.

Calcium cyanamido is heated with sodium bisulphate and water, the residue filtered off, and the liquor evaporated. The proportions of the reacting substances are so adjusted that the solution contains more than 1·3 pts. (preferably 3 pts.) of Na_2SO_4 to 1 pt. of $(NH_4)_2SO_4$; on evaporation the whole of the sodium sulphate crystallises out, and by further evaporation of the mother liquor, technically pure ammonium sulphate is recovered direct. If necessary, sodium sulphate is added to the solution before evaporation.—C. I.

Nitrogen-containing compounds [calcium cyanide]; Process for making metal —— augmented by gaseous catalysts. J. H. Reid, Assr. to International Nitrogen Co. U.S.P. 1,388,603, 23.8.21. Appl., 12.9.17.

A METAL carbide associated with a gaseous catalyst (*e.g.*, hydrogen chloride, carbon tetrachloride) is exposed to the action of nitrogen and heat, the temperature being maintained below that at which a metal cyanamide is formed.—H. R. D.

Aluminium chloride crystals; Method of preparing ——. H. Howard, Assr. to The Grasselli Chemical Co. U.S.P. 1,430,449, 26.9.22. Appl., 6.3.22.

A CONCENTRATED solution of aluminium chloride is treated with gaseous hydrogen chloride, and the crystals which separate are freed from adhering acid by washing with basic aluminium chloride solution.

Insoluble precipitates [e.g. of aluminium hydroxide]; Process for the separation of —— from solutions. M. Buchner. G.P. 301,332, 5.6.14.

Two solutions which on interaction yield an insoluble precipitate, *e.g.*, aluminium sulphate and ammonia, are separated by a porous partition. The precipitated aluminium hydroxide is thus deposited on the partition, whilst the ammonium sulphate diffuses through. By continuous addition of ammonia to the solution this may be concentrated until solid ammonium sulphate separates, and the process rendered continuous. Metallic hydroxides deposited in this way are in a granular form.—C. I.

Separation of the elementary constituents of air or other gaseous mixtures; Process for the ——. [Extraction of argon.] L'Air Liquide Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. E.P. 184,454, 22.7.22. Conv., 12.8.21.

IN the separation, *e.g.*, of argon from air, by liquefaction and rectification, a gaseous mixture containing a considerable proportion of an element (*e.g.*, argon) of boiling-point intermediate between those of the two main constituents of the mixture, is withdrawn from the usual rectifying column, and a quantity of gas is introduced into the column substantially equal to that removed and of the same composition minus the amount, extracted outside of the column, of the element of intermediate boiling-point (*e.g.*, argon) or of gas rich in that element. The gases obtained by vaporising the liquid produced during the rectification of the gases removed from the main column may be returned to the main column and the vaporisation may be utilised to effect the rectification. Alternatively the liquid may itself be returned to the main column at a point below that at which the gases are removed.—H. H.

Gases; Process for separating mixed —— by centrifugal diffusion. Process for separating oxygen and nitrogen from the air by centrifugal diffusion. R. F. Heinrich. G.P. (A) 347,601, 20.12.19, (B) 354,630, 28.11.20.

(A) A MIXTURE of gases flows at high velocity and under high pressure through a stationary or rotating spiral system which is provided with porous walls, constructed of, *e.g.*, earthenware, on the side having the smaller radius of curvature. For example, if air is passed through the apparatus, the heavier oxygen molecules are thrown by centrifugal force against the impermeable wall, while the lighter nitrogen molecules collect against the permeable wall, through which they diffuse into the atmosphere or into a collecting tube. (B) The diaphragm in the apparatus described in (A) is constructed of layers of fine wire gauze with porous material, such as kieselguhr or charcoal, embedded therein, the upper layer of the gauze being in the form of a wire brush with a large number of fine points. The diaphragm is connected with a source of high-tension electric current and the remainder of the apparatus is earthed. In treating air in the apparatus, the oxygen of density 1·1056 (air=1) is converted into ozone of density 1·7, while the nitrogen is unaltered, the greater difference in density increasing the efficiency of the separation. In addition, particles of charcoal in the diaphragm absorb a large quantity of ozone, and this aids in preventing the remainder of the ozone from diffusing through the diaphragm.—L. A. C.

Oxygen; Aqueous solutions containing —— and methods of producing same. O. Y. Imray. From Aquazone Laboratories, Inc. E.P. 185,659, 13.10.21.

COMPRESSED air under a pressure of 130—140 lb. per sq. in., preferably in the form of a jet, is continuously forced through water, which is agitated, for 30—40 min., the temperature being kept about 54° F. (12° C.). The oxygen is preferentially dissolved and the product contains more than 35 c.c. of oxygen per litre of water. Containers are filled with the product under pressure, and hermetically sealed. When the pressure is released several days elapse before the whole of the excess of oxygen has been evolved. The solution has a powerful oxidising action and has valuable therapeutic properties.—J. B. F.

Iodine; Tablet for producing ——. L. Davis, Assr. to Brewer and Co., Inc. U.S.P. 1,429,276, 19.9.22. Appl., 26.11.21.

A SOLID tablet which will liberate iodine on contact with water is compounded of potassium iodide, potassium bromide and bromate, and urea nitrate or analogous compound.—C. I.

Hydrogen; Drying —— by compression and cooling. Berlin-Anhaltische Maschinenbau A.-G. G.P. 300,711, 30.8.16.

HYDROGEN is compressed, cooled, and dried prior to storage in low-pressure holders, the compressed gas before cooling being passed through a tubular heat exchanger, through which, in the opposite direction is passing the compressed dried gas on its way to the expansion device. The holders may be sealed with oil, glycerin or other liquid instead of water. Alternatively the gas may be dried by reducing its pressure whilst it passes through a cooling device and before it reaches the high-pressure containers.—A. B. S.

Sulphur; Recovery of —— from material containing the same, especially spent gas-purifying material. Badische Anilin- und Soda-Fabr. G.P. 357,033, 25.3.19.

HOT inert gases, such as the products of combustion of producer gas, are led through a mass containing sulphur, *e.g.*, spent gas-purifying material, and the issuing stream of gas is cooled to a point above the melting point of sulphur, whereby liquid sulphur is deposited. A portion of the gas is subsequently withdrawn and the remainder is mixed with a fresh supply of hot gas and again passed through the material, or a portion of the gas may be circulated repeatedly through the mass before it is cooled.—L. A. C.

Sodium bicarbonate; Production of ——. Nitrogen Corp., Assees. of E. E. Arnold and P. St. Clair, jun. E.P. 159,895, 8.3.21. Conv., 11.3.20.

SEE U.S.P. 1,423,510 of 1922; J., 1922, 669 A.

Separating constituents of gaseous mixtures, Method of ——. [*Recovery of argon from air.*] G. Claude, Assr. to L'Air Liquide, Soc. Anon. pour l'Etude et l'Exploit. des Proc. G. Claude. U.S.P. 1,426,461, 22.8.22. Appl., 6.12.17.

See E.P. 114,817 of 1917; J., 1918, 416 A.

Sulphur; Manufacture of finely divided ——. A. Mittasch and F. Winkler, Assrs. to Badische Anilin- und Soda-Fabrik. U.S.P. 1,429,522, 19.9.22. Appl., 19.8.21.

See E.P. 177,103 of 1921; J., 1922, 373 A.

Regulating the strength of lye. U.S.P. 1,429,129. *See* I.

Gas purification. E.P. 185,780. *See* IIA.

Sludge acids. U.S.P. 1,429,140. *See* IIA.

Concentrating graphite. G.P. 356,503. *See* X.

VIII.—GLASS; CERAMICS.

Patents.

Glass; Materials or receptacles for the handling of molten ——. Naaml. Vennoots. Philips' Gloeilampen Fabrieken. E.P. 172,610, 9.11.21. Conv., 4.12.20.

Surfaces which come into contact with molten glass after its removal from the furnace are constructed of chromium or of alloys of chromium or aluminium with iron, cobalt, or nickel, or other metals or alloys characterised by high melting points, by the absence of the evolution of gas when heated, and by the production of a firmly adhering coating of oxide or oxides insoluble in the molten glass. Thus an alloy consisting of 60% of iron and 40% of chromium may be employed.—J. S. G. T.

Enamelling processes. De Dietrich et Cie. E.P. 165,785, 22.6.21. Conv., 5.7.20.

Economy of fuel is obtained by causing the ignition of a current of hot air and purified producer gas as the mixture enters the enamelling kiln, combustion of the gases being completed in direct contact with the articles to be enamelled.—C. A. K.

Mineral product for use as an abrasive, polish, and the like. W. G. W. Sandison. E.P. 185,578, 16.7.21.

A mineral (serpentine) consisting of hydrated magnesium silicates and containing 3—5% of iron is crushed and calcined until partial fusion occurs. The cooled material is then crushed to the desired degree for use as an abrasive. [Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 2321 of 1883.]—C. A. K.

Kilns for burning bricks, tiles, terracotta and the like; Construction of ——. J. B. and A. H. Jones. E.P. 185,664, 18.10.21.

A group of intermittent kilns is connected by suitable flues and dampers, so that the hot gases from the bottom of any one kiln are conveyed through a common interconnecting flue to another kiln ready for burning. The gases enter the second kiln from a peripheral flue outside the kiln or under the line of fireboxes; vertical flues placed between the fireplaces then convey the gases to the upper part of the kiln chamber. Each kiln is provided with a direct flue to a separate chimney, so that an alternative method of firing is possible.—C. A. K.

Sheet glass; Method of and apparatus for drawing ——. W. J. Mellersh-Jackson. From Libbey Owens Sheet Glass Co. E.P. 185,921, 28.7.21.

Gas-tight seals between metals and vitreous materials. E.P. 185,952. *See* IIB.

IX.—BUILDING MATERIALS.

Cements of high strength. J. Hendrickx. Chim. et Ind., 1922, 8, 296—304.

In a study of factors influencing the quality of Portland cement, viz., chemico-physical composition, calcining and quenching, and fineness of grinding of the calcined product, the author recommends for general practice a standard chemical formula $xSiO_2,2{\cdot}5CaO+yAl_2O_3,3CaO+Fe_2O_3,3CaO$, the silica modulus lying between 2·5 and 1·8. Physical structure can be controlled, less empirically than heretofore, by a determination of "calcining capacity": 1 g. of raw mix, after partial calcining under standard conditions, should leave a residue of 6—7·5% after treatment with acid and alkali (Le Ciment, 1920). A spectrographical study of cements of high strength does not show that the presence of small amounts of rare elements (*e.g.*, beryllium) influences the strength as in the case of steels. Experiments on variations in the speed of calcining and of cooling, and a microscopical study of the resulting products, show that greater strength is obtained the larger the crystals in the clinker. Two kinds of crystals are observed, one with strong double refraction; the hydraulic properties of Portland cement are attributed, however, entirely to the non-birefringent kind. Soft aluminous cement was found to be a mixture of two crystalline components—aluminates and silicates in a vitreous base of iron—and not aluminates in iron silicate as hitherto supposed. Here the non-birefringent crystals are identical with the alite of Portland cement. A study of tensile strengths under varying "fineness moduli" (*i.e.*, sp. gr.÷wt. per litre of crushed cement) while again emphasising the importance of large crystals, shows that fine grinding of the clinker will correct faults in the less easily regulated processes of calcining and cooling. "Calcining capacity" can be improved in its turn, thus increasing the output of the kiln and quickening the speed of calcining.—J. B. P.

Wood; Impregnation of —— *with mercuric chloride.* R. Nowotny. Oesterr. Chem.-Zeit., 1922, 25, 102—104.

In Kyan's process for impregnating wood with mercuric chloride, the wood absorbs the salt more rapidly than the water, with a consequent fall in the concentration of the solution. The wood may be steeped in a ⅔% solution of mercuric chloride, and more of the salt may be added from time to time to maintain the solution at this strength, but equally good results may be attained by starting with a 0·7% solution without any further addition of the salt. Absorption both of solution and of mercuric chloride proceeds rapidly at first and later at a diminishing rate, but a maximum absorption is not attained even after a considerable period; the quantities absorbed, both of solution and of mercuric chloride, are parabolic functions of time. Data obtained during the treatment of pine and fir wood are tabulated. It is desirable in practice that all wood destined for use for the same purpose should be impregnated to the same extent, and thus it is essential to take into consideration not only the initial concentration of the solution and the time of treatment, but also the variations in rate of absorption by different species of wood. A series of experiments showing, *e.g.*, that fir and pine must be treated for 10 days and 7 days respectively for equal absorption.—L. A. C.

Patents.

Composition for hard tennis courts, skating rinks, paths, and the like; Method of production of ——. A. D. Thompson and H. A. Bird. E.P. 185,838, 10.6.21, and 2.3.22.

A mixture of sand, York stone or other stone chippings or cement, granulated cork, shredded rubber, "chromium oxide viride," and copper dust or filings.

Wooden poles and the like; Process for impregnating —— *with fluorides, and copper, zinc, and mercury salts.* H. Marten. G.P. 356,902, 14.10.20.

Wooden poles, such as telegraph poles, are treated with solutions of fluorides, or copper sulphate or zinc chloride, until the salts have penetrated nearly to the tops of the poles. The poles are then, in the same apparatus, treated at the base with mercuric chloride solution until it has penetrated through a length of about 2 m. The portion of the poles to be embedded in the earth is thereby impregnated with mercuric chloride, while the portion exposed to the air contains fluorides or copper or zinc salts as preservatives.—L. A. C.

Lime kilns, cement kilns, and the like; Furnace-drawing apparatus for ——. C. Candlot. U.S.P. 1,429,925, 26.9.22. Appl., 9.8.21.

See E.P. 150,994 of 1920; J., 1921, 697 A.

Drying apparatus [*for timber*]. E. C. R. Marks. From Natural Air Dryers, Inc. E.P. 186,207, 22.7.21.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Grey cast iron; Soft annealing of ——. E. Piwowarsky. Stahl u. Eisen, 1922, 42, 1481—1483.

A number of annealing experiments were carried out at various temperatures and for different periods of time on a pearlitic grey iron (carbon 3·18%, graphite 2·49%, silicon 2·95%, sulphur 0·068%, phosphorus 0·102%, manganese 0·63%) and on this material alloyed with 1% of nickel and 20% of steel respectively. Annealing below Ar1 did not produce decomposition of the pearlite in the case of the iron alloyed with 20% of steel and the rate of decomposition for the other two materials was not sufficient for practical purposes. In the temperature interval between Ar1 and Ac1 the softening is at a rate sufficiently high for practical purposes if the silicon content is high enough. Quick heating to a little above the Ac1 point with a final cooling through the Ar1 interval at a rate less than 1° to 2° per min. is the surest means of obtaining quick annealing.—T. H. Bu.

Grey cast iron; Determination of the critical temperature for annealing ——. E. Schüz. Stahl u. Eisen, 1922, 42, 1484—1488.

In pearlitic grey cast iron, the phosphide eutectic, unless segregated, has no practical influence on the hardness. The influence of graphite on the hardness has also been exaggerated, the size of the graphite flakes having very little effect. On annealing thick grey iron castings the separation of ferrite is frequently propagated from the edges to the centre. In experiments made to determine the temperature at which pearlitic grey iron is decomposed into ferrite and temper carbon, the critical range was found to be lower than is usually accepted. With an annealing period of 24 hrs. the decomposition of the carbide commences at 500° C. and is complete at 600° C.; for a 6-hrs. anneal the action commences at 550° C. and is complete at 650° C.; whilst with an annealing period of 3 hrs. the decomposition begins at 575° C. and is complete at 650° C. The bearing of the results obtained on the iron-carbon diagram is considered.—T. H. Bu.

Iron; Recrystallisation of technical ——. P. Oberhoffer and H. Jungbluth. Stahl u. Eisen, 1922, 42, 1513—1519.

The relation between the grain size, amount of deformation the metal has undergone, and subsequent temperature of annealing has been determined for four samples of technical iron containing up to 0·18% C, and the results are reproduced on space diagrams. For all annealing temperatures above 600° C. the maximum grain size is obtained after the metal has been subjected to compression sufficient to reduce its height 10%, and the individual grains are largest when such metal has been annealed at 800° C., an average grain size of 15,000—20,000μ^2 being then obtained compared with an original value of less than 1000μ^2. The presence of silicon and manganese in the metal tends to decrease the maximum grain size, whereas ageing increases it. No relation between recrystallisation and pearlite formation could be found. —A. R. P.

Iron; Effect of heat treatment on the hardness and microstructure of electrolytically deposited ——. N. B. Pilling. Trans. Amer. Electrochem. Soc., 1922, 35—43. [Advance copy.]

The effect of annealing electro-deposited iron was observed at intervals of 100° C. up to 950° C. The original hardness of the iron was unaffected by annealing up to 200° C. An increase in hardness of more than 70% occurred at 300° C., the maximum value being reached between 300° and 400° C. At this stage the hardness (45, scleroscope) was equivalent to that of a 1·2% carbon steel in the annealed condition. Annealing at temperatures above 400° C. produced progressive softening, interrupted by a slight hardening at 900° C., following the A3 transformation. The needle-like striations in normal electrolytically deposited iron coalesced into larger elongated grains at 600°—700° C. A considerable quantity of hydrogen was evolved during the annealing operations and was assumed to be due to an unstable compound of iron and hydrogen. Active evolution of hydrogen occurred at 90° C., but complete decomposition of the iron-hydrogen compound was not effected until the A3 transition point was exceeded.—C. A. K.

High-speed steel; Shrinkage and expansion of —— *due to heat treatment.* M. A. Grossmann. Chem. and Met. Eng., 1922, 27, 541—544.

When high-speed steel (0·65% C, 18·0% W, 4·0% Cr, 1·0% V) was heated, quenched, and drawn at varying temperatures there was a regular trend of the contractions and expansions (measured at room temperature) irrespective of the quenching temperature. Increasing values for contraction were observed when the steel was reheated to 1000° F. (540° C.), followed by an expansion when heated at 1000°—1100° F. (540°—590° C.), above which temperature contraction again set in. When the steel was drawn some change took place up to 1000° F. (540° C.), which decreased the hardness due to quenching from higher temperatures; the increasing hardness after annealing at above 1100° F. (590° C.) is attributed to the appearance of a new constituent. Microscopical examination supports the evidence for the existence of a new constituent. By correlating the evidence it is considered that a secondary martensite is formed when the steel is annealed at 590° C., probably from a secondary stable austenite. Martensite II is more stable than the primary martensite formed on cooling steel, and is decomposed only by subsequent heating at temperatures higher than 1100° F. (590° C.), which causes the final contraction of the steel and its return ultimately to the dimensions of the annealed condition.—C. A. K.

Copper; Electrolytic refining of ——. Separation of silver from argentiferous slimes. J. M. Fernández Ladreda. Anal. Fís. Quím., 1922, **20**, 199—206.

Argentiferous slime from the electrolytic refining of copper, containing sulphates of iron and copper, is roasted at such a temperature that the copper and iron sulphates are decomposed and the silver is converted into silver sulphate, which is separated by leaching. The recovery of silver may be made more complete by addition of potassium bisulphate, copper sulphate, and sulphuric acid. The roasting must be carried out in an oxidising atmosphere to avoid the formation of cuprous oxide.—G. W. R.

Zinc; Effect of single impurities on the electro-deposition of —— from sulphate solutions. J. T. Ellsworth. Trans. Amer. Electrochem. Soc., 1922, 187—202. [Advance copy.]

The effect of small quantities of each of the following metals as a single impurity in zinc sulphate cells was investigated: copper, manganese, cadmium, iron, cobalt, antimony, and calcium. Tests on pure zinc sulphate solutions showed that with sufficient zinc ions present, fairly high acidity, and not too low current density, an efficiency of 90—100% could be reasonably expected during the first 24 hrs. and of 80—90% for the next 24 hrs. Antimony, copper, and cobalt seriously reduce this efficiency, and the recommended maxima for these impurities are, 0·7 mg. per l., 10 mg. per l., and 12 mg. per l. respectively. Iron does not affect the efficiency if less than 50 mg. per l. is present, while cadmium actually improves it, but should not exceed 0·5 g. per l. or the deposit becomes rough and black. Manganese has no effect unless more than 1 g. per l. is present, when it causes pitting and eventually the formation of large holes. Lime is objectionable only when the solution is nearly saturated with calcium sulphate, which then may crystallise on the cathode and contaminate the deposit.—A. R. P.

Zinc; Electroplated —— and the diffusion of electro-deposits into zinc. W. G. Traub. Trans. Amer. Electrochem. Soc., 1922, 13—17. [Advance copy.]

When copper, brass, gold, or silver coatings are deposited on zinc the coatings disappear after a few months. Experiments show that this is due to diffusion of the surface metal into the zinc and may be prevented by first coating the zinc with nickel which does not diffuse into it.—A. R. P.

Aluminium; Simple crucible furnace for melting ——. A. G. Lobley. Trans. Amer. Electrochem. Soc., 1922, 169—172. [Advance copy.]

A furnace suitable for melting and keeping molten aluminium for the manufacture of small die castings consists of a nichrome ribbon resistor wound in a helix and supported on thin firebrick shelves around, but not touching, a fireclay crucible. The crucible is removable for renewals without disturbing the resistor, and the whole is insulated in a brickwork container with kieselguhr. The capacity of a crucible is 35—40 lb. of aluminium, which is melted by a current of 20 amps. at 200 volts, the energy consumed being 0·78 kw.-hr. per lb. of metal. This furnace showed a saving of 15% in running expenses compared with a gas-fired crucible furnace, and the metal losses are considerably reduced.—A. R. P.

Nickel deposition; Application of the contractometer to the study of ——. E. A. Vuilleumier. Trans. Amer. Electrochem. Soc., 1922, 159—168. [Advance copy.]

The primary cause of the peeling of electrodeposited nickel seems to be a tendency of the deposited metal to undergo a contraction which causes the deposit to bend towards the anode. This may be measured by depositing the nickel on a thin platinum sheet cathode and ascertaining by means of the contractometer (Kohlschütter and Vuilleumier, Z. Elektrochem., 1918, 24, 300) the amount of bending. While an increase in the p_H of the solution causes at first a more rapid bending, still greater acidity reduces it at the same time as the cathode efficiency. Iron salts increase the bending 50%, but a trace of zinc causes a marked decrease and the deposit becomes more velvety. At times there are delays and spurts in the contraction, especially when very little hydrogen is evolved at the cathode; when much hydrogen is evolved the nickel expands, possibly owing to the formation of nickel-hydrogen analogous to palladium-hydrogen.—A. R. P.

[*Nickel;*] *Effect of impurities in nickel salts used for electrodeposition* [*of* ——]. M. R. Thompson and C. T. Thomas. Trans. Amer. Electrochem. Soc., 1922, 123—138. [Advance copy.]

Small amounts of zinc in nickel sulphate and nickel ammonium sulphate used for making up plating baths tend to cause the deposits to have bright edges and smooth surfaces, while larger amounts cause the formation of bright spots and tend to increase pitting, the effect in each case becoming more marked the longer the deposition is continued. The effect of zinc may be counteracted to a great extent by neutralising the solution with nickel carbonate to p_H 6·7, filtering, and re-acidifying to p_H 5·8, the electrolysis being then conducted at a high current density for some hours. Copper, even in small amounts, causes the deposits to become rough and somewhat burred, and the effect is more marked the longer the deposition is continued. The solution may be purified in the same manner as in the case of zinc. Iron does not seem to have a deleterious effect on the deposits even when they contain as much as 7% Fe. On the contrary, the presence of iron in deposited nickel makes the metal whiter, more finely crystalline and harder. The authors recommend that the impurities in nickel salts used for electroplating should not exceed 0·05% Zn, 0·02% Cu, 0·1% Fe, and 0·1% of free sulphuric acid.—A. R. P.

Current distribution and cathodic electrodeposition upon surface cavities of bodies in electrolytic baths. K. Arndt and O. Clemens. Chem.-Zeit., 1922, 46, 925—926.

The distribution of current along numerous paths from anode to cathode in an electrolytic bath is of consequence in electrodeposition upon uneven surfaces, and is especially marked in the case of electrodeposition from solutions of gold and potassium cyanides, the deposition of gold upon the side of the cathode remote from the anode being almost equal to that upon the nearer side. The authors have investigated the distribution of the deposited metal upon the respective plates of a composite cathode consisting of two plates electrically connected and disposed at different distances from a single anode, more especially in the case of the electrodeposition of nickel. The proportional electrodeposition upon more remote parts of the cathode increases as the concentration of metallic ions in the electrolyte decreases, the resistance of the bath being unaltered. A similar increase accompanies an increase of specific conductivity of the electrolyte, the total content of electrolyte being maintained constant. The effect is pronounced in cyanide baths, as the ionic concentration of the metal is small owing to the formation of complex anions.—J. S. G. T.

Nickel alloys which maintain their rigidity over a wide range of temperature. P. Chevenard. Comptes rend., 1922, 175, 486—489. (*Cf.* J., 1920, 26 A.)

Alloys of nickel were studied from the standpoint of their rigidity at temperatures ranging up to 850° C., and a diagram is given in which their behaviour under test conditions is shown in comparison with that of electrolytic iron and of chrome-nickel steel. An addition of 15% of chromium to nickel raises by 150° the upper temperature limit of the range within which the metal remains rigid, but raising the chromium content to 22·6% gives only a slight further increase. The former proportion is found to be more advantageous, as difficulties of manufacture and forging increase considerably with chromium content. The best results were obtained with nickel containing 9% of chromium and 5·8% of tungsten; in this alloy the nickel may be replaced by ferro-nickel of 60% nickel content without detriment to the rigidity, and the manufacture of the alloy is thus facilitated and the cost is decreased. The method of determining rigidity was based on measurements of a wire from which a weight was suspended, the wire being placed in a furnace of constant temperature. Photographic records of the stretching of the wire were made and the increase in length was plotted as a function of time. The quaternary alloys of iron, nickel, chromium, and tungsten are tough, highly resistant to chemical action, and considerably more rigid at high temperatures than the usual types of steel.
—H. J. E.

Patents.

[*Iron and steel; Composition for use in the*] *case hardening, hardening, and tempering* [*of* ——]. E. J. Dickins. E.P. 185,564, 6.7.21.

A composition for application to portions of iron and steel articles which it is desired should remain soft when the article is subjected to a hardening or case-hardening process, consists of a mixture containing 56% of kaolin, 19% of barium sulphate, 19% of powdered silica, and 6% of a solution of sodium silicate of sp. gr. 1·2.—A. R. P.

Iron and steel wire; Solution for use in drawing ——. O. Vogel. G.P. 299,031, 21.6.16.

A slightly acid solution of copper sulphate is mixed with one or more chlorides, *e.g.*, sodium chloride and ferric chloride. The iron or steel wire is coated with copper by immersion in this solution, and after drawing, the copper coating is removed by treatment with an ammoniacal solution of copper sulphate. By using the mixture of salts copper separates more easily than from copper sulphate alone, and the copper adheres better to the wire, so that a thinner coating can be used than hitherto.—T. H. Bu.

Iron and steel wires; Solution for use in wet drawing of ——, *also for pickling.* O. Vogel. G.P. 299,032, 31.5.16.

The medium consists of two or more suitable chlorides, including preferably ferric chloride, with the addition of sufficient ammonia to produce a certain quantity of colloidal ferric hydroxide. By the addition of ammonia the solution adheres better to the wire and its lubricating action is increased. The composition of the solution remains unchanged and the wire keeps clean till the end. When the solution is to be used for pickling the ammonia is omitted.—T. H. Bu.

Ferro-tungsten; Method of purifying tin-bearing ——. F. M. Becket. U.S.P. 1,429,272, 19.9.22. Appl., 26.5.20.

The comminuted alloy is treated with an acid solvent for tin.—C. I.

Calorising metals; Furnace apparatus more particularly adapted for ——. F. H. Rogers. From Calorizing Corp. of America. E.P. 184,839, 19.4.21.

In apparatus specially adapted for calorising metals (by heating with aluminium powder or the like in an atmosphere of non-oxidising gas), gas is delivered to a rotary retort through a pipe consisting of a portion rotating with the retort and a stationary portion connected with the former by means of a gas-tight joint. The non-rotating part is pivoted to the upper end of a vertical support so as to permit of slight eccentric motion of the retort. Close connexion between the non-rotary and rotary parts of the delivery pipe is maintained by means of a coiled spring. The closing plates on the retort are arranged so as not to be subjected to any weight, this being carried by flanges on the retort resting on bearing rollers.—C. A. K.

Metallurgical furnace. C. C. Roller. U.S.P. 1,429,777, 19.9.22 Appl., 30.10.20.

The down flue of a metallurgical furnace communicates with a tunnel in which are rails capable of being raised or lowered and which support a car having a detachable body. By raising or lowering the rails, the car may be moved into and out of engagement with the flue, making a joint therewith.
—A. J. H.

Furnace; Ore-treating ——. C. C. Grimes. U.S.P. 1,430,445, 26.9.22. Appl., 26.3.19.

An inclined retort is heated by a vertical flue communicating with the bottom of the retort chamber. Within the upper part of the retort pipe is a perforated fume-collecting pipe.—C. I.

Alloys; Readily fusible ——. A. de W. Mulligan. E.P. 185,012, 23.8.21.

Fusible alloys possessing physical properties which render them suitable for temperature indicators for bearings contain Sb 0·8—2·5%, Sn 12—29·6%, Pb 12—61%, Cd 6·6—18%, Bi 3—50%. The ratio of the content of tin to that of antimony is 12 to 1.
—C. A. K.

Ores containing copper silicate; Treatment of ——. H. L. Sulman, T. J. Taplin, jun., W. G. Perkins, and H. F. K. Picard. E.P. 185,242, 9.6., 16.7., 6.8., and 9.12.21.

Ores containing copper silicate (chrysocolla) and copper carbonate (malachite and azurite) are heated, after crushing, at 150°—400° C. and treated with an ammoniacal solvent. The heating process reduces the copper without any fritting and the reduced material is obtained as a porous mass. The reduced material may be re-oxidised before leaching.—C. A. K.

Annealing and/or other heat treatment of metals. W. and C. A. Barron. E.P. 185,277, 8.7.21.

An annealing pot is provided with a double lid forming a chamber through which a stream of non-oxidising gas is passed during the heating and cooling periods.—C. A. K.

Tungsten carbides; Process for the manufacture of —— *without free carbon for use as tools and implements of all kinds.* P. C. Rushen. From Akt.-Ges. B. Felder-Clement. E.P. 185,313, 15.8.21.

Tungsten carbides are made best at a temperature higher than the temperature of formation of the carbides, but this results in the separation of graphite during cooling (G.P. 289,066 and 286,184; J., 1916, 423; 1915, 1250). The free carbon is removed and a coarse crystalline structure prevented by the addition of molybdenum, molybdic acid, molybdenum oxide or carbide, to the fused crude tungsten carbide. The molybdenum compound volatilises completely and enables free carbon to be removed with it, so that it is not necessary to oxidise all the free carbon to its oxides. 7—8% of molybdenum is used for effective decarburisation. The fused tungsten carbide is suitable for casting, particularly in moulds with the use of centrifugal force (E.P. 157,756).—C. A. K.

Tin; Process for the electrolytic refining of ——. W. P. Thompson. From W. J. Aikens. E.P. 185,808, 31.5.21.

A BATH, suitable for the electrolytic refining of crude tin containing lead, is formed by dissolving tin in a 15·5% solution of hydrofluosilicic acid until 4·5% of the weight of solution in tin is dissolved, and adding to the solution thus obtained 0·1 to 0·3% of phosphoric acid to precipitate lead, and 0·1% of cresylic acid to prevent the formation of crystalline or hair growths on the cathode. Addition of 0·05—0·01% of glue to the bath renders the deposit harder and more compact. Crude tin is used as anode and pure tin sheets as cathodes.—A. R. P.

Tungsten or molybdenum; Electrolytic treatment of metalliferous materials containing ——. R. E. Pearson, E. N. Craig, and Durelco, Ltd. E.P. 185,842, 11.6.21.

TUNGSTEN or molybdenum ores or waste products are ground and mixed to a paste with sulphuric acid, and the mixture is placed on a lead plate which forms the anode of an electrolytic cell containing dilute sulphuric acid. On passing a current through the cell the basic impurities, *e.g.*, iron, manganese, calcium or sodium oxides, in the material on the anode pass into solution, leaving a residue of tungsten or molybdenum oxides. Alternatively the anode may consist of nickel or a nickel alloy, and the electrolyte of caustic soda, whereby soluble sodium tungstate or molybdate is formed and the foreign metals are left as anode slime. The process is applicable to the utilisation of scrap molybdenum or tungsten metal.—A. R. P.

Copper; Process for colouring ——. F. Laist, F. F. Frick, E. Klepetko, and L. P. Davidson, Assrs. to Anaconda Copper Mining Co. U.S.P. 1,428,170, 5.9.22. Appl., 29.11.21.

COPPER or bodies containing copper are subjected to the action of a concentrated solution of a copper salt.—C. A. K.

Zinc from complex ores; Process for recovering ——. J. T. Ellsworth. U.S.P. 1,429,330, 19.9.22. Appl., 12.7.21.

IN a cyclic process for extraction of zinc by a solvent and deposition of the metal by electrolysis, the solution prior to electrolysis is concentrated, separated from the crystals formed, and diluted to such an extent that the concentration of the soluble salts therein will be insufficient to produce supersaturation at any subsequent stage in the cycle.—B. M. V.

Flotation process; Differential ——. B. Stevens. U.S.P. 1,429,544, 19.9.22. Appl., 8.3.20.

THE ore pulp is treated with a selective flotation agent consisting of a substance which dissolves one of the metals that is capable of being floated and which is saturated with that metal.—A. R. P.

Ore concentration, more especially for purifying graphite; [Flotation] process of ——. Elektro-Osmose A.-G. (Graf Schwerin Ges.). G.P. 356,503, 22.7.19.

CRUSHED ores are subjected to a flotation process in a medium composed of a molten substance of greater density than water, and from which gases are evolved, at or above its melting point, owing to decomposition or dehydration. The ores may, if desired, be mixed with oil or be subjected to a preliminary oil-flotation purification process. Gases or steam may be blown into the molten material.
—J. S. G. T.

Ores; Concentration of —— by flotation. Elektro-Osmose A.-G. (Graf Schwerin Ges.). G.P. 356,815, 6.2.19.

ORE pulp is agitated by means of air in the lower part of a vessel, the upper part of which is covered, partly or wholly, with a sieve through which the gangue particles are dispersed, while the froth is withdrawn over an open rim. The level of the liquor in the vessel is maintained automatically so that contamination of the froth with gangue particles does not occur.—A. J. H.

Lead and zinc; Extraction of ——. W. G. Waring, Assr. to G. Battella. U.S.P. 1,430,270, 26.9.22. Appl., 17.8.21.

ORES containing lead and zinc are extracted with a hot ammonium sulphate solution to remove the zinc, and the residue containing the lead is treated with an ammonium carbonate solution containing ammonia equivalent to the sulphur trioxide present in the residues. Lead carbonates are formed, and an ammonium sulphate solution containing zinc. The ammonium sulphate solution can be used again for the extraction of the zinc.—H. C. R.

Pure nickel; Process for the preparation of —— from impure nickel sulphate. E. Günther. G.P. 356,531, 10.4.21.

A SOLUTION of crude nickel sulphate is treated with sodium chloride sufficient to convert all the metals present into chlorides, and the resulting sodium sulphate is crystallised out by strongly cooling the solution. The chloride liquor so obtained is treated with hydrogen sulphide to remove the metals of group 2, and the filtrate is oxidised and treated with limestone to precipitate iron and manganese. The remaining sulphuric acid is precipitated with barium chloride and from the clear liquor nickel hydroxide is precipitated and reduced to metal, which is pure except for a trace of cobalt.
—A. R. P.

Metals; Treatment of ——. Th. Goldschmidt A.-G., und L. Schertel. G.P. 356,532, 16.2.17.

MATERIALS containing volatile metals or metals yielding volatile oxides are subjected while in the molten condition to a blast of burning gas. Oxidation of the metals occurs, the metallic oxides are volatilised and are separated, and subsequently converted into metal.—A. J. H.

Ores; Process for treating ——. W. J. Mellersh-Jackson. From Soc. Metalurgica Chilena "Cuprum." E.P. 184,501, 10.2.21.

SEE U.S.P. 1,303,701 of 1919; J., 1919, 541 A. [Reference is directed, in pursuance of Sect. 8, Sub-sect. 2, of the Patents and Designs Acts, 1907 and 1919, to E.P. 172,356.]

Matte and other materials and solutions containing copper and nickel; Treatment of ——. H. G. Fairweather. From N. V. Hybinette. E.P. 185,859, 15.6.21.

SEE U.S.P. 1,382,361 of 1921; J., 1921, 628 A.

Lead alloys. W. P. Thompson. From Soc. Thoumyre Fils. E.P. 186,118, 15.6.21.

See G.P. 354,978 of 1921; J., 1922, 767 A.

Steel ingot, and method of and mould for producing same. Method and apparatus for casting steel ingots. E. C. R. Marks. From Valley Mould and Iron Corp. E.P. 186,080, 18.3.21, and 186,093, 20.4.21.

Carbon for hardening steel and iron. G.P. 357,226. *See* IIB.

Materials for handling molten glass. E.P. 172,610. *See* VIII.

Electrode for welding. E.P. 185,580 and 185,813. *See* XI.

XI.—ELECTRO-CHEMISTRY.

Anode carbons; Stability of ——. K. Arndt and W. Fehse. Z. Elektrochem., 1922, 28, 376—381.

A method of estimating the graphite content of a specimen of carbon consists in determining the electrical resistance of the material, powdered and carefully graded, under a definite mechanical pressure, and comparing the result with a standard curve obtained from carbons of known graphite content. The chemical resistance of the carbons was determined by using them as anodes in the electrolysis of a solution of sodium chloride and chromate, and determining the loss in weight. The resistance increases generally with the graphite content, but the highest resistance was shown by a carbon containing 75% of graphite. Microscopical examination showed that the structure of the carbon must be fairly coarse and free from cavities, and that this condition is best fulfilled in specimens graphitised up to about 75%.—E. H. R.

Resistor carbons; Resistivities of some granular ——. C. E. Williams and G. R. Shuck. Trans. Amer. Electrochem. Soc., 1922, 109—121. [Advance copy.]

The electrical resistances of granular varieties of graphite, carbon, coal-tar residue, coke, coal, and charcoal have been determined at various temperatures up to 1600° C. The samples were heated for several hours at 1000° C. prior to being tested. The difference of resistivities of the various samples was not large at 1000°—1200° C. The temperature-coefficient of resistance was in all cases negative up to 1000°—1200° C., approaching zero at that temperature, and becoming positive at still higher temperatures. This change was more pronounced in graphite than in the other forms of carbon. The resistivity increased as the size of granule decreased. High resistivity accompanied the presence of volatile matter. Ash contained in the granules increased the contact resistivity and temperature-coefficient only slightly, while the effect of extraneous ash or foreign matter of high resistivity was very marked in this connexion.—J. S. G. T.

Alloys [used as heating elements]; Electrical properties of —— at high temperatures. M. A. Hunter and A. Jones. Trans. Amer. Electrochem. Soc., 1922, 139—158. [Advance copy.]

Materials used as heating elements are divided into two classes. The first, including nickel, copper-nickel and iron-nickel alloys, have high specific resistances at the operating temperature and are suitable for use up to 500° C. The second, including nickel-chromium, nickel-iron-chromium, and iron-chromium alloys, in addition withstand oxidation, and are more or less suitable for use up to 1100° C. Tables are given of the comparative values of the specific resistances of the various alloys at intervals of 100° C. for the range 20° C.—1000° C., and of the respective values of the specific resistances in ohms/mil foot at room temperature. The life of a nickel-chromium alloy is related to its chromium content. For temperatures in excess of 1000° C. the chromium content of the wire should be as high as possible. An alloy containing 20% Cr is recommended as possessing the best manufacturing and operating characteristics. The resistance of a bright wire increases on oxidation by 3—4·5%.
—J. S. G. T.

Insulating compounds; Arc action on some liquid ——. C. J. Rodman. Trans. Amer. Electrochem. Soc., 1922, 45—56. [Advance copy.]

Results are given of tests of the electrical disruption of insulating liquids of low viscosity and high fire and flash points, between ball electrodes, at and below the liquid surface, the maximum difference of potential employed being 100,000 volts. Among the liquids tested were gasoline (68°), various transformer oils, benzol, monochlorobenzol, orthodichlorobenzol, dichloromethane, chloroform, and carbon tetrachloride, and mixtures of halogen compounds with mineral oils. The products obtained on disruption were: finely divided, non-conducting amorphous carbon, saturated and unsaturated hydrocarbons lower in the series, hydrogen, unsaturated hydrocarbons, carbon monoxide, methane, and ethane, and hydrochloric acid in the case of chlorinated compounds. Increase of molecular weight in the paraffin series was accompanied by a decrease of gas evolved per kilowatt-sec. of arc rupture. A similar decrease likewise accompanied increased halogenation of the oils. The average yield of gas from a mineral oil was about 97 c.c., and from a highly chlorinated oil was as low as 4·2 c.c. per kilowatt-sec., the gas in the latter case being non-explosive when mixed with air in any proportion. Liquid dielectrics are apparently broken down by a temperature-pressure effect of very short duration rather than by the effect of high frequency alone.—J. S. G. T.

Corona effect; Chemical reactions induced by the —— in circuits traversed by continuous currents. C. Montemartini. Gazz. Chim. Ital., 1922, 52, II., 96—97.

Since the corona effect is due to the emission of electrons, the gas surrounding the conductor producing the effect should be ionised, and the effect should be capable of inducing those chemical reactions which are caused by discharges in rarefied gases or by the dark discharge. As far as a number of these reactions (formation of ozone, decomposition of carbon dioxide, formation of ammonia from nitrogen and hydrogen, etc.) are concerned, this is found to be the case. (*Cf.* J.C.S., Nov.)
—T. H. P.

Chromate electrolysis. Lottermoser and Falk. *See* VII.

Insulating varnishes. Weber. *See* XIII.

Current distribution and cathodic electro-deposition. Arndt and Clemens. *See* X.

Electrolytic oxidation of isoeugenol. Lowy and Moore. *See* XX.

Patents.

Galvanic cell. A. Heil. E.P. 173,515, 28.12.21.

The carbon pole of a galvanic cell is surrounded by a depolariser consisting of manganese dioxide or hydrated manganese dioxide mixed with carbon or graphite. The negative pole is of copper gauze, copper-plated lead, or copper-plated carbon, surrounding the depolariser and immersed in the electrolyte, which consists of dilute sulphuric acid together with copper sulphate and manganese sulphate. The whole is contained within an airtight lead casing. The cell is free from "gassing" and can be used as an accumulator.—J. S. G. T.

Galvanic cell with electrodes composed of manganese dioxide and acetylene soot. P. Burger. G.P. 357,090, 17.6.21.

About 5—20% of graphite is mixed with the soot incorporated in the electrodes. The mixture can be pressed into solid blocks sufficiently porous to soak up electrolyte, and the graphite confers a greater conductivity upon electrodes made from the mixture.—J. S. G. T.

Oxyhydrogen gas cell, employing fused alkali as electrolyte. E. Baur. G.P. 357,290, 20.2.21.

Bell-shaped metal vessels are used as electrodes, and are closed below by a mass of the same metal of large superficial area, in the form of a brush or wire net. The gas flows over this brush or net into the electrolyte. Gas leaking from the bell is delivered to a second bell surrounding the first, and is brought into heat-exchanging relation with a further supply of gas.—J. S. G. T.

Electric accumulators [*; Desulphating* ——]. W. O. Garbutt. E.P. 185,797, 11.5.21.

Sulphated lead electrodes are desulphated, after removal of sulphuric acid by passing a current of the customary density and voltage between them when immersed in a solution of an alkali hydroxide or peroxide of sp. gr. 1·100 or above, *e.g.*, a 10% solution of sodium hydroxide or peroxide.

—J. S. G. T.

Electrodes for arc welding and metal cutting and process for making the same. W. H. Boorne. E.P. 185,580, 19.7.21.

The electrode consists of a metal rod or core wound transversely with a carbonaceous fibre saturated with a solution of sodium borate and covered by means of an extrusion machine with a coating of a mixture of magnesite, aluminium, and sodium silicate while the fibre is wet. The coating may include graphite (not less than 98% of carbon) and crocidolite asbestos or amosite, with or without granulated magnesium.—T. H. Bu.

[*Iron*] *welding rods or electrodes and soldering sticks* [*; Composition for coating* ——]. E. H. Jones, and Alloy Welding Processes, Ltd. E.P. 185,813, 3.6.21.

A suitable proportion of "ferro-carbon alloy" containing 50% C and 50% Fe, or of "silicon-carbon" alloy (60% Si, 35% C, and 1·5% Fe), or of both, is added to the paste with which the welding rod is coated, so that the weld metal has sufficient carbon and/or silicon to give it the characteristics of cast-iron.—A. R. P.

Electric furnace. M. S. Clawson. U.S.P. 1,428,489, 19.9.22. Appl., 13.7.20.

An electric furnace comprises a main supporting member carrying a central member, and side members movable towards or from the central member and mounted on pivots. Resistance members, adapted to hold the material to be treated, are engaged between rotary heads mounted in the central and side members respectively.—J. S. G. T.

Electric conductors; Method of making [*aluminium*] ——. J. Lind. U.S.P. 1,429,441, 19.9.22. Appl., 26.4.21.

Aluminium conductors are insulated by heating and then quenching in an aqueous solution of soda.

—J. S. G. T.

Electric resistance heater for high temperatures. B. Bauer and A. von Zeerleder, Assrs. to Soc. Anon. des Ateliers de Sécheron. U.S.P. 1,426,245, 15.8.22. Appl., 10.12.19.

See E.P. 133,706 of 1919; J., 1921, 629 A.

Negative plate for electric accumulators and the manufacture thereof. A. Pouchain. U.S.P. 1,429,300, 19.9.22. Appl., 22.6.20.

See E.P. 161,434 of 1920; J., 1921, 550 A.

Insulating material; Treating peat for manufacturing an ——. R. Graeffe. U.S.P. 1,429,503, 19.9.22. Appl., 6.1.21.

See E.P. 166,856 of 1920; J., 1921, 626 A.

Electrical dehydrator. U.S.P. 1,428,178. *See* IIA.

Treating air electrically. U.S.P. 1,388,112. *See* VII.

XII.—FATS; OILS; WAXES.

Copra cake; Extraction of ——. A. P. West and J. M. Feliciano. Philippine J. Sci., 1922, 20, 509—517.

Copra cake was extracted with different solvents for various intervals of time in a Soxhlet apparatus. Ether, carbon tetrachloride, and benzene gave approximately the same percentage extraction. Chloroform, acetone, and petroleum ether dissolve not only the oil but also small quantities of non-fatty substances, while ethyl and methyl alcohols dissolve a considerable quantity of the latter. By extracting copra cake with carbon tetrachloride and afterwards extracting the oil-free cake with methyl alcohol the non-fatty material was obtained. It had a high acid and saponification value and contained a small percentage of nitrogen, which is possibly mainly in the form of amino-acids.

—H. C. R.

Fatty oils; Polymerisation of ——. J. Marcusson. Z. angew. Chem., 1922, 35, 543—544. (*Cf.* J., 1920, 755 A.)

The action of light on tung oil in the absence of air causes the oil to change into a solid the melting point of which varies with the nature and intensity of the illumination. The mass can be separated by treatment with acetone into a soluble fraction, consisting mainly of unchanged oil, and an insoluble fraction, which can be purified by recrystallisation from hot acetone, and consists of β-elæostearin (m.p. 61° C.). A small quantity of an infusible substance which is insoluble in hot acetone and in all usual fat-solvents remains behind. The formation of β-elæostearin by the action of light on α-elæostearin is a case of stereoisomeric rearrangement from the cis to the trans form. If the glyceride is exposed to the air or illuminated in a sealed glass tube polymerisation takes place, with the formation of the product insoluble in fat-solvents mentioned above. An acid can be prepared from the polymerised substance having an iodine value only one fourth that of elæostearic acid and a molecular weight twice as great. The formation of β-elæostearin causes the film of dried tung oil to be lacking in durability. This may be overcome by heating the oil to a high temperature before using it as an ingredient of paints and varnishes, as by this means it is converted into polymerised products which no longer give β-elæostearin on exposure to light, and a uniform and elastic film is obtained. The films formed by the drying of fatty oils contain unchanged oil, free fatty acids and oxy acids, and neutral polymerisation and oxidation products both in the sol and gel form.—H. C. R.

Pine oil. Sandqvist. *See* XIII.

Iodine value. Lührig. *See* XIXA.

Vitamin which promotes calcium deposition. McCollum and others. *See* XIXA.

PATENTS.

Vulcanised oil product. W. O. Snelling. U.S.P. 1,430,034, 26.9.22. Appl., 8.8.19.

A VULCANISED oil product is obtained by treating a fatty oil with excess of sulphur chloride and subsequently bringing the material into intimate contact with water.—D. F. T.

Furfural; Process for making soaps containing ——. Aschkenasi. G.P. 356,437, 27.5.20.

FURFURAL is dissolved in hot or cold solutions of sodium, potassium, or resin soaps, or is incorporated with soap shavings. The products do not change on keeping, although furfural alone is very easily attacked by alkalis.—H. C. R.

Soap contained in the sludge of carbonate of lime; Process for the removal of ——. P. Krebitz. U.S.P. 1,430,017, 26.9.22. Appl., 15.6.21.

SEE G.P. 355,492 of 1920; J., 1922, 770 A.

Oil-bearing materials, such as nuts, seeds and copra; Preservation and preparation for transportation of —— *[by compression in bulk]. Preservation and preparation for transportation of cotton seed.* A. W. MacIlwaine. E.P. 186,133 and 186,277, 17.6.21.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Varnishes; Changes in the electrical conductivity of [insulating] —— *during drying.* H. C. P. Weber. Trans. Amer. Electrochem. Soc., 1922, 89—96. [Advance copy.]

CERTAIN varnishes used for insulating purposes decompose during drying owing to oxidation, with the formation of acidic substances which are slightly volatile and of low electrical resistance. These may accumulate in certain parts of the insulation and cause an electrical breakdown. If they are allowed to volatilise by heating the material during drying, the resistance increases appreciably and the resulting insulation is satisfactory.—A. R. P.

Pine oil [" liquid resin," " polyterpene," " sulphate resin "]. H. Sandqvist. Z. angew. Chem., 1922, 35, 531—533.

THE oil is obtained as a by-product in the manufacture of wood pulp by the sulphate process from pine wood. From pure pine wood 45 kg. of oil is obtained per 1000 kg. of sulphate-cellulose. It is of use in the manufacture of detergents and for this purpose is purified by boiling with very dilute sulphuric acid, drying, and distilling under slightly reduced pressure at 260° C. with steam superheated to 360° C. About 75% distils over and 16% of pitch remains behind and can be used as a substitute for montan wax. The analysis of various samples taken from Swedish factories gave the following results. Crude oil: Viscosity (18° C., water=1) 717—8,000,000; sp. gr. at 15°/4° C., 0·977—1·026; water, 0·69—7·2%; ash, 0·07—4·62%, acid value, 107—160; insoluble in ether, <0·1—4·2%. Refined oil: Viscosity, 334—4000; sp. gr. at 15°/4° C., 0·967—1·001; acid value, 146—158·5; " indifferent matter," 12—19%; resin acids, 34—53%, of acid value 166·5—176; fatty acids, 29—51%, of acid value 189—193. The " indifferent matter " is not quite neutral and contains a substance of m.p. 136°—137° C., similar to phytosterol. The resin acids have sp. gr. 1·104 and are coloured dark brown. They are liquid at 130° C. The fatty acids have a mean sp. gr. 0·968. The liquid portion gave some stearic acid on hydrogenation. The technical application of pine oil depends largely on the possibility of separating the resinous and fatty acids.—H. C. R.

d-Pimaric acid of m.p. 212° C.; Preparation of ——. E. Knecht and E. Hibbert. J. Soc. Dyers and Col., 1922, 38, 221—222.

l-PIMARIC acid, of m.p. 161° C., $\alpha_D = -80°$, when exposed to the air for prolonged periods, or when subjected to alkaline oxidation is partially converted into the *d*-pimaric acid, $C_{20}H_{30}O_2$ of m.p. 212° C., $\alpha_D = +62·5°$, described by Laurent. Vesterberg and others. The reaction may conveniently be carried out by allowing a dilute solution of the sodium salt to stand overnight with sodium hypochlorite solution. The crystalline precipitate is filtered off, dissolved in boiling water, and decomposed with sulphuric acid. By recrystallising the liberated acid from alcohol, it is obtained in a pure condition in about 10% yield.—G. F. M.

Polymerisation of fatty oils. Marcusson. *See* XII.

PATENTS.

Friction facing and process of making same. L. Kirschbraun. E.P. 185,809, 1.6.21.

FRICTION facings are produced from a mixture of an incombustible fibrous pulp and a phenol resin, which is saturated with a binder and baked at a suitable temperature for producing the necessary strength and hardness. For example, asbestos pulp is mixed with about 5% of a comminuted soluble phenol resin and is then formed into sheets. Friction facings are cut from these and are calendered and sized in the usual way, afterwards saturated with bitumen of low melting point (100° F. or less) and then baked at 400°—500° F. (204°—260° C.) for about 24 hrs. The product has a tensile strength greater than 2000 lb. per sq. in. and a Brinell hardness greater than 15. The hardness is dependent on the phenol resin used.
—A. J. H.

Floor coverings and process of making same. L. Kirschbraun. E.P. 185,816, 6.6.21. (*Cf.* U.S.P. 1,302,810 of 1919; J., 1919, 494 A.)

FLOOR covering is made by passing a mixture of fibrous stock and a non-adhesive emulsified matrix over the inner cylinders of a multi-cylinder paper machine, simultaneously forming a felted ply of fibrous stock on an outer cylinder of the machine, then drying and coalescing the pitch binding material in the inner plies; the pitch binder forms an ingredient of the matrix, which also contains water, clay, sodium silicate, and aluminium sulphate. The outer top ply is substantially devoid of the pitchy medium and is coated with a drying oil of a different colour, providing a surface on which a design may be printed.—D. F. T.

Coating materials and methods of forming the same. British Thomson-Houston Co. From General Electric Co. E.P. 185,910, 18.7.21.

FOR the production of a comparatively permanent coating resistant to ordinary abrasion, high temperature, water, and weak acid, *e.g.*, for lamp shades and reflectors, kaolin or similar material is peptised by means of sodium hydroxide, an alkali silicate being then added as a binding agent together with any desired opacifying or colouring ingredients. The mixture is applied to the surface and is then treated with a fixing solution containing, for example, zinc chloride and aluminium sulphate, which reacts with the alkali silicate and prevents subsequent chemical action between this and atmospheric carbon dioxide.—D. F. T.

Coating composition and process of making the same. M. I. Strauss. U.S.P. 1,386,380, 2.8.21. Appl., 18.5.17.

Shellac is dissolved in caustic soda, the solution filtered, acidified with sulphuric acid, and the resulting precipitate washed, dried, and dissolved in alcohol, to yield a coating composition which, after drying, is impervious to, and unaffected by, gasoline and the like. Solid pigments, such as Venetian red or the like, may be added to the composition.

Condensation product of phenol and formaldehyde and method of making same. Phenolic condensation product and method of making same. W. Achtmeyer. U.S.P. (A) 1,429,265 and (B) 1,429,267, 19.9.22. Appl., 10.3.21.

(A) 100 pts. of phenol is condensed with 100 pts. of 40% formaldehyde solution in 30—40 pts. of hot water containing 3—5 pts. of sodium tungstate and 9—12 pts. of sodium phosphate in solution, and the resinous product is separated from the watery layer. (B) A phenolic substance is condensed with methylenediphenyldiamine.—A. R. P.

Japanese lacquer; Process of drying ——. Y. Shibata and Y. Nishizawa. U.S.P. 1,429,542, 19.9.22. Appl., 29.3.20.

A Japanese lacquer preparation containing 5—30% of a complex salt of metals and ammonium is claimed.—A. R. P.

Titanium complex [pigment] and method of producing same. H. H. Buckman. U.S.P. 1,429,841, 19.9.22. Appl., 20.12.20.

Fine white titanium pigments are obtained by heating under pressure with sulphuric acid and water, finely divided ilmenite and barium sulphate; after the addition of more water and re-heating, the solid product is dried and calcined.—D. F. T.

Plastic product. W. O. Snelling. U.S.P. 1,430,036, 26.9.22. Appl., 20.10.20.

A rosin ester is applied as a substitute for chicle. —D. F. T.

Zinc-lead fume; Treatment of ——. W. G. Waring, Assr. to W. G. Battelle. U.S.P. 1,430,271, 26.9.22. Appl., 17.8.21.

Zinc-lead fume intended for use as a pigment and containing sulphur is roasted at a low temperature to remove volatile impurities and to convert the cadmium into the soluble sulphate, which can be removed by leaching with water.—H. C. R.

Painter's size; Process for the preparation of ——. F. Sichel, Kommanditges., and E. Stern. G.P. (A) 349,280, 7.11.20, and (B) 353,568, 29.12.20.

(A) The size is made by digesting a mixture of starch with wholly or partly saponified fats, resins, or waxes, with an alkaline-earth hydroxide and a salt of an alkali metal which reacts to form alkali hydroxide. The product is dried or concentrated. (B) Part of this prepared product is added to further batches of raw material, and the mixture is subjected to the above treatment.—A. R. P.

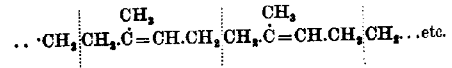
Plastic compositions; Production of —— from solid or semi-solid acid tars or the like. Plauson's Forschungsinst. G.m.b.H. G.P. 354,539, 6.12.19.

Acid tars or the like are treated at 80°—160° C., under atmospheric or increased pressure, with aldehydes in the presence or absence of phenols and/or condensation accelerators, such as sulphuric or hydrochloric acid, or starch. The products are either treated with organic solvents to extract constituents suitable for use in the manufacture of lacquers, or are used as plastic compositions. In the manufacture of the latter, sawdust is either added to the acid tar or mixed with the condensation product, or sawdust may be impregnated with extracts of the condensation product, and subsequently mixed with the insoluble residue remaining after extraction.—L. A. C.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Caoutchouc; Hydrogenation of —— and its constitution. H. Staudinger and J. Fritschi. Helv. Chim. Acta, 1922, 5, 785—806.

Purified plantation rubber was completely hydrogenised by treatment with hydrogen in presence of platinum at 270° C. and about 100 atm. With a nickel catalyst complete hydrogenation could not be obtained under these and even more severe conditions. The hydrogenated rubber has the composition $(C_5H_{10})_n$ and behaves towards bromine as a saturated compound. It forms a colourless amorphous mass, without the elastic properties of rubber but retaining its colloidal properties; it forms colloidal solutions in benzene, ether, and chloroform, but is insoluble in alcohol and acetone. It is attacked by bromine in sunlight, forming a brominated compound resembling rubber. The hydro-caoutchouc must be regarded as a high-molecular paraffin hydrocarbon with so large a molecule that C_nH_{2n+2} is practically equivalent to C_nH_{2n}. It is unattacked by vulcanising agents. This supports the view that the vulcanisation of rubber is a purely chemical process due to combination of the vulcanising substance with the rubber at the double bonds, and not an adsorption phenomenon. The distillation of both rubber and hydro-caoutchouc in a high vacuum, 0·1 to 0·3 mm., was studied. The latter, being a saturated substance, needs a higher temperature than rubber. The products obtained from rubber were isoprene, dipentene, a hydrocarbon, $C_{15}H_{24}$, containing two double bonds, probably a hydrogenated naphthalene derivative, and hydrocarbons $C_{20}H_{32}$ and $C_{25}H_{40}$. The decomposition products from hydro-caoutchouc had the composition $(C_5H_{10})_n$, the lowest obtained being a pentene and the highest $C_{50}H_{100}$. All these observations are in agreement with the theory that the rubber molecule consists of isoprene molecules condensed in a chain of the following type:—



$$\cdots CH_2 \vdots CH_2.\overset{CH_3}{\dot{C}}{=}CH.CH_2 \vdots CH_2.\overset{CH_3}{\dot{C}}{=}CH.CH_2 \vdots CH_2 \cdots \text{etc.}$$

The vertical dotted lines indicate where splitting of the molecule may occur. Rubber separated from latex by means of acetone, then extracted with a mixture of chloroform and acetone, and hydrogenated gave the same results as plantation rubber. (*Cf.* J.C.S., Nov.)—E. H. R.

Rubber latex; Experiments to preserve ——. H. P. Stevens. Bull. Rubber Growers' Assoc., 1922, 4, 457—458.

Ammonia, sodium fluoride, sodium silicofluoride, "Agrisol A" and "Agrisol B" (cresol preparations) were found to be satisfactory preservatives; the three last-named, however, were used in conjunction with caustic soda, which itself exerts a marked effect. Ammonium carbonate, pyridine, sodium carbonate, formalin, sodium sulphite, Izal, carbolic acid, and cresylic acid (the three last with alkali) were unsatisfactory. Ammonia is effective when added in the proportion of ¼ oz. of concentrated solution to one quart of latex, but it is advisable to use twice this quantity; the proportion of caustic soda used was 2¼ pts. of "saturated solution" to 100 pts. of latex, but a much smaller proportion would probably suffice. For some manufactures preservation with the volatile ammonia may be advantageous, but for the majority of purposes latex preserved with caustic soda would be just as good.—D. F. T.

Patents.

Cellular [rubber] material; Process of producing ——. K. H. Fulton. E.P. 185,477, 25.5.21.

A mixture of raw rubber, sulphur or other vulcanising agents, and finely divided charcoal is shaped into the desired form and treated under high pressure in a jacketed vessel with an inert gas such as nitrogen, whereby the gas is occluded in the particles of charcoal without changing the size of the mass. While still under pressure, the material is vulcanised and subsequently cooled by the admission first of steam or hot water, and then of a cooling medium into the outer jacket. The pressure is then reduced to 1 atm., and the material is again heated, whereby the occluded gas is liberated from the particles of charcoal, causing the mass to swell and assume a cellular structure. A hard cellular material is prepared by using Para rubber and an excess of sulphur, and only carrying the vulcanisation at first to the stage at which a soft, cellular rubber is formed, this being subsequently hardened by further heating, *e.g.*, in a press if smooth boards suitable, *e.g.*, for lining refrigerators are required. In the manufacture of tyre fillers and the like, the original mixture contains balata in addition to Para rubber, and fibrous filaments run through the material from end to end to facilitate contact between the gas and the charcoal. The final heating is performed with the tyre mounted on a rim.—L. A. C.

Vulcanised oil product. U.S.P. 1,430,034. *See* XII.

XV.—LEATHER; BONE; HORN; GLUE.

Formaldehyde-tanned leather; Chroming of ——. E. Griliches. Collegium, 1922, 199—201.

The adsorption of chromium by hide is not appreciably affected by a preliminary treatment with formaldehyde. It was much higher with normal chromium sulphate than with basic chromium solutions. The acidity of chrome tanning liquors was much higher after chroming formaldehyde-treated leather than after direct chrome tannage. The amount of acid taken up by the formaldehyde-tanned leather as compared with pelt showed a decrease of 19—31%. The results confirm the results of Stiasny and Gerngross (*cf.* J., 1920, 730 A) on the diminution in the absorption of acid by formaldehyde-treated hide powder.—D. W.

Patents.

Tanning preparation. J. K. Tullis, Assr. to Fulcra Tan Co. U.S.P. 1,430,477, 26.9.22. Appl., 25.3.20.

A tanning material consists of a solution of commercial quebracho extract in the acidulated light liquor from the sulphite digesters used in paper pulp manufacture, the acidity being produced by a sulphonic acid.—W. C.

Tanning process. F. Wayland. U.S.P. 1,430,479, 26.9.22. Appl., 22.11.20.

The grain is separated from the nerve layer of a raw hide and held in a taut condition while being subjected to the action of a tanning reagent for converting it into leather.—W. C.

Gelatin; Extraction of ——. C. Collard. E.P. 166,896, 23.7.21. Conv., 24.7.20.

Gelatin is extracted from osseine by heating it with water in a number of digesters connected in series with one another at their upper ends by pipe connexions each having two taps; a heater is connected with the bottom of each digester and with the upper connecting pipe at a point between the taps. The osseine is extracted in each digester by thermo-siphon action until a certain degree of concentration is attained and the liquor is then transferred to the next digester.—D. W.

Tanning process. L. and G. Dufour. U.S.P. 1,429,851, 19.9.22. Appl., 28.3.21.

See E.P. 125,362 of 1919; J., 1920, 165 A.

XVI.—SOILS; FERTILISERS.

Kaolin; Decomposition of —— *by organisms.* W. J. Vernadsky. Comptes rend., 1922, 175, 450—452.

Silicious diatoms accompanied by a large number of bacteria were placed in contact with clay in a nutritive medium (free from silicon) contained in a glass vessel the interior of which was lined with paraffin wax. It was found that the development of the organisms was associated with the formation of hydrated aluminium oxide, whereas in the control experiment no chemical change in the clay could be detected. The author suggests that this decomposition of silicate plays a considerable part in natural processes.—H. J. E.

Microbiological analysis of soil as an index of soil fertility. I. The mathematical interpretation of numbers of micro-organisms in the soil. S. A. Waksman. Soil Sci., 1922, 14, 81—101.

The reliability of bacterial counts when only 2 or 3 plates are used is small. Large numbers of plates should be used and the limit of error calculated. The dilutions used for counting bacteria are too high for the counting of fungi. About 1/100th dilution should be used for the latter and a special acid medium is necessary. More than one sample of soil should be taken and a composite sample drawn from among the field samples. A scale of relative reliability based on the number of samples drawn and the number of plates made is suggested. —A. G. P.

Micro-organisms in soil; Tentative outline of the plate method for determining the number of ——. S. A. Waksman and E. B. Fred. Soil Sci., 1922, 14, 27—28.

The standard method of enumerating soil micro-organisms suggested by the Society of American Bacteriologists is outlined. The media included are albuminate-agar, caseinate-agar, and soil extract-agar-gelatin. The reaction of the medium is to be adjusted to about p_H 6·8 or 6·5 after sterilisation. From 5 to 10 plates for each dilution per sample are recommended, and the number of colonies per plate counted should be between 50 and 150. The incubation temperature is 28°—30° C., except for gelatin; and the period, 8—10 days for bacteria, 14 days for actinomycetes, and 2—3 days for fungi on synthetic media.—A. G. P.

Legume bacteria; Movement of —— *in soil.* W. C. Frazier and E. B. Fred. Soil Sci., 1922, 14, 29—36.

From a study of soya beans inoculated and uninoculated with the legume bacteria, and grown in close proximity, it is concluded that the organisms move extremely slowly or not at all in soil. —A. G. P.

Soil colloids; Influence of —— on availability of salts. N. E. Gordon and E. B. Starkey. Soil Sci., 1922, 14, 1—7.

The adsorption of calcium and potassium salts by silica, iron, and alumina gels was investigated. The amount adsorbed increased, within limits, with the concentration of the salt solution. Iron and alumina gels have a considerably greater adsorptive power than silica gels. Adsorbed salts are very slowly removed from the gels by washing. The adsorption of calcium and potassium ions increases with increasing p_H values of the solutions. With the phosphate ion the reverse in the case. Change of p_H value produces considerably greater adsorption changes with potassium salts than with calcium salts.—A. G. P.

Nitrate nitrogen and p_H values of soils; Variation of —— from the nitrogen availability plots. A. W. Blair and A. L. Prince. Soil Sci., 1922, 14, 9—17.

Plots which had received various fertiliser treatments were examined periodically for nitrates and p_H values. The variation of p_H value due to fertilisers was very small on limed plots, but considerable where lime was lacking. Limed plots gave consistently higher p_H values than the unlimed. Ammonium sulphate produced the lowest p_H values in both series. The plot having the lowest p_H value showed the greatest lime requirement by the Veitch method, whilst soils with p_H 7 showed no lime requirement. Nitrate figures were at their lowest immediately after the removal of crops, and were always higher on the unlimed plots, but there was no correlation between the nitrate figures and the crop yields. Soils sufficiently acid to inhibit the growth of ordinary farm crops had very considerable nitrate contents. Nitrification decreased with temperature. Excess of available nitrate caused " lodging " of grain crops.—A. G. P.

Fertility of rice soils; Possible correlation between the —— and their titration curves. O. Arrhenius. Soil Sci., 1922, 14, 21—26.

Attempts to correlate the productivity of rice soils and their hydrogen ion concentrations were unsuccessful. Titration of soil extracts, however, showed that those soils which possessed the greater buffer capacity were the more productive. Buffer capacity was measured directly by the amounts of acid or alkali which a soil could take up without appreciable alteration in p_H value.—A. G. P.

Rock phosphate; Composting —— with sulphur in slightly alkaline calcareous soils. W. Rudolfs. Soil Sci., 1922, 14, 37—59.

The conditions governing the oxidation of sulphur in soils and the subsequent solution of added rock phosphate have been examined with a view to the commercial utilisation of the process. In a calcareous soil the oxidation of sulphur proceeded normally, and the solution of the phosphate was not retarded. Increased temperature of incubation increased the rate of oxidation and solution of phosphate, and in a calcareous soil the influence of temperature was much more evident when large amounts of soil were used. Light was slightly detrimental to the sulphur-oxidising organisms, bacterial activity was stimulated by small amounts of sulphuric acid, and by sodium carbonate in a calcareous soil poor in organic matter. In a richly organic soil sodium carbonate had no stimulating effect. Sodium bisulphate solution, acetic acid, ferrous sulphate, and aluminium sulphate failed to act as stimulants to the organisms; and sodium chloride, and, to a less extent, hydrochloric acid retarded their activity. Partial sterilisation of the soil had no beneficial effect. The amount of soil used may be reduced to 1·6—1·7%, and ammonium sulphate may be used to replace the bulk of calcareous soil poor in nitrogen. The use of sulphur in quantities comparable to the amount required in the commercial manufacture of superphosphate gave good results. The addition of sulphurous acid to produce an acid reaction at the commencement of the process considerably increased the rate of oxidation. Aeration of the mixture increased the rate of reaction, but too much air caused it to cease almost entirely. The hydrogen ion concentration at the completion of the process reached p_H 3·1—2·9, but the titratable acidity increased after this point was reached. The mixtures tended to form aggregates which varied in acidity and in available phosphate content according to their size.—A. G. P.

Potato scab; Influence of soil reaction upon the growth of actinomycetes causing ——. S. A. Waksman. Soil Sci., 1922, 14, 61—79.

Actinomyces scabies will grow in acid soils up to p_H values of 5·0—5·2, with occasional strains surviving at p_H 4·8. The saprophytic soil actinomycetes are more resistant than strains of *A. scabies*. It is possible, by treating soil with sulphur inoculated with *Thiobacillus thiooxidans*, to increase the acidity sufficiently to control the growth of *A. scabies*.—A. G. P.

Cobalt and nickel in plants. Bertrand and Mokragnatz. *See* XIXA.

Patents.

Lime-nitrogen [crude calcium cyanamide] process and product. J. M. A. Stillesen. U.S.P. 1,386,445, 2.8.21. Appl., 8.8.11. Renewed 30.11.17.

Crude calcium cyanamide is treated with water and then with carbon dioxide to convert the free lime into basic or normal calcium carbonate. To avoid risk of decomposition of the calcium cyanamide by the heat of the reaction, solid or liquid carbon dioxide is preferably used, the heat evolved in the union of lime and carbon dioxide being thus counteracted by the heat absorbed in the vaporisation and expansion of the carbon dioxide.

Fertiliser material and process of producing same. A. F. Hoffman. U.S.P. 1,428,633, 12.9.22. Appl., 23.4.18.

A fertiliser material containing basic ferric sulphate and organic matter is precipitated from acid coal mine water by partial neutralisation. —T. A. S.

Fertiliser; Treatment of calcium cyanamide for production of a ——. Bambach und Co. Chem. Ges.m.b.H. G.P. 300,022, 30.12.13. Addn. to 299,131.

A solution of sodium ammonium sulphate, prepared as described in the original patent (*cf.* p. 858 A), is treated with superphosphate, so as to produce a solution of sodium ammonium phosphate, which, on evaporation, yields a fertiliser. —A. B. S.

XVII.—SUGARS; STARCHES; GUMS.

Beet juice; Action of lime on the protein substances separated during the defecation of ——. V. Stanek. Z. Zuckerind. Czechoslov., 1922, 46, 663—669, 671—676.

Raw beet juice was limed and heated, and the effect of this treatment on the proteins thus precipitated was studied. It was found that under the conditions of liming in practice, about 11% of the precipitate may pass into solution, but part will be re-precipitated on carbonating. This hydrolytic action of lime was found to result in the formation of albumoses, peptones, and polypeptides, but it was not possible to isolate amino-acids. Decomposition products of lecithin, *e.g.*, glycerophosphoric acid and choline, were detected. Betaine could not be identified.—J. P. O.

Sucrose; Correction for the volume of the lead precipitate when using basic lead nitrate as clarifying agent in determination of ——. C. Sijlmans. Archief Suikerind. Nederl.-Indië, 1922, 30, 517—520. Int. Sugar J., 1922, 24, 496.

In the method of operating the double polarisation method recently described (J., 1921, 863 A), in which lead nitrate followed by sodium hydroxide is employed for clarification, a considerable precipitate is produced, for which it is necessary to make an allowance. This is done by making two polarisations, the new method of clarification being applied in both, but a determined amount of sucrose added in the second. In this way the volume of the lead precipitate was found to amount to 3·2 c.c. per 100 c.c., causing the result in the case of molasses to average about 1·26% too high.—J. P. O.

Sucrose; Estimation of —— *in presence of other sugars by means of the hydroxides of the alkaline earths.* A. Behre and A. Düring. Z. Unters. Nahr. Genussm., 1922, 44, 65—70.

Sucrose is estimated by heating the material (20 g.) with 1·2 g. of lime and 50 c.c. of water for 1 hr. at 60°—80° C. Other sugars are thus destroyed and the sucrose is determined polarimetrically. Barium hydroxide (4 g.) may be substituted for the lime, but in this case heating for 2 hrs. under a reflux condenser is necessary. With a 200-mm. polarimeter tube the sucrose content is given by the formula P×0·75×5.—A. G. P.

Sucrose, dextrose, lævulose, and invert sugar; Relative sweetness of ——. N. Deerr. Int. Sugar J., 1922, 24, 481.

Solutions of various sugars were diluted until they had the same sweetness as that of a 10% solution of dextrose. The following results for relative sweetness were thus obtained: sucrose, 100; dextrose, 60; lævulose, 120; and invert sugar, 95. The difference between this result for invert sugar and that obtained by Sale and Skinner (J., 1922, 776 A) may be due to the different concentration at which the liquids were tasted.—J. P. O.

Glucose-ammonia and iso-glucosamine; Crystalline ——. A. R. Ling and D. R. Nanji. Chem. Soc. Trans., 1922, 121, 1682—1688. (*Cf.* J., 1922, 151 T.)

The crystalline compound obtained by the action of ammonia on dextrose in methyl alcoholic solution is glucose-ammonia, and is identical with the product obtained in aqueous solution (*loc. cit.*). It melts at 123°—124° C., and has $[\alpha]_D = +20{\cdot}3°$. It gives all the reactions of an aldehyde-ammonia, including the formation of a primary amine on reduction, glucamine being produced when a solution in 95% methyl alcohol is subjected to cathodic reduction. Further confirmation of the structure of glucose-ammonia was obtained by condensing it with formaldehyde sodium bisulphite, when an ω-sodium sulphonate,

$$HO.CH_2.[CH(OH)]_4.CH(OH).NH.CH_2SO_3Na,$$

was formed. On recrystallising glucose-ammonia from methyl alcohol it loses 1 mol. of water with the formation of isoglucosamine, m.p. 127°—128° C. —G. F. M.

Starch; New depolymerisation product of ——. A. Pictet and R. Jahn. Helv. Chim. Acta, 1922, 5, 640—644.

When potato starch is heated in glycerin at 200°—210° C., until a sample no longer gives a colour with iodine, a new compound is formed which can be isolated by distilling off the glycerin under 2—4 mm. pressure, dissolving the residue in water, and precipitating with alcohol. The product, to which the name trihexosan is given, has the formula $(C_6H_{10}O_5)_3$, and forms a white, amorphous, slightly hygroscopic powder, $[\alpha]_D = +162{\cdot}2°$ in water. It does not reduce boiling Fehling's solution, is hydrolysed by hot dilute sulphuric acid to glucose, and forms a nonoacetyl derivative,

$$[C_6H_7O_5(C_2H_3O)_3]_3,$$

m.p. 153°—154° C. It is not identical with either of Pringsheim's triamyloses (J., 1913, 985). The existence of this compound supports the view that the starch molecule contains $C_6H_{10}O_5$ units combined in groups of three.—E. H. R.

Patents.

Sugar manufacture; System of pan boiling in —— *by using an auxiliary storage tank.* T. C. Jacobs. In part from H. M. Jacobs. E.P. 185,707, 30.3.22.

An auxiliary tank is connected with the vacuum pan system in a sugar factory and means are provided for the automatic transfer of the whole or part of the contents of any vacuum pan to the auxiliary tank for treatment by stirring or otherwise keeping it in motion while it is gradually cooling and for the automatic transfer of the virgin grain in the tank to any vacuum pan requiring "footing" for massecuites. This enables vacuum pans to be supplied with virgin grain which would otherwise be idle.—H. C. R.

Sugar juices; Process for purifying —— *by filtration and decantation.* F. Tiemann. U.S.P. 1,430,200, 26.9.22. Appl., 6.7.21.

See E.P. 161,987 of 1921; J., 1921, 633 A.

XVIII.—FERMENTATION INDUSTRIES.

Amylases of the cereal grains. The "insoluble" amylase of barley. J. L. Baker and H. F. E. Hulton. Chem. Soc. Trans., 1922, 121, 1929—1934.

The water-insoluble amylase of barley which is liberated by proteolytic action is associated with the alcohol-soluble group of proteins (hordein), since papain liberated amylase from the water-extracted residue, and from the residue after salt extraction (globulin-free material), but not from the residue from which hordein had been removed by alcohol. Since no amylase could be obtained by the action of papain on isolated hordein, nor from barley which had been boiled or heated to 120° C., it is concluded that the enzyme was pre-existent in the barley as an insoluble enzyme complex, and is not a cleavage product of some non-amylolytic protein. Amylase liberated by papain invariably exhibits only the characteristic properties of the soluble amylase of barley, and no light is therefore thrown on the appearance of the characteristic malt amylase during the germination of barley.—G. F. M.

Methyl alcohol; Detection of —— *in alcoholic drinks.* J. F. A. Pool. Pharm. Weekblad, 1922, 59, 973—979.

The method of Trillat and Wolff (J., 1900, 565), namely oxidation with bichromate, shaking with dimethylaniline, and oxidation of the aldehyde-aniline condensation product with lead peroxide, is capable of detecting 1 pt. of methyl alcohol added to 2000 pts. of various wines and spirits; about the same sensitiveness is obtained by the method of Fendler and Mannich (J., 1905, 1128), viz, oxidation with permanganate after distillation, and addition of morphene hydrochloride in strong sulphuric acid solution. Of 200 samples tested by these two methods, none showed methyl alcohol except in those cases in which it was added purposely. Methyl alcohol does not reduce permanganate more quickly than ethyl alcohol, as generally stated; this is true only of wood spirit, which contains aldehydes and other reducing agents.—S. I. L.

Yeasts from butter. Sandelin. *See* XIXA.

XIXA.—FOODS.

Wheat gluten. J. Gerum and C. Metzer. Z. Unters. Nahr. Genussm., 1922, **44**, 86—89.

Experiments are described which throw doubt on the existence of a stable insoluble compound of protein and phosphoric acid in wheat gluten. (*Cf.* Levy, Z. Unters. Nahr. Genussm., 1910, **19**, 120.) In the preparation of gluten from flour, temperature and amount of washing have little influence on the yield or physical properties of the protein. The greater part of the phosphorus in flour is washed out during the separation of the gluten. The maximum amount of phosphorus retained by the gluten was 22% of the total. By mixing rye with wheat flour the phosphorus in the gluten prepared from it was decreased. Fineness of milling also causes a reduction in the phosphorus content of the gluten. In mixed rye and wheat flours the yield of gluten decreases parallel with its phosphorus content. The ratio of phosphorus to nitrogen in gluten from pure wheat flour varies within certain limits and decreases proportionally to the amount of added rye flour. If, instead of rye, neutral indifferent substances are added to wheat flour, the yield of gluten and its phosphorus content appear to depend on the physical properties of the added material.—A. G. P.

Wheat gliadin; Rate of hydrolysis of ——. H. B. Vickery. J. Biol. Chem., 1922, **53**, 495—511.

Results are given of a large number of experiments in which measurements were made of the rate of hydrolysis of gliadin by acids of various concentrations and also by alkalis. Hydrolysis both of the amide nitrogen and of the peptide linkages proceeds more rapidly the higher the concentration of acid. In the early stages, alkalis are more effective than acids. Owing to secondary decompositions, however, considerably larger quantities of ammonia are liberated by alkalis than by acids. Hydrolysis is more rapid with barium hydroxide than with sodium hydroxide of equivalent concentration. —E. S.

Maize flour; Biochemical reaction of stale ——. J. Vintilesco and M. Haimann. Bul. Soc. Chim. Romania, 1922, **4**, 17—20. Chem. Zentr., 1922, **93**, IV., 765—766.

Commercial maize flour always has a slightly rancid taste and its behaviour on testing by Vintilesco and Popesco's reaction with hæmoglobin and guaiacum tincture (J. Pharm. Chim., 1910, **12**, 318) for rancid fats indicates that the rancidity is due to oxidation of the unsaturated fatty acids, which are present to a greater extent in maize than in wheat. Freshly milled maize flour and samples that have been kept in the dark in well-sealed vessels give a negative result with this test. If, however, the flour is exposed to the air, whether in sunlight or in the dark, the reaction becomes positive after a few days. The oil extracted from the flour with petroleum spirit reacts in the same way as the flour itself. That from the fresh flour had an iodine value of 119, while that from the flour after several days' exposure to the air had an iodine value of 102. Wheaten flour contains an oxidase which colours guaiacum tincture in the absence of hæmoglobin, and the test is therefore inapplicable.—H. C. R.

Water in meat sausages; Detection of added ——. S. Holzmann and J. Deininger. Z. Unters. Nahr. Genussm., 1922, **44**, 81—86.

The method of Feder (Z. Unters. Nahr. Genussm., 1913, **25**, 577) for the determination of added water in meat products was examined, and attempts were made to curtail the routine estimation of water, fat, and ash, and the subsequent calculation of added water. The meat ash (free from sodium chloride) was found to be uniformly 4—5% of the non-fatty organic matter. Sodium chloride may be estimated by extracting the shredded meat (5 g.) with 50 c.c. of distilled water for ½ hr. on a water bath and for 5 mins. over a free flame. The extract is neutralised and chlorides estimated volumetrically. A reliable figure for total mineral matter may be obtained by adding to the sodium chloride thus obtained, 4—5% of the non-fatty (protein) nitrogen. In a series of tests the non-fatty organic matter of meats was found to approximate fairly closely to the protein figures as determined by the Kjeldahl method. Cases of divergence may be due to changes in the character of the protein during digestion and the consequent invalidation of the protein factor 6·25. Added water in meat preparations cannot be estimated with very great accuracy by calculation based merely on an estimation of water and nitrogen, and in cases of dispute it is advisable to carry out the Feder method in its entirety. —A. G. P.

Butter and other edible fats; Semi-microchemical determination of water, fat, and sodium chloride in ——. H. Lührig. Pharm. Zentralh., 1922, **63**, 505—508.

For the determination of water the Perplex method is employed, using an ordinary analytical balance and small aluminium beakers with lip and handle or small porcelain casseroles. About 1 g. of butter or margarine is used for each test. In the case of margarine the danger of spirting is reduced by adding a little coarse pumice powder. The whole determination only takes 5—6 min., and very close agreement is obtained between the tests and in comparison with other methods. The fat is determined by extracting the residue in the beaker after the water has been boiled off, with anhydrous ether and filtering the extract into a weighed 50 c.c. conical flask, distilling off the ether, and heating to constant weight in a current of air in an oven. The residue after extraction of the fat is extracted with lukewarm water and washed on the same filter as that used for the ether extract. The sodium chloride is determined in an aliquot part of the filtrate by titration with silver nitrate in the usual way, the concentration of the silver nitrate being such that 1 c.c.=1 mg. Cl. All three determinations can be carried out in about 1 hr. —H. C. R.

Yeast types isolated from butter; Action of —— *on the constituents of milk.* A. E. Sandelin. Ann. Acad. Sci. Fennicae, 1922, **A 19**, [3]. Chem. Zentr., 1922, **93**, III., 838.

Various types of yeast isolated from butter (*cf.* Ann. Acad. Sci. Fennicae, Series A, **12**, No. 6) were examined with regard to their action on the various constituents of milk both when grown alone and in mixed cultures with *Streptococcus lactis*. All the yeasts used were *Torulæ* according to Hansen's classification with one exception, which was a *Mycoderma*. The yeasts could be divided into groups according to their action on the constituents of milk. No type was found to act on all the constituents of milk—fat, sugar, and casein. —W. H. G.

"Cyclon"; Absorption of —— by different foodstuffs. [Detection of hydrocyanic acid.] J. D. Jansen, W. Schut, and M. Wagenaar. Chem. Weekblad, 1922, **19**, 373—375.

Various foodstuffs left exposed during the fumigation of a liner were found to contain up to 700 mg. HCN per kg., the greatest absorption being found for meat and water, and nothing detectable in coffee and mustard. The analyses were based on colorimetric determinations by means of phenolphthalein, which is regenerated from the colourless reduction product by hydrocyanic acid in presence of copper acetate. The reaction will detect 0·001 mg. HCN.—S. I. L.

Boric acid in shrimps; Estimation of ——. W. M. Deerns. Chem. Weekblad, 1922, **19**, 397—400.

In the estimation of boric acid in foodstuffs by the usual method the presence of phosphates causes incorrect results. To estimate the error arising through the presence of phosphates, shrimps were mixed with a known quantity of boric acid and sodium bicarbonate, dried, and ignited in a muffle. The ash was lixiviated with water. The solution was acidified with a few drops of hydrochloric acid and boiled in a flask fitted with a reflux condenser for 20 mins. The solution was neutralised with baryta and the last traces of acid removed by a solution of potassium iodide and iodate. The boric acid was then titrated with potassium hydroxide free from carbon dioxide in presence of mannitol. In a series of experiments too much boric acid to the extent of 0·40—0·53% was indicated. The amount of phosphates in shrimps is 0·4—0·6%. The analysis of shrimps to which no boric acid had been added gave an indication of the presence of 0·59—0·57% of boric acid. To avoid the error due to phosphates, after ignition and treatment with hydrochloric acid, a solution of ferric chloride was added and the liquid neutralised with chalk and filtered. 200 c.c. of the solution was drawn off by a pipette and the test continued as described. The results obtained were correct to within 1%.—H. M.

Cobalt and nickel; Presence of —— in plants. G. Bertrand and M. Mokragnatz. Comptes rend., 1922, **175**, 458—460.

An examination of various food products of vegetable origin for traces of nickel and cobalt showed that the former is present in every case, whilst the latter is absent only from carrot and oats; further investigation may reverse the negative result obtained in these two cases. The substances examined consisted of carrot (root), onion (bulb), potato (tuber), spinach (leaf), lettuce (leaf), cress (stem with leaf), tomato (fruit), apricot (fleshy part of fruit), bean (whole green pod, also dried seed), lentil (grain), buckwheat (grain), wheat (grain, also husk), oats (grain), maize (grain), rice (polished grain), mushroom (whole). The quantity of metal per kg. of fresh substance varies in the case of nickel from 0·01 mg. to 2 mg. and in the case of cobalt from 0·005 mg. to 0·3 mg.—H. J. E.

Alfalfa [lucerne] plant; Water-soluble constituents of the ——. T. B. Osborne, A. J. Wakeman, and C. S. Leavenworth. J. Biol. Chem., 1922, 53, 411—429.

The investigation of the press-juice previously obtained (J., 1922, 74 a) has been continued. After removal of the colloid obtained by addition of 20% of alcohol, a second precipitate may be obtained by raising the alcohol content of the filtrate to 53%. This precipitate contains 8% of the original nitrogen, which is probably present as protein. The distribution of nitrogen, both before and after hydrolysis, has been determined in the two precipitates and also in the filtrate, and analyses have been made of the inorganic constituents of the three fractions. The filtrate appears to be suitable for investigating the water-soluble constituents of the juice; the present paper records preliminary experiments in this direction.—E. S.

Proteins of the lima bean, Phaseolus lunatus. D. B. Jones, C. E. F. Gersdorff, C. O. Johns, and A. J. Finks. J. Biol. Chem., 1922, 53, 231—240.

The lima bean contains 21·17% of protein (N × 6·25). By extraction with sodium chloride solution, an α- and a β-globulin were obtained, which were separated by fractional precipitation with ammonium sulphate. An albumin was also isolated. Analyses by Van Slyke's method gave the following values for basic amino-acids: α-globulin—cystine 1·60, arginine 5·67, histidine 3·71, lysine 7·84%; β-globulin—cystine 0·84, arginine 5·07, histidine 2·62, lysine 8·53%; albumin—cystine 1·07, arginine 5·74, histidine 2·54, lysine 5·97%. Positive tests were obtained for tryptophan in each case. The proteins of the lima bean are, in general, similar to those of other beans of the genus *Phaseolus* (*cf.* J., 1922, 342 a).—E. S.

Vitamin which promotes calcium deposition; Experimental demonstration of the existence of a ——. E. V. McCollum, N. Simmonds and J. E. Becker. J. Biol. Chem., 1922, 53, 293—312.

When heated for 12 to 20 hrs. in the presence of oxygen, cod liver oil no longer cures xerophthalmia in rats; its property of initiating healing in rickets, however, is not appreciably reduced. This treatment apparently destroys vitamin A but leaves intact the anti-rachitic factor, which must consequently be regarded as a fourth vitamin. Cod liver oil, shark liver oil, turbot liver oil, and butter cure xerophthalmia and also stimulate the deposition of calcium; coconut oil is deficient in vitamin A, but initiates healing in rickets; whilst cottonseed oil, maize oil, sesamé oil, and olive oil are deficient in both vitamin A and the anti-rachitic factor.—E. S.

Acids present in the cherry. Franzen and Helwert. *See* XX.

Protein precipitants. Hiller and Van Slyke. *See* XXIII.

Reaction of amino nitrogen with nitrous acid. Dunn and Schmidt. *See* XXIII.

Patents.

Food; Manufacture of ice and the use thereof for preserving ——. W. E. Gibbs. E.P. 185,986, 28.10.21.

Sodium hypochlorite in small concentration (*e.g.*, 0·025%) is added to water which is then converted into ice. Such ice is especially suitable for the preservation of fish. Other soluble hypochlorites may be used provided that they possess sufficient germicidal properties to exert a sterilising action on the fish when the ice melts and that they do not affect the appearance of the fish or impart an unpleasant flavour to it. Dilute chlorine water may also be frozen and used in a similar manner, but to prevent corrosion of iron containers from any acids formed the water should be made alkaline.—J. R.

Wheaten [flour]; Method of blending ——. C. G. Harrel, Assr. to The Campbell Baking Co. U.S.P. 1,429,504, 19.9.22. Appl., 6.9.21.

The fermentation of dough for baking purposes is controlled by determining the hydrogen ion concentration of the flour and permitting the dough in which the flour is incorporated to stand for a period of time having a definite relation to the hydrogen ion concentration.—J. R.

Dough; Method of determining condition of —— for baking products during fermentation process. C. J. Patterson, Assr. to The Campbell Baking Co. U.S.P. 1,429,526, 19.9.22. Appl., 29.8.21.

The condition of dough for baking products is ascertained by determining the hydrogen ion concentration of the mixed dough after fermentation has proceeded for a suitable time.—J. R.

Milk; Process and apparatus for acting upon ——. F. A. Plummer, Assr. to A. D. Gray. U.S.P. 1,430,403, 26.9.22. Appl., 28.4.20.

An apparatus for producing dried products from liquids, such as milk, consists of a vertical casing, the lower part of which is surrounded by a second casing. Air is introduced in tangentially oblique currents at the top of the cell, and meets the finely divided liquid under treatment, which is also introduced at the top. The current of air and suspended matter moves rapidly downwards in a cyclone and is discharged through numerous fine openings into the second chamber, which is provided with means whereby the air continues its cyclonic movement, with the result that the solids produced by evaporation of the particles of liquid are acted upon by centrifugal force and gravity and are separated from the air.—J. R.

Baking powder. B. Bleyer. G.P. 356,168, 1.4.20.

The powder comprises a mixture of a salt, such as sodium bicarbonate, which evolves gas on heating, and a compound of casein and lactic acid (*cf.* G.P. 344,707; J., 1922, 432 A). The product has a pleasant taste, is not hygroscopic, and evolves large quantities of carbon dioxide.—H. C. R.

Baking or drying substances. E.P. 185,460. *See* I.

XIXb.—WATER PURIFICATION; SANITATION.

Disinfectants; Standardisation of ——. K. Rülke. Chem.-Zeit., 1922, **46**, 897—898.

Attention is drawn to the greatly differing figures for the disinfecting power, or carbolic acid coefficient, of a disinfectant given by the Rideal-Walker test using an ordinary sterilised broth on the one hand, and milk or similar emulsion on the other. Where, for example, in the former case 0·1% of a solution of higher phenols had the same effect as 1% of carbolic acid, in the latter case a 1·25% solution of carbolic acid and 1·4% solution of the higher phenols was required. The same discrepancy is found in the case of determinations of the antiseptic power. Kobert's method of determining the antiseptic power in milk to which colloidal sulphur has been added, using bacteria which produce hydrogen sulphide, and finding the amount of disinfectant required to prevent the formation of this gas within a certain time as indicated by lead acetate paper, is recommended for use where a bacteriological laboratory is not available. A disinfectant can be sufficiently characterised by means of a curve for the disinfecting or germicidal power at 17·5° C., and a second curve for the antiseptic power under the usual conditions, but one curve alone is not sufficient. Further, a disinfectant should be standardised in respect to the particular bacteria for the destruction of which it is to be used in practice.—G. F. M.

Patents.

Turbid water or liquid; Filtration of ——. R. H. L. Pennell. E.P. 185,798, 11.5.21.

In a water purification plant especially suitable for small towns, pre-filtration is effected in stages by passing the liquid through a number of chambers containing graded filtering medium. The rate of flow of the liquid through each successive chamber is decreased by successively increasing the area of the respective chambers. The water to be filtered is led into a well which it leaves at or near the bottom and passes upwards through a catch pit wherein coarse foreign matter is deposited and from which the liquid traverses in succession a number of scrubbing and straining vessels, the liquid in each case percolating upwards before finally percolating downwards through one or more sand filters. The last filtering stage consists of sand filtration tanks working in parallel. The water is admitted from the last of the strainers to the upper surface of the sand constituting the filtering medium and passes downwards to outlet wells in communication with the bottom of the tanks. —J. R.

Sewage; Purification of —— by treatment in centrifugal separators. E. Green. E.P. 185,444, 2.4.21.

The perforated basket of a centrifugal machine is lined with segmental bags filled with porous material (*e.g.*, charcoal in asbestos bags) to form a filtering medium. When the layer of sediment is of a certain thickness, the admission of sewage is stopped automatically and the machine allowed to run to dry the cake, which when dry is broken up by a squeegee or scraper and discharged through a suction pipe without stopping the machine. The filtering medium is easily removable; when clogged it is removed and rendered permeable again by heating to a high temperature.—B. M. V.

[Sewage] sludge; Dehydrating activated ——. C. L. Peck, Assr. to The Dorr Co. U.S.P. 1,430,182, 26.9.22. Appl., 17.3.21.

The sludge is made slightly acid to methyl orange under conditions which result in gas evolution. The solid material in the sludge thereby gradually rises to the surface and forms a floating mass, of which a considerable part is above the liquid level of the sludge. Solid matter is then withdrawn from this portion of the floating mass to any desired extent. —J. R.

Disinfecting and preserving; Process for —— [with colloidal aluminium hydroxide]. E. de Haën, Chem. Fabr. "List" G.m.b.H., and M. Buchner. G.P. 356,833, 30.3.19.

Colloidal aluminium hydroxide containing a high percentage of water is prepared by adding concentrated ammonia solution to a cold 2% solution of an aluminium salt, and subsequently heating the mixture. The product on application to open wounds builds a thick scab without formation of pus, and exerts a bactericidal action due to adsorption.—L. A. C.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Morphine content of powdered opium; Loss in —— on storage. H. E. Annett and H. D. Singh. Pharm. J., 1922, **109**, 304—305.

Samples of dry powdered opium stored for four years lost about 3% of morphine calculated on the dry weight of the opium, the amount of the loss being irrespective of the original morphine content. The destruction of the morphine may possibly be due to the action of oxidising enzymes, which have been shown to be present. There is considerable evidence that moist opium does not undergo any change on storage.—G. F. M.

Atropine; Volatilisation and hydrolysis of —— in toxicology. P. Hardy. J. Pharm. Chim., 1922, 26, 220—226.

Considerable losses of atropine take place in aqueous solution in consequence of hydrolysis and also by reason of the fact that the alkaloid is volatile in steam. With suitable methods of extraction, however, these losses may be obviated and accurate estimations of atropine may be made if proper precautions are taken.—H. J. E.

Yohimbine; Determination of —— in yohimbé bark. A. Schomer. Pharm. Zentralh., 1922, 63, 385—386.

A method described previously (J., 1921, 320 A) yields better results, especially in the case of barks of low yohimbine content, when the yohimbine hydrochloride is crystallised from a cold solution. The brown residue containing the hydrochloride (obtained as described) is treated with 5 c.c. of ether, the latter is evaporated, the residue then dissolved in 3 c.c. of cold absolute alcohol and the solution kept at 0° C. for 18 hrs. The crystals which form are collected, washed with chloroform, then with ether, dried at 100° C., and weighed. —W. P. S.

Amygdalin; The biose of ——. Constitution of the disaccharides. VI. W. N. Haworth and G. C. Leitch. Chem. Soc. Trans., 1922, 121, 1921—1929.

The methylation of amygdalin by means of methyl sulphate in presence of sodium hydroxide resulted in the formation of the methyl ester of heptamethylamygdalinic acid, a crystalline compound, m.p. 91° C., $[\alpha]^{15}_{D} = -51{\cdot}7°$ in ethyl alcohol. Graded scission of this compound by dilute acid gave three cleavage products, namely, *dl*-mandelic acid, tetramethylglucose of the usual butylene oxide form, and a trimethylglucose which was readily converted on the one hand into tetramethylglucose, and, on the other hand, by oxidation with dilute nitric acid into the lactone of trimethylsaccharic acid, indicating that both terminal positions in the hexose chain were unoccupied by methyl groups, and were therefore the positions of attachment of the aromatic complex and the other hexose residue. This evidence shows that the amygdalin biose is, apart from stereochemical reservations, structurally identical with maltose and quite definitely cannot be cellobiose. As regards the stereochemical formulation of the biose, the results based on the selective action of enzymes are somewhat anomalous, but favour the view that maltose is actually a glucose-α-glucoside, and amygdalin itself would then be mandelonitrile-β-maltoside. Should it ultimately be found, however, that the biose is a β-glucoside, this would not, of course, affect the structural formula above ascribed to the sugar, but it might point to its identity with isomaltose or gentiobiose.—G. F. M.

Saffron; Detection of colouring matter of ——, in investigations relating to laudanum poisoning. M. Guerbet. J. Pharm. Chim., 1922, 26, 218—220.

The facts that crocin, the colouring matter of saffron, gives an insoluble substance, crocetin, when hydrolysed by heating with acid, *e.g.*, dilute hydrochloric acid, and that crocetin gives with concentrated sulphuric acid an intense blue coloration changing to violet and brown, may be utilised for detecting poisoning by preparations of laudanum containing saffron. The method admits of the subsequent detection and estimation of meconic acid and the opium alkaloids in the solution from which the crocetin has been separated by filtration. —H. J. E.

Chemical constituents of green plants. XX. Acids present in the cherry (Prunus avium). H. Franzen and F. Helwert. Z. physiol. Chem., 1922, 122, 46—85.

Malic acid is much the most important acid of the cherry. There are present also traces of oxalic acid, and small quantities of succinic acid, citric acid, lactic acid, and of unsaturated acids. —W. O. K.

Muscarine; Isolation of ——, the potent principle of Amanita muscaria. H. King. Chem. Soc. Trans., 1922, 121, 1743—1753.

About 0·12 g. of pure muscarine aurichloride was isolated from 25·5 kg. of fresh *A. muscaria* after a long and tedious process which consisted essentially of several precipitations of the clarified alcoholic extract first with aqueous, and then with alcoholic mercuric chloride, and finally with phosphotungstic acid. The precipitated bases consisted chiefly of choline and muscarine in the proportion of about 20:1, and the former was largely removed by fractionation of the *d*-hydrogen tartrates. Fractionation was continued by means of the aurichlorides, and finally large delicate leaflets of pure muscarine aurichloride were isolated. The whole operation was controlled physiologically by following the distribution of activity by observations of the effects produced on an isolated loop of rabbit's intestine. Pure muscarine chloride was found to be about seven times as active as arecoline, and five times as active as acetylcholine. Physiological assay assigns a content of 0·4 g. of muscarine chloride to the extract from 25·5 kg. of fresh fungus. Muscarine chloride has a molecular weight of about 210; it is quite stable towards alkali and cannot therefore be an ester of choline, nor is there any evidence for the accepted formula with one oxygen atom more than choline, or that it is a quaternary base. It appears to be an alkaloidal base of considerable complexity.—G. F. M.

Animal nucleic acid; Preparation and analysis of ——. P. A. Levene. J. Biol. Chem., 1922, 53, 441—447.

The author's method for the preparation of animal nucleic acid has been improved. The ground glands (10 lb.) are boiled for 35 mins. with 5 l. of water containing 250 g. of sodium hydroxide. The mixture is then neutralised with acetic acid, treated with a colloidal solution of iron (50 c.c.), filtered, and left overnight. Addition of 2 vols. of methyl alcohol containing 2% of hydrochloric acid to the solution precipitates the nucleic acid. The method has been applied to thymus gland, spleen, kidney, pancreas, and liver. In the case of liver the product contains considerable amounts of glycogen and must be further purified. Nucleic acids from the above organs have the same elementary composition, which corresponds with that of a hexose tetranucleotide. Estimations of the purine bases also agree with the tetranucleotide theory.—E. S.

Mercuration in the aromatic series. II. Thymolmercuriacetates and their derivatives. E. Mameli and A. Mameli-Mannessier. Gazz. Chim. Ital., 1922, 52, II., 1—16. (*Cf.* J., 1922, 518 A.)

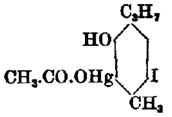
The action of mercuric acetate on thymol under various conditions yields, besides the thymoldimercuriacetate already known, also two new compounds, thymol-*o*- and thymol-*p*-monomercuriacetates,

$$C_3H_7.C_6H_2(OH)(CH_3).Hg.O.CO.CH_3.$$

A number of the corresponding salts in which the acetoxy group is replaced by another acid radicle, are also described. (*Cf.* J.C.S., Nov.)—T. H. P.

Mercuration in the aromatic series. III. Mercurated derivatives of p-iodothymol. E. Mameli. Gazz. Chim. Ital., 1922, 52, II., 18—23.

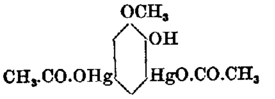
The action of mercuric acetate on *p*-iodothymol, which has only one free ortho-position with respect to the hydroxyl, readily yields the monomercuri-derivative, *p*-iodothymol-*o*-mercuriacetate,



from which the corresponding mercurichloride, mercuribromide, mercurihydroxide and internal oxide are obtainable. (*Cf.* J.C.S., Nov.).
—T. H. P.

Mercuration in the aromatic series. IV. Dimercurated derivatives of guaiacol. E. Mameli. Gazz. Chim. Ital., 1922, 52, II., 23—27.

The action of mercuric acetate on guaiacol yields mono- and di-mercuriacetates in proportions varying with the experimental conditions. Guaiacol-*o.p*-dimercuriacetate,



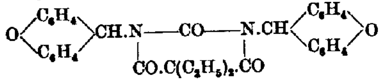
and the corresponding chloride, nitrate, and internal oxide are described. (*Cf.* J.C.S., Nov.)
—T. H. P.

Aniline arsenates. E. Paternò. Gazz. Chim. Ital., 1922, 52, II., 28—31.

When aniline is treated cold with aqueous arsenic acid it always yields dianiline arsenate, and this, when distilled either in a vacuum at 60° C. or in a current of steam or when left in a desiccator over sulphuric acid, loses aniline to form the monoaniline salt, m.p. 154° C. The melting point of the dianiline salt varies, for different samples and different methods of heating, from about 140° C. to about 150° C., and cannot be ascertained exactly, the salt readily undergoing change. In aqueous solution the monoaniline and dianiline salts are hydrolysed to two and three molecules respectively. The maximum solubility of aniline in water is about 3·7% at −0·6° C., and that of water in aniline about 2·8% at −5·4° C.—T. H. P.

Veronal and hypnotics derived from barbituric acid; Reaction of ——. R. Fabre. J. Pharm. Chim., 1922, 26, 241—249.

Veronal, and the malonylureas generally, readily condense with xanthydrol to form crystalline dixanthyl derivatives, *e.g.*,



$$O\left\langle{}^{C_6H_4}_{C_6H_4}\right\rangle CH.\underset{|\qquad\qquad\qquad}{N\text{———}CO\text{———}}\underset{|}{N}.CH\left\langle{}^{C_6H_4}_{C_6H_4}\right\rangle O \atop CO.C(C_2H_5)_2.CO$$

when boiled therewith for a few minutes in acetic acid solution. Similar derivatives are not formed by other hypnotics, and the reaction is therefore valuable for the characterisation and identification of the malonylureas. It can easily be carried out with as little as 0·01 g. of the hypnotic, or with the crude product as isolated by the usual methods from the viscera in toxicological investigations. The dixanthyl derivatives are easily characterised by their melting points, which may be directly determined on the crystals deposited from the acetic acid solution, after washing them with small quantities of boiling alcohol, recrystallisation being unnecessary. The melting points of the dixanthyl derivatives of the principal malonylureas are as follows:—veronal 245°—246° C., phenylethylmalonylurea (gardenal) 218°—219° C., diallylmalonylurea (dial) 242°—243° C.—G. F. M.

Methylguanidine and ββ-dimethylguanidine; Preparation of —— by the interaction of dicyanodiamide and methylammonium and dimethylammonium chlorides respectively. E. A. Werner and J. Bell. Chem. Soc. Trans., 1922, 121, 1790—1794.

The reaction for the preparation of guanidine salts by heating dicyanodiamide with an ammonium salt (J., 1920, 801 A) has been extended to the preparation of methyl- and dimethyl-guanidine hydrochlorides. Thus, fusion of an intimate mixture of dicyanodiamide and dimethylammonium chloride for 3 hrs. at 180° C., and extraction of the product with alcohol gave a nearly quantitative yield of dimethylguanidine hydrochloride. Methylguanidine hydrochloride prepared in a similar way is a very hygroscopic salt. If the fusion is carried out at lower temperatures considerable quantities of dimethyldiguanide hydrochloride are present in the reaction product. This substance is not to be regarded as an intermediate product of the reaction; it is, on the contrary, produced by a reversible change from guanidine, and the mechanism of the formation of guanidine from dicyanodiamide previously put forward (*loc. cit.*) is still in the authors' opinion the correct one.
—G. F. M.

Piperitone. IV. Interaction of dl-piperitone and semicarbazide, and the isolation of pure dl-piperitone. J. Read and H. G. Smith. Chem. Soc. Trans., 1922, 121, 1863—1872.

A specimen of piperitone prepared by fractional distillation from the oil of *Eucalyptus dives* was converted into the semicarbazone by interaction with semicarbazide hydrochloride (a) in cold aqueous alcoholic solution for 2 days, (b) in cold aqueous alcoholic solution in presence of sodium acetate, and (c) in boiling aqueous alcoholic solution in presence of sodium acetate. From preparation (a) a yield of 36% of the α-semicarbazone, m.p. 226°—227° C., was obtained and a further 34% yield of the more strongly basic β-semicarbazone, m.p. 174°—176° C. on the addition of ammonia to the mother liquor. Preparation (b) gave a mixture of the two semicarbazones, and (c) a 62% yield of the α-semicarbazone and only a very small amount of the β-compound. A semicarbazide-*dl*-piperitone of the constitution $C_9H_{16}:C(OH).NH.NH.CO.NH_2$ was the product of the reaction of *dl*-piperitone and semicarbazide hydrochloride in alkaline medium. This substance forms glistening leaflets, m.p. 186°—187° C., yields a stable hydrochloride, and represents a definite intermediate additive stage in the semicarbazone formation. From the semicarbazones the ketone was regenerated by steam distillation in presence of 20% of oxalic acid. For the preparation of pure *dl*-piperitone by this method a preliminary purification of the fractionation product by means of sodium bisulphite was necessary. A colourless, optically inactive product was then obtained having the following characters:—b.p. 113° C. at 18 mm., sp. gr. at 20°/4° C. 0·9331, $n_D^{20}=1·4845$, mol. refractivity 46·70.—G. F. M.

Isoeugenol; Electrolytic oxidation of ——. A. Lowy and C. M. Moore. Trans. Amer. Electrochem. Soc., 1922, 65—76. [Advance copy.]

Attempts to convert isoeugenol into vanillin by electrolytic oxidation (*cf.* E.P. 1624 of 1895; J., 1896, 49), using both aqueous sodium hydroxide and dilute sulphuric acid in the cathode chamber, failed in all cases to yield more than traces of vanillin, resinous products of indefinite composition being the main products.—L. A. C.

Isoprene; Addition of hydrogen halide to ——. H. Staudinger, W. Kreis, and W. Schilt. Helv. Chim. Acta, 1922, 5, 743—756.

When isoprene combines with 1 mol. of hydrogen bromide, addition takes place at the α and δ positions, with production of dimethylallyl bromide, $(CH_3)_2C{:}CH.CH_2Br$. This condenses readily with sodium malonic ester to form ethyl dimethylallylmalonate from which, by hydrolysis, dimethylallylmalonic acid $(CH_3)_2C{:}CH.CH_2.CH{:}(COOH)_2$ is obtained, m.p. 95·5°—96° C. The halogen of dimethylallyl bromide is exceedingly reactive, and the compound reacts readily with guaiacol forming an ether which on heating isomerises to *p*-dimethylallylguaiacol, an oil, b.p. 140° C. at 10 mm. With magnesium, dimethylallyl bromide reacts to form, as principal product, the hydrocarbon tetramethyldiallyl, $(CH_3)_2C{:}CH.CH_2.CH_2.CH{:}C(CH_3)_2$, b.p. 45°—50° C. at 11 mm. (*Cf.* J.C.S., Nov.)

—E. H. R.

Isoprene dibromide. H. Staudinger, O. Muntwyler, and O. Kupfer. Helv. Chim. Acta, 1922, 5, 756—767.

By the action of bromine on isoprene in carbon bisulphide solution a dibromide is formed having the constitution $CH_2Br.C(CH_3){:}CH.CH_2Br$. When treated with alcoholic sodium methoxide this loses hydrogen bromide forming a mixture of monobromoisoprenes which could not be separated. The monobromoisoprenes and also dibromoisoprene, obtained by removal of 2 mols. of hydrogen bromide from isoprene tetrabromide, gave no rubber-like polymerisation product. (*Cf.* J.C.S., Nov.)

—E. H. R.

Terpin; Melting point of commercial ——. J. M. Clavera. Anal. Fís. Quím., 1922, 20, 243—246.

The melting point of freshly crystallised terpin hydrate, with rapid heating, is 118·2° C. Anhydrous terpin has m.p. 104·7° C. (*Cf.* J.C.S., Nov.)—G. W. R.

Sulphurised hydrocarbons [ichthyol]; Sulphonated derivatives of the naturally occurring ——. C. Pépin and G. Reaubourg. J. Pharm. Chim., 1922, 26, 258—261.

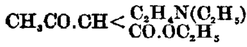
As the therapeutic value of ichthyol is largely dependent on the amount of "sulphidic" sulphur it contains, as distinguished from total sulphur, which comprises in addition sulphonic and sulphatic sulphur, it is desirable that more precise standards should be laid down for commercial ichthyol preparations, and the following are suggested. Colour, brownish red; completely soluble in water, and the solution after evaporation at 100° C. to constant weight should give an extract weighing at least 50% of the weight of the original product. On ignition there should be no residue. After precipitation by albumin and hydrochloric acid, the addition of barium chloride to the filtrate should only produce a slight opalescence, indicating almost complete absence of ammonium sulphate. The sulphidic sulphur, which can only be estimated indirectly by subtracting from the total sulphur the sulphonic plus sulphatic sulphur, should be at least 15% of the dry residue. Lastly the presence of unsaturated compounds should be indicated by decolorisation of bromine water.—G. F. M.

Reaction of amino nitrogen with nitrous acid. Dunn and Schmidt. *See* XXIII.

Patents.

Dialkylaminoalkyl compounds; Manufacture of aliphatic ——. Farbw. vorm. Meister, Lucius, und Brüning. E.P. 167,781, 13.8.21. Conv., 13.8.20.

Aliphatic dialkylaminoalkyl compounds are obtained by the interaction of halogeno-alkyl-dialkylamines and the alkali salts of β-ketonic acids and like compounds of the type $R.CO.CHR_1.X$, where R and R_1 are hydrogen atoms or any other radicles, and X is an electro-negative group. For example, ethyl α-diethylaminoethylacetoacetate



$$CH_3CO.CH{<}\begin{matrix}C_2H_4N(C_2H_5)_2\\CO.OC_2H_5\end{matrix}$$

a colourless strongly alkaline liquid, b.p. 130°—132° C. at 10 mm., is obtained by boiling chloroethyldiethylamine with an alcoholic solution of the sodium compound of ethyl acetoacetate. The same compound can also be obtained by the action of diethylamine on ethyl α-bromoethylacetoacetate. The preparation of the following compounds is also described: diethylaminoethylmalonic diethyl ester, b.p. 145°—150° C. at 10 mm. pressure; ethyl diethylaminoethylcyanoacetate, b.p. 135° C. at 12 mm. pressure; *bis*-diethylaminoethyldiketohexamethylene-diethylcarboxylate, diethylaminoethylacetonediethylcarboxylate, diethylaminoethylcamphorcarboxylic acid methyl ester hydrochloride, m.p. 184°—185° C., and diethylaminoethylacetylacetone, b.p. 137°—139° C. at 20 mm. pressure.

—G. F. M.

Nicotinic acid; Manufacture of dialkylamides of ——. O. Y. Imray. From Society of Chemical Industry in Basle. E.P. 184,625, 7.6.21.

Dialkylamides of nicotinic acid are prepared by treating a halide or ester of the acid with a dialkylamine. *Example.* Nicotinic acid chloride is heated with an equivalent quantity of diethylamine hydrochloride for 2 hrs. at 160° C. The mass is dissolved in water, mixed with concentrated potassium hydroxide solution, and extracted with ether. The ether is distilled off, and the crude diethylamide distilled in a vacuum. It is a yellowish oil, b.p. 280° C., readily soluble in water and organic solvents, and is precipitated from aqueous solution by concentrated alkali hydroxide. The dipropylamide of nicotinic acid is a yellow oil, b.p. 184° C. at 17 mm., and the piperidide a thick oil boiling at 310° C.—G. F. M.

Cyanamide; Method of and apparatus for producing a solution of —— *from calcium cyanamide.* Wargons Aktiebolag, and J. H. Lidholm. E.P. 186,020, 17.5.22. Conv., 1.12.21.

In the ordinary method of preparing a solution of cyanamide by the continuous addition of calcium cyanamide to water or to a dilute solution of calcium cyanamide and treatment with carbon dioxide, the bulk of the solution increases during the operation and the formation of dicyanodiamide may commence in the storage tank before the alkaline liquor passes on to the carbon dioxide treatment. This is avoided by adding the cyanamide to the circulating liquor in a relatively small vessel, whence it passes immediately to the combined pump and agitator in which it is treated with carbon dioxide. After cooling, the solution passes to a large storage tank in which it accumulates.—C. I.

Anæsthetic compound. O. Kamm and E. H. Volwiler. U.S.P. 1,388,573, 23.8.21. Appl., 14.6.20.

Diallylaminoalkyl esters of benzoic acid or its substitution products are prepared by the interaction of benzoyl chloride or its substitution products with a diallylaminoalkyl alcohol. The γ-diallylaminopropyl ester of *p*-aminobenzoic acid is obtained from γ-diallylaminopropyl alcohol (b.p. 215°—217° C. at 755 mm.; prepared by condensing trimethylenechlorhydrin and diallylamine) and forms a hydrochloride of m.p. 138° C. The β-diallylaminoethyl ester of *p*-aminobenzoic acid forms a hydrochloride of m.p. 158°—160° C. The products possess anæsthetic properties.

Hydroxylamines; Salts of aromatic ——. N. Sulzberger. U.S.P. 1,390,260, 6.9.21. Appl., 18.12.18.

An aromatic hydroxylamine is treated with an organic acid. Phenylhydroxylamine oxalate prepared in this way is of value as a photographic developer.

Aromatic aminoalcohols; Process of preparing optically-active ——. A. Gams and E. Wybert, Assrs. to Soc. of Chem. Ind. in Basle. U.S.P. 1,423,101, 18.7.22. Appl., 14.10.21.

Optically-active salts of aminoketones are reduced to the salts of the corresponding optically-active amino-alcohols, and these are subsequently separated from each other and converted into the free bases.—L. A. C.

Urea; Process of manufacturing ——. C. Bosch and W. Meiser, Assrs. to Badische Anilin u. Soda Fabrik. U.S.P. 1,429,483, 19.9.22. Appl., 9.7.20.

A mixture of ammonia and carbon dioxide in suitable proportions is heated under pressure so as to prevent the separation of ammonium salts, and the compressed gaseous mixture is transferred at the same temperature to a reaction vessel, in which the temperature is reduced so as to form a melt, which is kept at a temperature suitable for the production of urea.—J. S. G. T.

Urea; Manufacture of —— from ammonia and carbon dioxide. N. W. Krase. U.S.P. 1,429,953, 26.9.22. Appl., 3.3.21.

Ammonium carbamate is heated to 140°—165° C. under pressure in the presence of an aqueous liquid. (*Cf.* J., 1922, 610 A.)—L. A. C.

Aldehydes and anhydrides; Process of manufacturing —— from di-esters. F. W. Skirrow, Assr. to Shawinigan Laboratories, Ltd. U.S.P. 1,429,650, 19.9.22. Appl., 8.11.20.

An oxide of sulphur is used as a catalytic or decomposing agent in the decomposition of di-esters to form aldehydes and anhydrides.—L. A. C.

Amines; Process of making substituted ——. C. B. Chatfield. U.S.P. 1,429,714, 19.9.22. Appl., 5.3.19.

Substituted amines are prepared by gradual reaction under atmospheric pressure between a bromide of the substituting radicle and the amine in the presence of an alkali hydroxide, which neutralises the hydrogen halide liberated by the reaction.—L. A. C.

Esters; Process of making ——. W. H. Rodebush, Assr. to U.S. Industrial Alcohol Co. U.S.P. 1,430,324, 26.9.22. Appl., 8.5.19.

Esters are prepared by heating a mixture of ethylene dichloride, a salt of a fatty acid, and ethyl alcohol to 160°—180° C. under a pressure of about 150 lb. per sq. in.—L. A. C.

Powdered sulphur; Process for making an exceedingly fine —— incorporated with charred sugar. P. Mochalle. G.P. 355,120, 22.9.20.

An aqueous suspension of "sulphur-sugar" (prepared by heating a mixture of 1 pt. of sulphur and 3 pts. of sugar, and treating the product with 20 times its weight of water) is subjected to the action of a current of air at 40° C. for a long time, whereby the solution becomes acid and gradual decomposition takes place. The charred sugar adheres to the surface of the sulphur particles, which are then separated and dried. The dry sulphur forms a fine, floury, yellowish-grey powder, can easily be suspended in water, and is in consequence better suited for use in medicine and skin therapeutics than the usual sulphur suspensions. —H. C. R.

[*Organic*] *silver compounds; Preparation of complex* ——. F. Hoffman-La Roche und Co. A.-G. G.P. 356,912, 14.12.20. Conv., 1.12.20.

Silver compounds readily soluble in water and of therapeutic value are prepared by heating thioacyl derivatives of aromatic amines with organic or inorganic silver salts. Silver nitrate solution is added, drop by drop, to a solution of thioglycolaminophenol in aqueous sodium hydroxide, and silver thioglycolaminophenol containing 37·2% Ag is precipitated by subsequent addition of alcohol. Thioglycolaminophenol, m.p. 105° C., is prepared by reaction between chloroacetylaminophenol and aqueous sodium disulphide. Chloroacetylaminosalicylic acid, prepared by treating aminosalicylic acid with chloroacetyl chloride, on treatment in alkaline solution with sodium disulphide and subsequent acidification yields thioglycolaminosalicylic acid, m.p. 223° C. The acid is converted into the sodium salt by the action of sodium in alcoholic solution, and is then treated with silver nitrate or acetate, yielding silver thioglycolamino-sodium-salicylate. Similar products, containing 6·1% Ag, are prepared from thioisovaleryl- and thiopropionylaminosalicylic acids. The products in aqueous solution yield no precipitate on the addition of sodium chloride, hydrogen sulphide, or ammonium sulphide.—L. A. C.

Squills (Scilla or Urginea maritima); Process for extracting a therapeutic drug from ——. C. W. Rose and L. Rosenthaler. G.P. 357,043, 14.3.14.

The plant is first extracted with ethyl or methyl alcohol, acetone, or ethyl acetate, the solvent evaporated, and the extract dissolved in an aqueous solution of an alkali carbonate or bicarbonate. The solution is filtered, evaporated to dryness, and the residue again extracted with ethyl or methyl alcohol, acetone, or ethyl acetate, and the solvent removed under vacuum. The residue is soluble in water to a clear solution, and is valuable as a drug in cases of heart failure. It can be taken internally or injected, and is sometimes even more effective than digitalis preparations.—H. C. R.

ar-Tetrahydro-β-naphtholcarboxylic acid and its esters and acyl derivatives; Preparation of ——. Tetralin Ges.m.b.H. G.P. 357,663, 23.5.17.

Potassium ar-tetrahydro-β-naphthoxide, after drying by heating in a current of hydrogen at 150°—160° C., is treated with carbon dioxide under pressure at 160°—170° C. After absorption of 1 mol. of carbon dioxide the product is dissolved in water, and tetrahydro-β-naphthol-*o*-carboxylic acid, m.p. 177°—178° C., after crystallisation from dilute alcohol, is precipitated by the addition of hydrochloric acid. The product can be employed as a drug or as an intermediate in the manufacture of dyestuffs, while its esters and acyl derivatives can be used as solvents and drugs or in the manufacture of perfumes. The methyl ester has b.p. 184°—185° C. at 20 mm., and the acetyl-derivative, prepared by the action of acetic anhydride in the presence of sulphuric acid on the acid at 100° C., melts at 142°—143° C.—L. A. C.

Methylsulphites of secondary aromatic-aliphatic amines; Manufacture of ——. Farbw. vorm. Meister, Lucius, und Brüning. E.P. 164,002, 30.5.21. Conv., 31.5.20.

See U.S.P. 1,426,348 of 1922; J., 1922, 786 A. [Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 16,713 of 1897 and 6991 of 1909.]

Thymol; Manufacture of ——. J. Y. Johnson. From Badische Anilin und Soda Fabrik. E.P. 186,202, 18.7.21.

SEE U.S.P. 1,412,937 of 1922; J., 1922, 438 A.

Alcohol; Process for the production of —— from gas containing ethylene. C. A. Basore. Reissue 15,211, 25.10.21, of U.S.P. 1,385,515, 26.7.21. Appl., 2.9.21.

SEE J., 1922, 33 A.

Solutions containing oxygen. E.P. 185,659. *See* VII.

XXI. — PHOTOGRAPHIC MATERIALS AND PROCESSES.

Silver bromide emulsions; Effect of colloids on ——. R. Schwarz and H. Stock. Z. wiss. Phot., 1922, 22, 26—32.

THE influence of catalysts on the photochemical decomposition of pure silver bromide has been investigated, the amount of decomposition being determined by the method previously described (J., 1921, 791 A). Platinum sol delays the inversion point and solarisation; silver sol and silicic acid sol act as positive catalysts, and aluminium hydroxide as a negative catalyst. Ferric hydroxide and stannic acid coagulated the emulsion.—W. T.

[Potassium] sulphite-quinol [developer]; Ageing and decay of ——. J. Pinnow. Z. wiss. Phot., 1922, 22, 72—80.

A BRIEF review is given of the changes which potassium sulphite-quinol undergoes by the action of the oxygen of the air. Potassium quinolmonosulphonate is a slow and comparatively weak developer. No evidence was obtained of the formation of the sulphonic acid in the sulphite-quinol mixture at room temperatures.—W. T.

Actinometers; Chemistry of ——. A. Benrath and A. Obladen. Z. wiss. Phot., 1922, 22, 47—64.

THE mercuric chloride-ammonium oxalate actinometer was found to be reliable only within narrow limits. The ferric chloride and oxalic acid-uranyl acetate actinometers gave results in good agreement. Electrolytes retard the reduction of ferric chloride and the decomposition of oxalic acid. The authors argue that this is caused by a reduction in the ionisation and that the ferric and oxalate ions are the photochemically active parts.—W. T.

Ultra-violet absorption; Simple method for the measurement of ——. C. Winther, B. Rasmussen, and E. Schreiner. Z. wiss. Phot., 1922, 22, 33—46.

THE photographic method of Merton (Trans. Chem. Soc., 1913, 103, 124) has been adapted for the quantitative measurement of ultra-violet absorption. An improved fluorometer has been constructed for extinction measurements of certain wave lengths and the accuracy of the instrument has been tested by thermo-electric controls.—W. T.

PATENTS.

Colour photography. H. C. J. Deeks, Assr. to American Raylo Corp. •U.S.P. 1,430,059—61, 26.9.22. Appl. (A) 25.6.14, (B) 11.10.16, (C) 17.11.16. Renewed (A) 9.11.20, (B,C) 9.4.21.

(A) A COLOURED photographic print is made by dyeing a film containing a volatile solvent by bringing it into contact with a photographic element bearing a dye insoluble in water but soluble in the volatile solvent. (B) A colour sheet for making coloured photographic positives for transfer by a suitable agent consists of a base carrying a medium which can be sensitised. This medium contains a dye soluble in the agent, and with the dye a protective material also soluble in the agent, but inert to the treatment to which the colour sheet is submitted to prepare it for transfer; so that the pigment resulting from the combined dyestuff and protective material will not affect nor be affected by the treatment, but will yield to the transfer agent. (C) The pigment used in making coloured photographs is a combination of a dyestuff soluble in water and alcohol, together with a material soluble in alcohol but insoluble in water. The pigment will thus retain its colour in aqueous solutions but will give it up in alcohol or alcohol-containing solutions.—W. C.

Printing plates; [Photographic] process for producing ——. E. Albert. U.S.P. 1,430,347, 26.9.22. Appl., 19.5.14.

A PLATE which has an etching ground and overlying sensitive bichromated colloid layer is treated, after exposure, with a solvent, which permeates only the unexposed portions of the coating, removing these portions and their underlying etching grounds, but not affecting the exposed parts of the sensitive film nor the etching ground beneath those parts.—W. C.

[Photographic] coating composition and process. L. D. Wood. U.S.P. 1,430,484, 26.9.22. Appl., 1.7.22.

FOR the reproduction of sound waves which have been photographically recorded, a sensitive compound is used, consisting of 20 pts. of potassium platinum-barium-cyanide crystals, 10 pts. of sodium tungstate, 70 pts. of selenium crystals, 34 pts. of salt, 33 pts. of sulphur, and 33 pts. of phosphorus. It is prepared by melting a mixture of potassium platinum-barium-cyanide crystals, sodium tungstate, and selenium crystals, adding a mixture of salt, sulphur, and phosphorus, heating the molten mass for about 30 mins., or until the flame colour of both barium and potassium rises from the mass, and then crystallising by immersing the mass in water at about 40° F. (4° C.).—W. C.

Films. U.S.P. 1,429,174 and 1,429,179. *See* V.

Salts of aromatic hydroxylamines. U.S.P. 1,390,260. *See* XX.

XXII.—EXPLOSIVES; MATCHES.

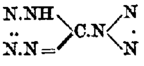
Primers; Microscopy of small arms ——. E. M. Chamot. Pamphlet. Ithaca, New York, 1922. 61 pp.

THE most important causes of the defective functioning of American military primers during the war are enumerated, and photomicrographs of typical primers of this class and also of sections of early primers and cartridge cases are given. The method of manufacture of primers is outlined and the instruments used in their routine microscopical inspection are fully described and illustrated. A binocular dissecting microscope of the Greenough type was used for the inspection of primers, and a comparison eye-piece attached to two chemical microscopes was found useful for comparing different lots of the constituents of primer compositions. The apparatus used for making photomicrographs of primers is also illustrated, as also are all the various tools used in the dissection of primers. Full details are given of methods for removing the primers from the cartridge cases, removing the anvils, and sectioning the primers, which can be accomplished without much risk of igniting them. Many photomicrographs of sectioned primers (chiefly of the loose anvil type) are given, illustrating common defects likely to cause miss-fires. The microscopy of the components of primer compositions is touched on and photomicrographs of samples of the commoner ingredients shown. The defects brought to light by microscopical inspection of primers during the war are analysed. Of these 28·5% were defects in assembly and other mechanical imperfections; 25% poorly compressed or with thick pellets of composition, and 12·6% due to the flame produced not being hot enough. —H. C. R.

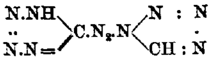
Patents.

Initial primers and a process for their manufacture. H. Rathsburg. E.P. 185,555, 27.6.21.

An initial priming composition for detonators or percussion caps is afforded by one or more explosive salts of tetrazol or triazol compounds or their derivatives mechanically mixed or crystallised with another explosive constituent. The most important salts are those of lead and cadmium. An example of a filling for a blasting detonator is 1 g. of tetryl, 0·15 g. of the lead or cadmium salt of tetrazylazoimide,



and 0·15 g. of the lead salt of azotetrazol,



—H. C. R.

Burning compositions; Binder for ——. Torch fuse-lighter. E.P. Aurand, Assr. to Atlas Powder Co. U.S.P. (A) 1,388,501 and (B) 1,388,502, 23.8.21. Appl., 5.5.21.

Nitrostarch gelatinised with acetone, amyl acetate, butyl acetate, or other solvent, is used as a binder for (A) black powder or other compositions for rockets, flares, signals, etc., or (B) mealed black powder or similar mixtures for fuse-lighters.

Explosive composition and the manufacture thereof. E. M. Werner, Assr. to The Hoynesite Explosives Co. U.S.P. 1,430,272, 26.9.22. Appl., 15.11.21.

A composition which includes in its ingredients an alkali chlorate mixed with a solution of nitrobenzol and resin.—H. C. R.

Explosive; Preparation of an —— from ammonium nitrate and carbonaceous material. Verein Chem. Fabr. in Mannheim. G.P. 346,224, 19.12.16. Addn. to 334,547 (J., 1922, 789 A).

In addition to, or in place of, ammonium nitrate and oxalate and the amino-bases specified in the chief patent, ammonium perchlorate is added to the mixture. The resulting product is safer to handle and more easily detonated.—A. R. P.

Fuse for blasting with liquefied gas and method of producing the same. A. Kowastch. U.S.P. 1,424,487, 1.8.22. Appl., 19.7.20.

See E.P. 148,534 of 1920; J., 1921, 872 A.

XXIII.—ANALYSIS.

Shaking machine for large quantities of fluid [; Laboratory ——]. H. Franzen. Z. physiol. Chem., 1922, **122**, 86—87.

An apparatus is described suitable for stirring up large amounts of lead precipitates in aqueous suspension, whilst treating them with carbon dioxide or hydrogen sulphide.—W. O. K.

Calorimetric determinations. P. E. Verkade. Chem. Weekblad, 1922, **19**, 389—393.

The special benzoic acid obtainable from the *Institut International d'Etalons physico-chimiques*, The University, Rue des Sols, Brussels, should always be used for standardising bombs. The heat of combustion accepted for this material is 6324 cals. per g. weighed in air. (*Cf.* J.C.S., Nov.)—S. I. L.

Ferrocyanide; Influence of the alkalis on the titration of some metals with ——. W. D. Treadwell and D. Chervet. Helv. Chim. Acta., 1922, **5**, 633—639.

The electrometric titration of zinc with potassium ferrocyanide was described by Treadwell and Weiss (J., 1920, 137 A). It is now found that when cadmium or zinc salts are titrated with potassium ferrocyanide in neutral or weakly acid solution, the sharpness of the end point can be greatly increased by having present a small amount of a rubidium or preferably a cæsium salt. The cæsium salt replaces potassium in the precipitate. Thus a zinc salt with potassium ferrocyanide gives $Zn_3K_2[Fe(CN)_6]_2$, but in presence of a cæsium salt the precipitate has the composition $ZnCs_2Fe(CN)_6$. With sodium ferrocyanide in neutral solution the precipitate is the simple zinc salt $Zn_2Fe(CN)_6$. Lead nitrate can be titrated electrometrically with potassium ferrocyanide in neutral solution, but the precipitate, $Pb_2Fe(CN)_6$, is sensitive to acid. Consequently it is possible to titrate zinc in presence of lead in hot acid solution. In presence of a cæsium salt the lead is precipitated by ferrocyanide in the form of the double salt $Pb_3CS_2[Fe(CN)_6]_2$. (*Cf.* J.C.S., Nov.)—E. H. R.

Arsenic; Microchemical detection of ——. A. Piutti and E. Boggio-Lera. Gazz. Chim. Ital., 1922, **52**, II., 48—55.

For the detection of traces of arsenic the most suitable reagent is molybdic acid. With solutions containing 0·02—0·004 mg. of arsenic per c.c. a mixture of 1 c.c. of 3% ammonium molybdate solution, 10 c.c. of 3·4% ammonium nitrate solution, and 39 c.c. of 40% nitric acid (29° B., sp. gr. 1·251) is used, whilst with smaller concentrations of arsenic this mixture is diluted five times with 40% nitric acid. A drop of the arsenical solution is placed on a warm microscope slide, evaporated to one-third of its volume over a very small flame, treated with a drop of the molybdic reagent, and evaporated either on a water-bath or with great care over a small flame. When the drop is diminished to one-half its volume, the slide is tilted, the tilting being gradually increased; the evaporation should occupy at least 6—7 minutes. The cold residue is treated with a drop of a solution containing 5 g. of ammonium nitrate and 4 c.c. of nitric acid per 100 c.c. of water, covered with a cover-glass and examined under a magnification of at least 250 diameters. In presence of arsenic acid the edge of the drop is seen as a thin yellow line composed of characteristic, sulphur-yellow crystals. With practice, 0·001 mg. of arsenic per c.c., that is 0·00005 mg. per drop, is detectable in this way. If animal organs are to be examined, these should be destroyed in the usual way and the arsenic precipitated as sulphide, the latter being purified and then oxidised by means of nitric acid, which must be subsequently eliminated completely.—T. H. P.

Copper, thiocyanates, and pyridine; Sensitive reaction for ——. G. Spacu. Bul. Soc. Stiinte Cluj, 1922, **1**, 284—291. Chem. Zentr., 1922, **93**, IV., 737.

A compound insoluble in water and having the formula $CuPy_2(CNS)_2$ (Py=pyridine) is formed on adding a neutral solution of a thiocyanate and a few drops of pyridine to a neutral solution of a copper salt. The pyridine should be added before the thiocyanate solution, as otherwise a dark precipitate of copper thiocyanate is thrown down in concentrated solutions. In employing the reaction

to detect copper, strongly acid solutions must be evaporated and feebly acid solutions neutralised by the addition of pyridine, care being taken to avoid the addition of excess, as the precipitate is soluble in pyridine. The reaction is sensitive to 1:300,000 as a test for copper, to 1:2000 for pyridine, and 1:50,000 for thiocyanates. The sensitiveness can be increased to 1:800,000 for copper by shaking the mixed solutions with several drops of chloroform, which assumes an emerald green coloration.
—L. A. C.

Chlorides and bromides; Detection of —— in the presence of thiocyanates. G. Spacu. Bul. Soc. Stiinte Cluj, 1922, **1**, 302—305. Chem. Zentr., 1922, **93**, IV., 735.

Pyridine (8-10 drops) and excess of a neutral copper sulphate solution are added to a neutral solution containing thiocyanates, and after separating the precipitate of $CuPy_2(CNS)_2$ (*cf.* preceding abstract), the solution can be tested for chlorides and bromides by the usual methods.—L. A. C.

Phosphoric acid; Separation of —— in qualitative analysis. N. Tarugi. Boll. Chim. Farm., 1922, **61**, 545—552.

Gattermann and Schindhelm's method for the elimination of phosphoric acid by treatment with stannic chloride (J., 1917, 165) is unsatisfactory, since an appreciable proportion of the phosphoric acid remains unprecipitated and the precipitate contains portions of the iron, chromium, calcium, barium, etc. Further, a definite ratio between phosphate and stannic chloride is unattainable when the amount of the former is unknown.—T. H. P.

Radioactive indicators. F. Paneth. Z. angew. Chem., 1922, **35**, 549—552.

Use has been made of radioactive isotopes of metals such as lead and bismuth for indicating the presence of minute and unweighable quantities of these elements or their compounds. Quantities of the radioactive isotopes of the order of a millionth of a milligram are easily detected by the electroscope. Once mixed with the inactive isotope, they cannot be separated by chemical means, so that the presence of the radioactive isotope indicates the presence of the inactive one also. Practical applications have been made in analytical chemistry in determining the solubility of very sparingly soluble substances (*cf.* J., 1913, 866, 1131) and the study of adsorption phenomena. In electrochemistry it has been established by this method that an interchange of metallic ions occurs in solution on mixing two salts of the same metal, but that no such interchange occurs when one or both of the compounds are unionised. The actual deposition of an unweighable quantity of metal on the electrode before the minimum potential of electrolysis is reached has also been established. In colloid chemistry the active surface of powders has been measured for the first time by the use of a radioactive indicator (*cf.* J., 1922, 485 A), and the distinction between crystalloid and colloid in diffusion through parchment membranes has been studied down to a dilution of 10^{-11} g.-mol. per litre. In inorganic chemistry the conditions for the preparation of bismuth and lead hydrides (*cf.* J., 1920, 747 A) were studied by this means and the method was successfully applied to the measurement of the gas-tightness of rubber fabrics for gas masks.
—H. C. R.

Protein precipitants. A. Hiller and D. D. van Slyke. J. Biol. Chem., 1922, **53**, 253—267.

With the object of ascertaining the extent to which proteins and protein products are precipitated by different protein precipitants, the action of a number of these substances both on blood and Witte's peptone has been studied. The results with the latter substance indicate that tungstic acid and picric acid precipitate protein intermediate products relatively completely without precipitating the amino-acids; trichloroacetic acid removes proteins only, nearly all the protein products passing into the filtrate; whilst metaphosphoric acid, colloidal iron, and mercuric chloride occupy an intermediate position with regard to their action on protein products. Using blood, all the substances studied removed proteins completely, and all, with the exception of alcohol, allowed similar amounts of amino-acids to pass into the filtrates. The recovery of added, mixed monoamino-acids was, however, incomplete in the cases of metaphosphoric acid and alcohol.—E. S.

Aliphatic amino nitrogen; Influence of position and of temperature upon the reaction of —— with nitrous acid. M. S. Dunn and C. L. A. Schmidt. J. Biol. Chem., 1922, **53**, 401—410.

The rate at which nitrous acid deaminises aliphatic amino-acids depends on the position of the amino group; the greater the distance of this from the carboxyl the more slowly the reaction proceeds. In all cases a decrease in temperature causes a diminution in the rate, but, contrary to the statement of Sure and Hart (J. Biol. Chem., 1917, **31**, 527) the deamination of the ϵ-amino group of lysine is not completely inhibited at 1° C. Casein is deaminised more slowly than lysine at ordinary temperatures.
—E. S.

See also pages (A) 852, *Pyridine* (Lehner). 855, *Nitrogen oxides* (Sanfourche). 856, *Nitrites* (Falciola). 857, *Potassium permanganate* (Fester and Brude); *Solubility of arsenic trichloride in hydrochloric acid* (Treadwell and Mussler). 869, *Micro-organisms in soil* (Waksman and Fred). 871, *Sucrose* (Behre and Düring, also Sijlmans); *Methyl alcohol* (Pool). 872, *Water in sausages* (Holzmann and Deininger); *Butter etc.* (Lührig). 873, *Hydrocyanic acid* (Jansen and others); *Boric acid in shrimps* (Deerns). 874, *Disinfectants* (Rülke). 875, *Atropine* (Hardy); *Yohimbine* (Schomer); *Saffron* (Guerbet). 876, *Veronal etc.* (Fabre). 877, *Ichthyol* (Pépin and Reaubourg).

Patent List

The dates given in this list are, in the case of Applications for Patents, those of application and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given: they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court, Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Eley. Furnaces. 28,665. Oct. 21.

Farbw. vorm. Meister, Lucius, u. Brüning. Apparatus for absorbing gases etc. by charcoal. 27,311. Oct. 9. (Ger., 25.11.21.)

Fothergill. Evaporators. 27,288. Oct. 9.

Grönqvist. 28,039. *See* X.

Holmes. Preparation of a solution. 27,915. Oct. 14.

Lawrence Patent Water Softener and Sterilizer Co., and Stevens. Heating liquids and softening or sterilising water. 28,254. Oct. 18.

Leigh. Crates for acid carboys. 28,255. Oct. 18.

Macconochie. 28,424. *See* II.

Marks (Kohlenscheidungs Ges.). Method of heating at moderate temperatures. 28,082. Oct. 16.

Neil and Neil. Furnaces. 28,443. Oct. 19.

Newby. Separation of moisture from pulverulent, granular, etc. materials. 28,355. Oct. 18.

Pellissier. Pulverisers. 28,199. Oct. 17. (Fr., 27.10.21.)

Petitpierre. Storing gases or inflammable liquids. 27,852. Oct. 13. (Belg., 20.10.21.)

Reynard, Tapping, and Thornley. Clarification and filtration of slimes etc.

Sinkinson. Filter washers. 27,707. Oct. 12.

Technical Research Works, and Lush. Method of activating and re-activating metallic catalysts. 28,600. Oct. 20.

Complete Specifications Accepted.

9356 (1921). Cannon. Furnaces. (186,639.) Oct. 18.

9653 (1921). Ward, Nielsen, and Lang. Treatment of gases, oil vapours, or gaseous mixtures. (186,945.) Oct. 25.

13,564 (1921). Miller and Lloyd. Grinding or crushing machines. (186,956.) Oct. 25.

16,279 (1921). Marshall. Discharging or charging devices for rotary dryers, kilns, furnaces, retorts, etc. (186,974.) Oct. 25.

17,951 (1921) and 3617 (1922). Bleloch and Stockman. *See* X.

18,100 (1921). A.-G. Kummler u. Matter. Preventing corrosion in evaporating and distilling apparatus. (166,129.) Oct. 18.

18,653 (1921). Bologa. Stills. (187,007.) Oct. 25.

22,885 (1921). British Thomson-Houston Co. (General Electric Co.). Chemical apparatus for precipitation purposes. (187,090.) Oct. 25.

29,020 (1921). Mather. Settings for stills etc. (186,849.) Oct. 18.

34,284 (1921). Lilienfeld. Manufacture of colloidally-soluble substances and of suspensions or emulsions. (173,230.) Oct. 25.

34,350 (1921). Maschenenfabr. Haas Ges. Neuwerk. Tunnel dryer with air circulation. (173,234.) Oct. 25.

19,192 (1922). Hall. Centrifugal separators. (183,133.) Oct. 25.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Accioly. Apparatus for treating mineral oil. 28,438. Oct. 18.

Appleby and Bentley. Gas-producers, retorts, etc. 27,821. Oct. 13.

Berg (Berg). Gas production. 27,425. Oct. 10.

Carpenter, and South Metropolitan Gas Co. Purification of coal gas. 28,605. Oct. 20.

Cureton and Rowlson. Combined press and retort for the manufacture of coke. 28,167. Oct. 17.

Danner. Emulsified liquified petrolatum. 28,134. Oct. 17.

Grönqvist. Production of incandescent heating conductors. 28,038. Oct. 16.

Johnson and Lucas. Gas-producers. 27,676. Oct. 12.

Macconochie. Dry centrifugal gas-cleaner. 28,424. Oct. 19.

Neath. Manufacture of gas from coal and oil. 28,459. Oct. 19.

Petitpierre. 27,852. *See* I.

Plauson's (Parent Co.), Ltd. (Plauson). Cracking and refining oils. 28,328. Oct. 18.

Reynard, Tapping, and Thornley. Fuel briquettes etc. 27,314. Oct. 9.

Soc. Ricard, Allenet et Cie. Rendering soluble liquid fuel mixtures of petrol and alcohol. 27,800. Oct. 13. (Belg., 28.12.21.)

Spencer. Grids for gas-purifiers. 27,970. Oct. 16.

Wilputte. Coke-oven decarbonisation. 27,273. Oct. 9.

Complete Specifications Accepted.

9653 (1921). Ward and others. *See* I.

10,132 (1921). Biddison. Combustible gas. (162,646.) Oct. 25.

13,174 (1921). Dunstan and Thole. Treatment of petroleum and petroleum distillates. (186,955.) Oct. 25.

17,918 (1921). Clewlow. Apparatus for dewatering and compressing peat. (186,690.) Oct. 18.

18,116 (1921). Hennebutte. Dry distillation process. (165,794.) Oct. 18.

18,405 (1921). Brodsky. Distillation of carbonaceous materials and utilising the gases for heating. (186,724.) Oct. 18.

18,493 (1921). Fuller-Lehigh Co. Manufacture of carburetted water-gas. (171,079.) Oct. 25.

19,289 (1921). Walkey and Bargate. Desulphurising petroleum and similar oil. (186,738.) Oct. 18.

19,537 (1921). Woodall, Duckham, and Jones, Duckham, and Kent. Total gasification of fuel. (186,742.) Oct. 18.

21,597 (1921). Foster. Gasification of coal and other carbonaceous material. (187,076.) Oct. 25.

III.—TAR AND TAR PRODUCTS.

Application.

* Barnard. Manufacture of benzidine. 27,305. Oct. 9.

IV.—COLOURING MATTERS AND DYES.

Applications.

Scottish Dyes, Ltd., Thomas, and Thomson. Colouring-matters. 27,328. Oct. 9.

Scottish Dyes, Ltd., and Thomas. Dyestuffs. 28,596. Oct. 20.

Complete Specifications Accepted.

8516 (1921). Soc. Chem. Industry in Basle, and Straub. Manufacture of chromium compounds of azo dyestuffs. (186,635.) Oct. 18.

32,234 (1921). Imray (Soc. Chem. Industry in Basle). Manufacture of β-thionaphthisatin. (186,859.) Oct. 18.

15,081 (1922). British Dyestuffs Corp., Green, and Saunders. Manufacture of intermediates for the production of colouring-matters. (186,878.) Oct. 18.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Clavel. Treatment of cellulose derivatives. 28,457. Oct. 19. (Fr., 27.10.21.)

Plauson's (Parent Co.), Ltd. (Plauson). Production of paper from peat. 28,327. Oct 18.

Riechers and Riechers. Treatment of threads of artificial silk, etc. 28,615. Oct. 20.

Complete Specifications Accepted.

18,497 (1921). Acheson. Graphitised vulcanised fibre and methods in preparing same. (172,924.) Oct. 18.

34,257 (1921). Claessen. Manufacture of elastic flexible sheet material from nitrocellulose. (174,331.) Oct. 25.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Applications.

Broomfield and Russell. Waterproofing. 28,139. Oct. 17.

Johnson (Badische Anilin u. Soda Fabrik). Treatment of cellulose esters for dyeing. 28,691. Oct. 21.

Scholefield, and Yorkshire Dyeware and Chemical Co. Manufacture and use of a colloidal substance for dyeing and scouring animal fibres etc. 27,984. Oct. 16.

COMPLETE SPECIFICATIONS ACCEPTED.

24,573 (1921). Linnemann. Apparatus for treating with liquid fibrous or artificial filamentary materials. (169,695.) Oct. 18.

32,885 (1921). La Fayette. Apparatus for treating yarns with dyes or other liquids. (182,758.) Oct. 25.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Brewster. Recovering and concentrating acetic acid from pyroligneous acid. 28,093. Oct. 16. (U.S., 19.10.21.)

Chem. Fabr. in Billwarder, and Hasenclever. Production of chrome-alum. 27,717-8. Oct. 12. (Ger., 12.10.21.)

Hartman. 28,032. *See* XI.

Howles and McDougall. Manufacture of lead arsenate. 27,828. Oct. 13.

Mourgeon. Ammonia manufacture. 27,696. Oct. 12.

Williams. Manufacture of salts derived pyrogeneously from metallic orthophosphates. 28,381. Oct. 18.

COMPLETE SPECIFICATIONS ACCEPTED.

15,428 (1921). Krebitz. *See* XII.

17,514 (1921). Manuf. de Prod. Chim. du Nord Etabl. Kühlmann. Mechanically-operated furnaces for roasting pyrites or like ores. (167,464.) Oct. 18.

18,806 (1921). Schmiedel and Klencke. Production of sulphuric acid. (187,016.) Oct. 25.

19,217 (1921). Holmes and Co., Adam, and Cooper. Manufacture of sulphate of ammonia. (187,035.) Oct. 25.

22,170 (1921). Langheinrich. Purification of graphite. (187,080.) Oct. 25.

27,114 (1921). Woodlands (Pátek). Production of hydrogen peroxide. (186,840.) Oct. 18.

34,281 (1921). Clerc and Nihoul. Manufacture of magnesia from dolomite. (173,502.) Oct. 25.

4610 (1922). Deuts. Gold- u. Silber-Scheideanstalt, and Liebknecht. Production of solutions containing hydrogen peroxide. (186,871.) Oct. 18.

VIII.—GLASS; CERAMICS.

APPLICATION.

Grönqvist. 28,039. *See* X.

COMPLETE SPECIFICATIONS ACCEPTED.

16,048 (1921). Frohman. Refractory material. (186,968.) Oct. 25.

30,884 (1921). Deussing. Production of artificial meerschaum. (172,004.) Oct. 25.

31,099 (1921). Feldenheimer and Plowman. Treatment of clay. (186,855.) Oct. 18.

IX.—BUILDING MATERIALS.

APPLICATION.

Woodroffe. Wood substitute. 28,527. Oct. 20.

COMPLETE SPECIFICATIONS ACCEPTED.

18,844 (1921). Dehn (Studebaker Corp.). Treatment of wood. (187,018.) Oct. 25.

32,671 (1921). Young, and Robertson Co. Fire-resisting asphalt or like hydrocarbonaceous material. (186,861.) Oct. 18.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Barron, Halliwell, and Hindley. Hardening surfaces of tools. 28,528. Oct. 20.

Crémer. Apparatus for electrolysis of metals. 28,242. Oct. 17. (Belg., 18.10.21.)

Grönqvist. Production of metallic conducting and, as catalysts, metallic-acting surface layers on refractory stone. 28,039. Oct. 16.

Grönqvist. Production of scale-proof surface layers on metals. 28,040. Oct. 16.

Hanciau. Recovery or extraction of gold, platinum, etc. 27,342. Oct. 9.

Harris. Apparatus for refining or separating metals. 28,370. Oct. 18.

Hennes. Preparation of ores etc. for leaching. 27,452, 27,458-9. Oct. 10.

Keet. Concentrator for ores etc. 28,208. Oct. 17.

McBride. Drying ores, concentrates, etc. 28,250. Oct. 17.

Metals Production, Ltd., and Perkins. Recovery of lead from lead sulphate. 27,608. Oct. 11.

Metals Production, Ltd., Perkins, and Taplin. Leaching copper etc. 27,609. Oct. 11.

Mordey. Electromagnetic separation or concentration of minerals. 28,499. Oct. 19.

Motte. Electric depositing, welding, and cutting. 27,593. Oct. 11. (Belg., 13.1.22.)

Rees. Recovery of metal from dross. 28,046. Oct. 16.

Roper. Foundry cupolas. 27,935. Oct. 14.

Saltrick. Iron and steel alloys. 27,553. Oct. 11.

Saltrick. Alloy steels. 27,554. Oct. 11.

Saltrick. Nickel alloys. 27,555. Oct. 11.

Smidth & Co. Agglomeration of ore etc. 27,934. Oct. 14. (Sweden, 20.10.21.)

Soc. Anon. Cockerill. Furnaces for direct reduction of ores. 28,584. Oct. 20. (Belg., 30.3.22.)

Soc. Anon. Cockerill. Treatment of ores containing iron etc. 28,618. Oct. 20. (Belg., 18.5.22.)

Soc. Ferrosilite. Solder for cast iron. 28,051. Oct. 16. (Fr., 20.4.22.)

Technical Research Works, and Lush. 28,600. *See* I.

COMPLETE SPECIFICATIONS ACCEPTED.

17,514 (1921). Manuf. de Prod. Chim. du Nord. *See* VII.

17,951 (1921) and 3617 (1922). Bleloch and Stockman. Apparatus for crushing or reducing minerals, ores, etc. (186,693.) Oct. 18.

18,263 (1921). Gillott. Alloy iron. (186,962.) Oct. 25.

18,748 (1921). Smith. Treatment and concentration of ores etc. (166,888.) Oct. 25.

20,857 (1921). Vivian. Flotation processes for concentrating ores etc. (186,760.) Oct. 18.

22,884 (1921). British Thomson-Houston Co. (General Electric Co.). Aluminium alloys. (187,089.) Oct. 25.

24,658 (1921). Jones (Soc. Anon. Le Nickel). Manufacture of pure nickel. (187,111.) Oct. 25.

25,545 (1921). Goldschmidt A.-G. Bearing metal alloy. (169,703.) Oct. 18.

34,406 (1921). Westinghouse Lamp Co. Preparation of rare metals. (173,236.) Oct. 25.

XI.—ELECTRO-CHEMISTRY.

APPLICATIONS.

Crémer. 28,242. *See* X.

Dutt and Godfrey. Leclanché batteries. 28,684. Oct. 21.

Hartman. Ozone generators. 28,032. Oct. 16.

Hill. Electric accumulators. 27,575. Oct. 11.

Motte. 27,593. *See* X.

Complete Specification Accepted.

18,363 (1921). Kohlmeyer. Electric storage batteries. (186,987.) Oct. 25.

XII.—FATS; OILS; WAXES.

Applications.

Burrows. Mixing ingredients for manufacture of soap. 27,539. Oct. 11.

Kammermann. Apparatus for extracting oils and greases from vegetable substances. 27,560. Oct. 11. (Belg., 9.8.22.)

Complete Specifications Accepted.

9652 (1921). Schicht A.-G., and Grün. Manufacture of nutritious fats. (160,840.) Oct. 18.

9704 (1921). Reavell, and Kestner Evaporator and Eng. Co. Extraction of oils, fats, waxes, etc. (186,642.) Oct. 18.

10,852 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of viscous oil compositions. (186,950.) Oct. 25.

15,428 (1921). Krebitz. Separation of saponaceous matter from lime-sludge. (186,960.) Oct. 25.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Consort. f. Elektrochem. Ind. Manufacture of resins from aldehydes. 28,505. Oct. 19. (Ger., 20.10.21.)

Schmidt. Waterproof coating substances. 28,023. Oct. 16. (Fr., 16.11.21.)

Torrance. Mills for reducing paints and pigments. 28,243. Oct. 17.

Warmund. Composition for producing coatings, seals, etc. 28,337. Oct. 18. (Ger., 18.10.21.)

White (Dick Co.). Ink. 27,473. Oct. 10.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Application.

Broomfield and Russell. Method in mixing rubber compounds. 27,991. Oct. 16.

Complete Specification Accepted.

18,230 (1921). Frost, and Harvey, Frost, and Co. Vulcanisable compositions. (186,709.) Oct. 18.

XV.—LEATHER; BONE; HORN; GLUE.

Applications.

Broomfield and Russell. Treatment of leather and leather waste. 27,992. Oct. 16.

Morin. Process for tanning hides etc. 27,937. Oct. 14. (Fr., 15.10.21.)

Complete Specification Accepted.

18,552 (1921). Claessen. Manufacture of artificial leather. (171,360.) Oct. 25.

XVI.—SOILS; FERTILISERS.

Application.

Thompson (Visser). 27,377. *See* XIX.

Complete Specification Accepted.

13,057 (1922). Ercole. Manufacture of fertilisers. (179,934.) Oct. 25.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Adams. Sewage purification machinery. 28,416. Oct. 19.

Daw. Treatment of sewage etc. 27,997. Oct. 16.

Dunham, Nette, and Nette. Preserving liquid eggs. 27,241. Oct. 9.

Howles and McDougall. Preparation of insecticides. 27,827. Oct. 13.

Howles and McDougall. 27,828. *See* VII.

Lawrence Patent Water Softener and Sterilizer Co., and Stevens. 28,254. *See* I.

Linley. Treatment and storage of beef. 27,940. Oct. 14.

Naaml. Vennoots. Internat. Oxygenium-Maatsch. Novadel. Treatment of meal, milling and meal products. 27,331. Oct. 9. (Holland, 8.10.21.)

Stacey. Manufacture of gaseous medium for treating flour. 27,660 and 27,895. Oct. 13 and 14.

Thompson (Visser). Dewatering activated sludge and producing a fertiliser therefrom. 27,377. Oct. 10.

Complete Specifications Accepted.

9652 (1921). Schicht A.-G. and Grün. *See* XII.

20,452 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of fruit juices, conserves, etc. from fruits, vegetables, etc. (186,756.) Oct. 18.

20,978 (1921). Schloesser. Utilising town refuse or similar waste material. (187,066.) Oct. 25.

3604 (1922). American Cotton Oil Co. Manufacture of a food for animals. (178,073.) Oct. 25.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Farbw. vorm. Meister, Lucius, u. Brüning. Manufacture of formaldehyde. 27,311. Oct. 9. (Ger., 25.11.21.)

Goldschmidt and Neuss. Manufacture of products from urea. 28,212. Oct. 17. (Ger., 17.10.21.)

Howles and MacDougall. Obtaining alkaloids or their salts. 27,826. Oct. 13.

Complete Specifications Accepted.

20,208 and 20,210 (1921). Wade (Lichtenthaeler). Manufacture of alcohol-ether mixtures. (187,051-2.) Oct. 25.

21,649 (1921). Meister, Lucius, u. Brüning. Preparation of aliphatic dialkylaminoalkyl compounds. (169,185.) Oct. 25.

26,247 (1921). Imray (Soc. Chem. Industry in Basle). Manufacture of optically-active aromatic amino-alcohols. (187,129.) Oct. 25.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Applications.

Landau and Landau. Photographic processes. 27,590. Oct. 11.

Shawcross. Production of sensitive ferric film photo papers or bearers. 28,430. Oct. 19.

Wadsworth Watch Case Co. Light-sensitive coating. 27,332. Oct. 9. (U.S., 21.11.21.)

Wadsworth Watch Case Co. Photographic processes. 27,333. Oct. 9. (U.S., 8.3.22.)

XXII.—EXPLOSIVES; MATCHES.

Complete Specification Accepted.

18,747 (1921). Herz. Manufacture of detonating-compositions for detonators or primers. (187,012.) Oct. 25.

XXIII.—ANALYSIS.

Application.

Bratby and Hinchliffe, Ltd., and Smith. Apparatus for ascertaining percentage of air present in carbon dioxide. 27,875. Oct. 14.

Complete Specification Accepted.

11,359 (1921). Svenska Aktiebolaget Mono. Gas-analysing apparatus. (162,249.) Oct. 25.

I.—GENERAL; PLANT; MACHINERY.

Evaporation of a liquid into a gas. W. K. Lewis. Chem. and Met. Eng., 1922, **27**, 112—114.

The author, in developing the theory of the evaporation of a liquid into a gas, assumes a long tunnel having non-conducting walls, through which flows unsaturated air at a such a low, constant mass velocity that the heat generated by friction may be neglected. The bottom of the tunnel contains a mat or wick kept constantly wet by water from below. The water is furnished to the wick at every point at a temperature equal to the temperature of the water on the upper surface of the wick at that point Humidification of the air takes place during its passage through the tunnel and if this is sufficiently long a state of equilibrium will be reached between the water and the air. At any point in the tunnel a constant set of conditions exists, namely, what is equivalent to a stationary film of air insulating the water from the main body of air and through which heat is diffused from the air to the water. At the same time water vapour is diffusing in the opposite direction through this film into the air. The heat necessary for evaporation can only be supplied by diffusion from the air. These considerations are expressed mathematically in the following equations: $-dW/Ad\theta=k'(p_w-p)$, $dQ/Ad\theta=h(t-t_w)$, and $dQ=-r_w dW$, whence $(p_w-p)=h(t-t_w)/k'r_w$, where W=wt. of liquid evaporated, A=area of liquid in contact with gas, θ=time, p=partial pressure of vapour, t=temperature, r=latent heat of vaporisation, k'=coefficient of diffusion, h=surface coefficient of conductivity of heat between gas and liquid. If P be the total pressure of vapour and vapour-free gas (*i.e.*, the barometric pressure) and H be the absolute humidity of the gas, then by expressing p in terms of P, and neglecting small quantities a close approximation to the last equation is $(t-t_w)=Kr_w(H_w-H)/h$, where $K=29k'P/18$. In considering the changes in humidity and temperature of the air as it moves along the tunnel, it is pointed out that for any movement of the air from the point under consideration there will be a drop in temperature of say dt and an increase in humidity of dH. The heat given up by the cooling must correspond to the heat of evaporation of the water taken up, that is $-Sdt=r_w dH$, S being the number of heat units necessary to change by one degree the temperature of unit weight of vapour-free gas plus the vapour it contains. If S and t_w are constants integration of this equation gives $H=St/r$ +constant. If the tunnel is sufficiently long saturation will occur at a certain point, and if at this point the temperature and humidity be denoted by t_e and H_e respectively, then insertion of these limits gives $(H_e-H)=S(t-t_e)/r_w$ and for this to be identical with $(H_w-H)=h(t-t_w)/kr_w$, H_e must equal H_w, $t_e=t_w$, and $S=h/k$; *i.e.*, the coefficient of heat transfer divided by the coefficient of vapour diffusion through the gas film is constant and equal to the humid heat of the gas. From the formula $S=h/k$ it is possible to predict the performance of a given apparatus, such as a humidifier, water cooler, gas scrubber, air dryer, or a light oil stripping column, for heat transfer or for diffusion.—S. G. U.

Melting point; Relation of —— to boiling point. R. Lorenz and W. Herz. Z. anorg. Chem., 1922, **122**, 51—60.

The ratio of the absolute melting point to the normal boiling point has been calculated for a large number of elements and compounds (inorganic and organic). The mean of all the results was found to be 0·62.—W. T.

Hardness of solid substances and its relationship to chemical constitution. A. Reis and L. Zimmermann. Z. physik. Chem., 1922, **102**, 298—358.

The hardness and the resistance to erosion (by a fine stream of mercury) of crystalline substances run parallel, but the erosion time (time required to produce a given effect) increases more rapidly than the hardness. The hardness depends on the face examined and on the direction of the scratch. In the case of salts which have lattices maintained by the electrostatic attractions of the ions, the hardness is determined by the charges and the distances between the ions. In compounds which have not a salt-like structure the hardness varies with the strength of the residual affinity of the molecules exerted outwardly. In mixed crystals the hardness is greater than the mean of the components and in some cases it is greater than that of the harder constituent. The hardness of compressed pastilles approaches that of the crystals of the substance. The tendency of a substance to form large crystals is to a certain extent a function of the chemical constitution and is often parallel with the hardness. (*Cf.* J.C.S., Nov.)—J. F. S.

Patents.

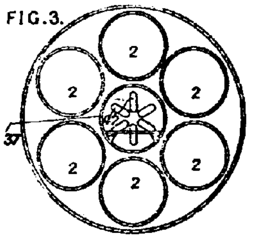
Centrifugal separators; Apparatus for cleaning the bowls of ——. Aktiebolaget Separator. E.P. 181,686, 13.4.22. Conv., 17.6.21.

The bowl is inverted in a tank or vessel and the slime or other adherent dirt removed by jets of steam or pressure water.—B. M. V.

Drying matter containing moisture; Rotary multiple cylinder for ——. J. and S. Buxton. E.P. 185,823, 9.6.21.*

Inside a large cylindrical tube (see fig.), which is mounted on roller bearings and can be rotated by worm gearing, are a number of smaller tubes (drying compartments), 2. Each of these may be fitted with a screw conveyor to move the material from the charging to the discharging end of the plant. Completely surrounding the drying compartments are narrow passages through which flow hot gases or steam. In the case of cylindrical drying tubes these passages may be formed by other tubes, through which air is drawn. In one type of plant steam is blown into the heating passages; the material is fed into the plant at one end and the cold air enters the air tubes at the same end of the plant. Both material and air pass along their respective tubes and are discharged into a chamber at the other end, where the material is removed by a worm conveyor whilst the warm air is drawn back through the drying tubes by means of a fan placed in the chimney,

FIG.3.



---

* The illustrations in the abstracts marked* are reproduced from the Illustrated Official Journal (Patents), by kind permission of the Controller of H.M. Stationery Office.

which is erected at the changing end of the plant. Any moisture formed by the condensation of the steam in the heating passages is automatically removed by a device placed at the lower end of the casing. In another type of plant the front portion of a central tube is used as a furnace, the hot gases from which are delivered at the other end of this tube direct to a chimney. In the portion of this tube between the furnace and the chimney are one or more tubes, 42, providing a means of communication between the atmosphere and the chamber into which the dried material is discharged from the drying compartments. A fan situated at the charging end of the plant and discharging into the chimney draws air through these tubes and causes the hot air to flow as a counter current over the material passing through the drying compartments, 2.—S. G. U.

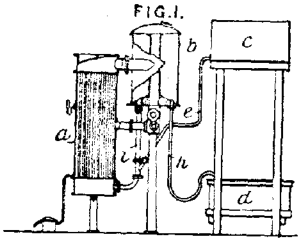
Drying machine. P. J. Shampay. U.S.P. 1,429,976, 26.9.22. Appl., 18.3.20. Renewed 27.2.22.

Round a tube termed the heater element rotates a vertical hollow shaft fitted with blades, forming a fan. This is housed centrally within a cylindrical casing, at the bottom of which is a series of fixed holders to which the goods to be dried are attached at one end. At the upper end of the casing is a horizontal disc capable of being moved along the axis of the casing. The goods to be dried are attached at the other end to the periphery of this disc.—S. G. U.

Evaporators and distilling apparatus. Blair, Campbell and McLean, Ltd., and J. L. Ferguson. E.P. 185,873, 23.6.21.*

A calandria, *a*, of the short vertical tube type, is connected in the usual manner with a separator, *b*. The steam in the separator passes down a vertical internal pipe, which after leaving the separator is fitted with two branches, one connected with the exhaust and the other with a pump, fan, or injector, which compresses a portion of the steam and returns it to the heating space of the calandria. Two outlets are provided at the bottom of the separator. One of these, *h*, is connected either direct or through a heat exchanger with the concentrated liquor tank, *d*. The other, *i*, is coupled to a nozzle placed in the weak liquor inlet pipe, so that some of the hot concentrated liquor can be mixed with the weak liquor entering the calandria. In another type of plant the weak liquor on leaving the heat exchanger mentioned above enters a second heat exchanger placed below the calandria, wherein it is further heated by the condensed steam from the calandria before passing to the mixing nozzle.
—S. G. U.

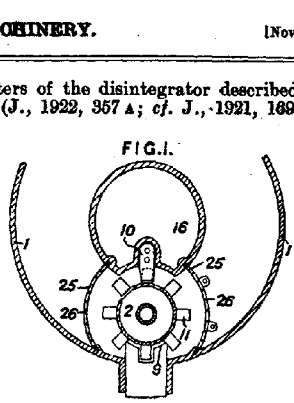
FIG. I.



Disintegrators; High-speed ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 185,878, 25.6.21.*

By fitting a pair of curved apertured plates, 26, which form part of a cylindrical surface, concentric with the beater shaft, 2, and close up to the tips of the beaters of the disintegrator described in E.P. 176,002 (J., 1922, 357 A; *cf.* J., 1921, 169 A) it has been found possible to diminish the formation of eddy currents and so reduce the power required to drive the mill by about 25%.—S. G. U.

FIG. I.



Grinding or crushing machine. J. W. Spensley. E.P. 186,462, 18.7.21, 23.2.22, and 13.4.22.

In a high-speed centrifugal disc mill or disintegrator with horizontal discs, one fixed, the other rotating, and each provided with intercalating rings of vertical pins, the horizontal discharge takes place substantially all round the circumference, the outlet being obstructed only by the small bosses or pillars necessary to secure the upper portion of the mill; the outer wall of the casing is at such a distance from the discs that sticky substances cannot accumulate sufficiently to obstruct the outlet. The fixed disc is preferably the upper one.—B. M. V.

Liquids; Apparatus for heating or cooling ——. G. L. Lebeau. E.P. 186,218, 5.8.21.

The apparatus consists of two cylinders, one inside the other, with an annular space between. Liquid is passed into the top of the outer cylinder through a pipe connected with a spraying device that distributes it in even films over the inner surface of the outer and the outer surface of the inner cylinder. The inside of the inner and the outside of the outer vessel are heated or cooled by means of a suitable liquid, so that the films of liquid in the annular space between them are rapidly brought to the desired temperature.—A. R. P.

Insulating material against loss or gain of heat. H. Arquint. E.P. 186,492, 17.8.21.

An organic substance which may be used as ropes or plaited work or as powder, is covered or mixed with clay, mortar, or the like, and after application to the article to be insulated is incinerated by heat, by treatment with acids or the like, or electrically.
—B. M. V.

Melting pot. J. B. McClain, Assr. to R. Meier. U.S.P. 1,423,501, 18.7.22. Appl., 25.10.20.

A pot of parabolic formation is provided with a flange for supporting it in a furnace. A horizontal outlet spout is provided at the bottom of the pot and there is a space around the spout for the circulation of heat so that the spout and the wall of the pot above it may be heated. A detachable nozzle can be inserted in the spout, and an internal valve, operated by a wheel above the pot, is provided for closing the nozzle.—T. A. S.

Gaseous mixtures; Apparatus for separation of ——. P. E. Haynes, Assr. to The Linde Air Products Co. U.S.P. 1,429,903, 19.9.22. Appl., 12.4.19.

An apparatus for fractionating gaseous mixtures by a process involving liquefaction of at least a part of the mixture, comprises a gas compressor, an expansion nozzle, a receptacle for collecting liquid issuing from or formed at the expansion nozzle, and a heater for the receptacle. The heater is connected with the compressor and with the expansion nozzle by conduits, in each of which is a cooler, both of these coolers being refrigerated by gases which have passed the expansion nozzle.

Filter. J. S. Kleithline. U.S.P. 1,430,234, 26.9.22. Appl., 18.8.21.

Inside a cylindrical shell having removable ends is placed a second perforated cylindrical shell having only one end removable. The cylinders are fixed together at the mid points of their lengths in such a manner that a liquid in passing from one end to the other of the outer shell must flow through the perforated cylinder, which is filled with a filtering material. An inlet valve is provided at one end of the outer shell and an outlet valve at the other. —S. G. U.

Fire-extinguishing composition. E. A. Louder, Assr. to Boyce and Veeder. U.S.P. 1,430,745, 3.10.22. Appl., 20.11.19.

The composition consists of carbon tetrachloride mixed with about 10% of carbon bisulphide. —B. M. V.

Crystals; Apparatus for the production of ——. C. C. Haferkamp, Assr. to The Diamond Match Co. U.S.P. 1,430,900, 3.10.22. Appl., 28.10.20.

An apparatus for producing crystals from hot liquors consists of a number of superposed, spaced annular units encircling a shaft capable of rotation. Two sets of vanes are mounted on the shaft, those of one set rotating in the spaces between the external flat surfaces of adjacent units, and those of he other set within the circular openings of the units. A cooling agent is circulated through the units.—A. J. H.

Furnaces; Rabble stones for mechanical roasting and calcining ——. Rheinisch-Nassauische Bergwerks- und Hütten-A.-G., W. Hocks, and G. Stohn. E.P. 178,059, 6.7.21. Conv., 7.4.21. Addn. to 163,023.

Furnaces. H. B. Cannon. E.P. 186,639, 29.3.21.

See U.S.P. 1,371,774 of 1921; J., 1921, 288 a.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Stone dusting of [coal] mines. (Part II.) F. S. Sinnatt, A. McCulloch, and J. R. Lomax. Lancs. and Cheshire Coal Research Assoc., Bull. 11, 1922, 27 pages and 3 plates.

The tendency of a coal dust to explode is proportional to the fineness of division of the dust. Thus a coal dust of 1/100 to 1/150-mesh ignited at 1350° C., whilst the same coal ground to pass through a 220-mesh sieve ignited at 850° C. The sensitiveness to inflammation is also inversely proportional to the percentage of volatile organic matter present in the coal, and there is a gradual transition from lignite to anthracite in this respect. The current required to ignite a sample of raw coal (1/200-mesh) was 11·5 ampères, whilst to ignite the pyridine extract a current of only 10·5 ampères was required, as contrasted with 15·0 ampères for the residue from the extraction. It is a fallacy to believe that carbonate minerals such as limestone possess a greater effect in preventing explosions than other minerals of the nature of shale on account of their carbon dioxide content. The temperature at which the carbon dioxide is given off is too high for this action to take place sufficiently rapidly. The presence of moisture tends to prevent explosions of dusts, and experiments carried out in America have proved that the presence of 30% of water in any bituminous coal dust renders it practically non-explosive. It is, however, very difficult thoroughly to wet fusain, which may constitute 20—50% of mine dusts. Fusain and ash have a retarding action on the liability of coal dust to explode. A quantity of 3 oz. of coal dust per cubic yard of air space is sufficient to cause a dust explosion. The least percentage of inert matter in mixtures with coal which will inhibit explosions is given as follows: for boiler ashes, 57; quicklime, 50; ground shale, 43; Chance mud, 38—40; gypsum, 33—35; magnesia, 28—30; anhydrous sodium carbonate, 12—13; soda crystals ($5H_2O$), 10; sodium bicarbonate, 9—10; and Glauber salts, 8. Fine grinding of the inert material produces the most effective results as regards retarding explosions. The analyses of seven shales are quoted, together with photomicrographs of inferior shale, mudstone, dust from inferior shale, shale suitable for stone dust, and dust prepared from the latter shale. Results (unpublished) obtained by Sinnatt and Grounds on the weathering of shale are also quoted, in which it is shown that weathering facilitates the grinding of shale, and that artificial weathering, *i.e.*, alternate heating and cooling, accelerates the breaking down of the shale to a greater degree than natural weathering.—A. G.

Spontaneous combustion of coals and lignites. E. Erdmann. Brennstoff-Chem., 1922, 3, 257—262, 278—283, 293—299.

A historical survey of the subject is given. An attempt to test the liability to spontaneous combustion by treatment with ozonised air was unsuccessful. An apparatus was devised to measure relative initial combustion temperatures (*cf.* Dennstedt and Schaper, J., 1913, 11). The sample (2—4 g.), in which was inserted the bulb of a thermometer, was placed in a glass vessel immersed in an oil bath, and a current of air or oxygen preheated to the same temperature was passed through the sample. The bath was gradually heated until the temperature of the coal began to exceed that of the bath. The lowest (constant) temperature at which the coal must be heated in order that, when subjected to the action of a current of air or oxygen, it should heat up ultimately to inflammation was taken as the initial ignition temperature. Various factors governing spontaneous combustion of brown coals were studied by tests in this apparatus. Increase in concentration of ozone and oxygen accelerated the ignition of the specimen. The inflammability was considerably increased when the size of the grains was diminished. When the moisture content of a coal was increased, its inflammability decreased. Wetting may, however, promote ignition in practice by removing the carbon dioxide which has collected in a pile and facilitating fresh access of oxygen. Weathering was shown to diminish the tendency to ignition, especially of finely divided brown coal, which after 8 days would no longer ignite in cold ozonised oxygen, while the ignition temperature in oxygen was also raised. This effect of weathering is in contrast to that found by Dennstedt and Schaper. The inflammability was also reduced by maintaining the coal for some time a little below its ignition temperature. The inflammability of various lignites and vegetable products was studied to identify, if possible, the active component. No connexion with the percentage of carbon, hydrogen, or oxygen could be traced. It is a question rather of the kind of grouping. Unsaturated compounds are a doubtful cause; polyhydric phenols are more probable active ingredients. The residue, after extraction of bitumen from lignites, is exceedingly prone to ignition. The practical conclusions arrived at are that excess of air and external sources of heat should be avoided, while provision of means of conducting heat away from storage heaps is beneficial. Wetting is not helpful, but a covering of wet fine coal which seals off the air is beneficial. Carbon dioxide and flue gases may also be used for excluding air. The application of these ideas to lignite briquettes is considered.—H. J. H.

Sulphur compounds of coal, their behaviour on distillation, and the sulphur compounds of coke. J. P. Wibaut. Brennstoff-Chem., 1922, **3**, 273—278. (*Cf.* J., 1922, 13 A, 281 A.)

The work of the author and others on this subject is critically reviewed. A method has been elaborated for distinguishing between pyritic sulphur and organic sulphur in coal and coke. When coal containing both mineral and organic sulphur was carbonised, the former was diminished, while the organic sulphur content increased. The carbon apparently fixed some of the sulphur given up by heated pyrites. The formation of carbon sulphides was confirmed by synthetic experiments starting from sugar charcoal and sulphur, and they are regarded as similar to the " physico-chemical complexes " of carbon and oxygen visualised by Rhead and Wheeler (*cf.* J., 1913, 276) in their study of the absorption of oxygen by carbon. The compounds are thermally very stable, and it seems improbable therefore that coke can be desulphurised on a manufacturing scale.—H. J. H.

Lignite; Gasification of ——. E. Dubois and G. Müller. Z. Ver. Deuts. Ing., 1922, **66**, 821—824. Chem. Zentr., 1922, **93**, IV., 854—855.

The high water content of lignite causes difficulties in using it in gas-producers, and it is necessary to dry it before use. In carrying out the drying care must be taken not to reduce the lignite to powder as its subsequent behaviour in the producer is influenced by the size of the lumps, and for this reason they must be subjected to as little movement as possible. High temperatures cannot be employed, and hence a large heating surface is necessary to secure efficient drying; this is best obtained by leading a warm mixture of gases directly through the mass of lignite. A lignite dryer and gas-producer plant designed on these lines and the results obtained with it are described. The lignite used gave the following results on analysis:—Water, 58·7%; ash, 2·23%; carbon, 24·4%; hydrogen, 1·92%; nitrogen, 0·25%; oxygen, 12·2%; sulphur, 0·28%; calorific value, 1945—2400 cals.; tar, 2·05%. The efficiency of gasification was 73·9%, or, with tar recovery, 76·7%. The efficiency of the whole plant, deducting the heat equivalent of the power consumed, was 68·7%.—H. C. R.

Methane; Use of —— in steel cylinders as a fuel and starting-gas for internal combustion engines. J. Bronn. Autotechn., 1922, **11**, 6—8. Chem. Zentr., 1922, **93**, IV., 855.

The chief advantages to be obtained in using methane as a motor fuel are that it is always ready for use even in the most severe cold weather, as it remains gaseous even at the pressure (150 atm.) of the steel cylinders, and its cheapness. Near where it is produced it is 6—7 times cheaper to use than petrol or benzol, and it can be obtained in sufficient quantity, since one ton of coal gives 55 cub. m. of methane as against 8 kg. of benzol, and 1 cub. m. of methane is the equivalent of 4·5 kg. of benzol.
—H. C. R.

Gas engines; Gas requirements of, and composition of exhaust gases from, large ——. D. Rauert. Stahl u. Eisen, 1922, **42**, 1545—1553.

The efficiencies of two-stroke and four-stroke cycle gas engines are compared with reference to the loss of fuel in the exhaust gases. The importance of correct sampling of the exhaust gases so as to prevent any admixture with the external atmosphere, sucked back into the exhaust tube, is emphasised. The loss of fuel in the exhaust gases with the two-stroke cycle is mainly due to inefficient scavenging of the cylinder. The percentage loss decreases with increasing load until the latter is about 75% of the full load, though the absolute loss remains approximately constant. With the gas engines examined the loss under a 75% load was about 10%, but this increased as the load was further increased until as much as 30% was lost when the engine was operating on a slight overload. The loss due to incomplete combustion during the working stroke decreases continuously as the load increases, varying from 30% at quarter load to 1 or 2% at full load. Only the latter loss is operative with four-stroke engines which are in consequence more efficient from this point of view.—W. P.

Paraffin wax; Oxidation of ——. H. Siebeneck. Petroleum, 1922, **18**, 1193—1196.

A paraffin wax from lignite producer tar, of m.p. 54° C., was exposed to the action of oxygen for a period of 55 hrs., as described previously (J., 1922, 282 A). The paraffin wax used (150 g.) contained no acids or esters, and its saponification value was *nil*. Its ultimate analysis was 85·23% C, 14·62% H, and 0·15% O. The temperature of the experiment was 135° C. Products of cracking were found early in the experiment. The absorption of oxygen after 12 hrs. was 9·39%, the acid value of the product 6·19 and the ester value 16·64. After the 12th hour carbon dioxide was evolved, the oxygen content fell to 2·94%, the acid value was doubled, and the ester value and the saponification value increased. After 33 hrs. the ester value fell, the acid value increased, while the saponification value remained approximately constant at about 102. At the conclusion of the experiment the ester value had fallen to 49·16 and the acid value had again risen a little. The rapidity of the reaction diminished towards the close of the experiment owing to the increase in the viscosity of the material to five times the original value. The products of oxidation most likely to find commercial use are the wax-like substances formed in the second phase of the process, between 12 hrs. and 33 hrs.—H. M.

Patents.

Coal; Treatment of —— [by flotation]. F. G. Price, and Minerals Separation, Ltd. E.P. 186,143, 20.6.21.

In the froth-flotation treatment of coal, the addition of various substances aids the separation of the constituents of bituminous coal. Starch solutions, tannic acid, gelatin, glue, albumins, caramel, and dextrin inhibit the flotation of fusain, which may thus be separated from clarain and vitrain. The use of starch is preferred and many varieties have been found to be efficacious. A solution containing 2% of starch and 2% of caustic soda may be used, not more than ¼ lb. of starch being necessary per ton of coal. Good results have also been obtained with ½ lb. of glue, 1 lb. of tannic acid, or ¼ lb. of egg albumin per ton of coal. Ordinary frothing agents, such as cresol, may be added, but may not always be necessary. In treating dirty coals it is advisable to carry out a preliminary concentration to remove ash and shale. A large-scale test was carried out on dross, which gave an exceedingly friable coke useless for metallurgical purposes. The dross contained 21·5% of ash, 26·0% of volatile matter, and 47·0% of fixed carbon. 120 tons of the dross was treated by flotation, the reagents used being 0·4 lb. of cresol, 0·6 lb. of paraffin oil, and 0·25 lb. of starch per ton. The concentrates weighed 80 tons and contained 6·2% of ash, 26·6% of volatile matter, and 53·2% of carbon, and were substantially free from fusain. On coking, an excellent metallurgical coke was produced.—W. P.

Smokeless fuels and coke; Production of ——. S. R. Illingworth. E.P. 186,085, 24.3.21.

Smokeless fuel is manufactured by blending two coals, so that the mixture has a content of resinic matter (soluble in boiling phenol or boiling pyridine and also in chloroform) not less than 5% but preferably not less than 8% of its weight. The mixture is heated to a temperature not exceeding 500° C., or to a temperature 50°—100° above the minimum temperature at which the resinic matter in the blend is destroyed. Coal may be blended with coke, semi-coke, or an ore such as iron ore. The smokeless fuels produced may be further carbonised and converted into a true coke.—W. P.

Peat or similar fuel; Utilisation of surplus power from hydro-electric plant for the preparation of ——. N. Testrup, and Techno-Chemical Laboratories, Ltd. E.P. 186,137, 20.6.21.

The peat is made into a paste on preheating rollers and then dried in a thin uniform film on heated drums. Vapours given off are compressed and heated and passed into the drums to be used as the heating medium. Surplus electric power is used for compressing the vapour, and peat fuel appliances are installed for use when this surplus power is not available.—W. P.

Gas producers. W. Climie. E.P. 186,262, 15.6.21.

The producer consists of two concentric casings separated by a water and steam space, to which are connected headers, adjacent to the producer, these headers being also connected with each other by means of pipes, surrounded by casings. On leaving the producer, the gas is passed through these casings (and if necessary through other similar tubes or passages), the walls of which are swept by brushes in order to filter out suspended matter from the gas. The brush sweepings are discharged through a valve-controlled outlet.—A. G.

Gas-producing apparatus. W. E. Elliott. U.S.P. 1,430,633, 3.10.22. Appl., 17.1.20.

A retort is situated lengthwise above a number of coal-burning compartments, and means are provided for conducting the gases from the compartments to one end of the retort, for introducing air at certain points inside the retort, and for retarding the passage of gas therethrough. A suction pipe communicates with the retort.—A. R. M.

Gas purification. H. F. Smith, Assr. to Gas Research Co. U.S.P. 1,430,696, 3.10.22. Appl., 9.11.18.

Sulphur dust is eliminated from gas generated in a producer using anthracite or similar fuel, by spraying water into the gas before it passes out of the generating chamber.—A. R. M.

Exhaust gases of internal combustion engines; Utilisation of the ——. A. Scherhag. E.P. 167,155, 17.6.21. Conv., 28.7.20.

The exhaust gases are taken up by a centrifugal fan at a point near the outlet of the engine and are mixed with fresh air (up to 400 times the volume of the combustion gases). The fan produces a separation of oily and sooty matter, and the hot mixture is used for the production of hot water supplies, air heating, evaporation or other industrial purpose. The temperature of the mixture is regulated solely by the amount of fresh air sucked into the system. For the purpose of evaporation or for heating water the exhaust gases are blown directly through the liquid, whilst for heating rooms or drying chambers the hot gas is blown directly into the room or chamber.—A. G.

Oily pastes or emulsions [*lubricants*] *from mineral and other oils; Manufacture of* ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 185,779, 6.4.21.

Emulsions of oil and water are prepared with the aid of a colloid mill (E.P. 155,836; J., 1922, 357 A). These emulsions are of pasty nature and can be used in the same way as Stauffer fat. The water content can be increased to 4 to 8 times that of the oil if 1—3% of a finely powdered solid, *e.g.*, magnesium or barium carbonate or oxide, be added. Graphite or talc or other solid lubricants can be incorporated. If it is desired to incorporate a large amount of water, as for making boring pastes and soap-like lubricants, suitable protective colloids or agents as paraffin wax, glycerin, etc. can be used. The advantage of the process consists in the fact that all the materials used are neutral.—T. A. S.

Hydrocarbon oils and other oils and fats; Process of increasing the consistency of ——. H. M. Frentrup and P. Kiederich. E.P. 185,782, 12.4.21.

A salve-like mass is made from pale spindle oil by adding to it castor oil and fish oil which have been partially hydrolysed by means of sulpho-aromatic acid. The hydrolysis of the vegetable and animal oil must not be carried beyond 50%. A salve melting at 72° C. is made by adding 100 kg. of pale spindle oil (sp. gr. 0·890—0·910) to 5·75 kg. of castor oil which has been partially hydrolysed by Twitchell reagent and to which 1·75 kg. of fish oil has been added. To the mixture 8 kg. of caustic lye (40%) is added and the mass stirred with a spatula.
—T. A. S.

Petroleum oil; Process of treating [*cracking*] ——. R. Cross, Assr. to Gasoline Products Co. U.S.P. 1,423,500, 18.7.22. Appl., 2.5.21.

Oil is heated to cracking temperature by passing it through a tube heated in a furnace. After leaving the tube the oil is maintained at cracking temperature, under the pressure of the evolved gases, in an insulated "reacting chamber." The process is continuous, oil and gas being continuously removed from the reacting chamber. Cracking takes place in the liquid phase.—T. A. S.

Oils; Apparatus for cracking ——. W. B. D. Penniman. U.S.P. (A) 1,429,622 and (B) 1,429,623, 19.9.22. Appl., 25.4. and 5.5.17.

(A) Stills in series are internally heated by means of a hot fluid, the fluid supply being thermostatically controlled. Oil is passed through the system in the opposite direction to the flow of heating fluid. (B) Oil is heated in a still by means of a steam coil. The vapours from the still pass through two chambers containing steam coils. The supply of steam to the various parts of the apparatus is thermostatically controlled.—T. A. S.

Hydrocarbons; Process for the constructive conversion of ——. H. R. Berry. U.S.P. 1,429,910, 19.9.22. Appl., 10.8.22.

Heated gas containing hydrogen and carrying hydrocarbon vapours is caused to flow in counter current to films of relatively cool oil. The pressure and temperature are so controlled that lower-boiling hydrocarbons are produced without the formation of carbon deposits.—T. A. S.

Hydrocarbons; Process and apparatus for producing lighter hydrocarbons from heavier ——. C. V. Woegerer, Assr. to J. R. and W. H. Clarke. U.S.P. 1,429,992, 26.9.22. Appl., 8.5.20.

Hydrocarbons are cracked by atomising them with water and lime and then with steam under pressure and at a temperature below 500° F. (260° C.). They are then allowed to settle under pressure to allow unconverted oil and lime to separate, and finally condensed under pressure.—T. A. S.

[*Paraffin*] *wax-sweating apparatus.* C. S. Dickens, T. E. Schley, and J. W. Newton, Assrs. to Magnolia Petroleum Co. U.S.P. 1,429,721, 19.9.22. Appl., 13.11.20.

WAX is carried by an endless foraminous belt through a series of chambers heated to sweating temperature. Each chamber may be heated to any desired temperature.—T. A. S.

Hydrocarbon; Method of separating —— from aluminium chloride. E. V. Owen, Assr. to The Hoover Co. U.S.P. 1,430,109, 26.9.22. Appl., 21.1.22.

MATERIAL containing aluminium chloride and hydrocarbon is delivered to a bath of liquid material maintained at a temperature sufficiently high to vaporise the aluminium chloride but not the hydrocarbon. —T. A. S.

Dehydrator; Central circulating —— for petroleum oils. Stratifying dehydrator. W. Meredith, Assr. to Petroleum Rectifying Co. U.S.P. (A) 1,430,245 and (B) 1,430,246, 26.9.22. Appl., 14.3. and 30.4.21.

(A) A HOLLOW cylindrical electrode is disposed centrally in a cylindrical container which is also an electrode. Means are provided to cause emulsion to enter the bottom of the inner electrode and pass outwards over the top into the space between the electrodes. A potential difference is maintained between the electrodes. (B) A charged electrode is supported in and surrounded by the emulsion to be treated. Means are provided for surrounding the electrode with a fluid envelope of higher dielectric strength than the emulsion to be treated.—T. A. S.

Dehydrator [*for petroleum emulsions*]. *Adjustable field dehydrator. Double field dehydrator.* (A) H. C. Eddy and J. T. Worthington, (B, C) H. C. Eddy, Assrs. to Petroleum Rectifying Co. U.S.P. (A) 1,430,294, (B) 1,430,295, and (C) 1,430,296, 26.9.22. Appl., (A) 2.3.21, (B, C) 25.6.21.

(A) EMULSIONS are treated in a tank fitted with a cylindrical electrode concentric with the tank, and means are provided for imparting a rotary movement to the body of emulsion. (B) A flat electrode moving in its own plane is suspended in a tank which is also an electrode. (C) A hollow electrode is suspended centrally in a tank which is also an electrode and has a member projecting centrally into the inner hollow electrode.—T. A. S.

Electrical dehydrators [*for petroleum emulsions*]; *Starter for ——. Method of automatic dehydration.* F. W. Harris, Assr. to Petroleum Rectifying Co. U.S.P. (A) 1,430,301 and (B) 1,430,302, 26.9.22. Appl., 1.11.20 and 31.5.21.

(A) AN emulsion is drawn from a bulk supply and passed through an electric field at such a rate that a permanent short circuit in the field is prevented. The coarse emulsion so formed is then submitted to the action of a second electric field in which the disruption of the current paths occurs automatically without mechanical agitation. (B) The dehydrator consists of a tank fitted with electrodes and means for closing the oil inlet valve to the tank on failure of the current supply.—T. A. S.

Fuel briquettes; Artificial ——. W. W. Strafford. U.S.P. 1,430,767, 3.10.22. Appl., 11.4.22.

SEE E.P. 176,822 of 1920; J., 1922, 361 A.

Fuel product and method of making same. C. J. Greenstreet. U.S.P. 1,431,225, 10.10.22. Appl., 9.5.22.

SEE E.P. 179,567 of 1920; J., 1922, 493 A.

Metaldehyde; Burner for ——. C. Tommasi, Assr. to Elektrizitätswerk Lonza. U.S.P. 1,431,549, 10.10.22. Appl., 19.7.21.

SEE E.P. 168,868 of 1921; J., 1922, 403 A.

Gases; Desulphurising ——. A. Mittasch and M. Schümann, Assrs. to Badische Anilin und Soda Fabrik. U.S.P. 1,430,920, 3.10.22. Appl., 20.8.20.

SEE E.P. 170,152 of 1920; J., 1922, 167 A.

Oils; Process and apparatus for the treatment of petroleum ——. S. L. Gartlan. U.S.P. 1,430,977–8, 3.10.22. Appl., 17.3.19.

SEE E.P. 179,644–5 of 1921; J., 1922, 536 A.

Fuel burners; Liquid ——. L. Hall and S. H. Flood. E.P. 186,652, 1.6.21.

Retorts, gas-producers and like apparatus; Charging means for ——. Merz and McLellan, E. G. Weeks, and A. W. Statters. E.P. 186,834, 7.10.21.

Chlorinating montan wax. U.S.P. 1,429,932. *See* XX.

Flash-point of oils. E.P. 185,814. *See* XXIII.

IIB.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Adsorption by sugar charcoal. Bartell and Miller. *See* IV.

Artificial daylight. Groom. Singleton. *See* XXIII.

PATENTS.

Low-temperature tar and semi-coke; Production of —— by distilling bituminous material, such as coal or lignite. Deutsche Erdöl-A.-G. G.P. 356,591, 7.2.19.

THE mixture of steam, gas, and tar obtained by passing a mixture of superheated steam and coal gas over coal, lignite, or the like, is cooled to a temperature sufficiently low to condense the tar, but high enough to prevent condensation of the steam. The residual gases are raised to their original temperature, and again circulated through the distillation apparatus.—L. A. C.

Coal, shale, and other bituminous material; Process for distilling ——. K. Prinz zu Löwenstein, A. Irinyi, and T. Kayser. G.P. 356,820, 4.8.20.

IN distilling bituminous material in apparatus provided with an internally heated screw-conveyor, the adhesion of the material to the conveyor is prevented by scrapers moving up and down independently of one another, the supports for the scrapers being in a chamber, situated on the upper side of the conveyor, in which the products of distillation are collected.—L. A. C.

[*Gas-filled*] *electric incandescence lamps* [; *Preventing blackening of the bulbs of ——*]. N. V. Philips' Gloeilampenfabrieken. E.P. 168,598, 27.8.21. Conv., 2.9.20.

BLACKENING of the bulbs of gas-filled electric incandescence lamps, having a filament not less than 0·1 mm. in diam., is prevented by placing a substance capable of generating a small amount of oxygen during the operation of the lamp, more especially an alkali nitrate or nitrite, on the small plate of mica customarily employed in these lamps. The quantity of oxygen generated must be just sufficient for the oxidation of the tungsten sputtered from the filament. A small quantity of phosphorus may likewise be present in the lamp. [Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 102,141; J., 1917, 1000.]—J. S. G. T.

Tungsten; Manufacture of —— [for lamp filaments]. The General Electric Co., Ltd., and C. J. Smithells. E.P. 186,497, 23.8.21.

Tungstic acid is mixed with a substance which will introduce into the resulting metal an oxide (*e.g.*, thoria) that is not reduced by hydrogen, and with a compound of an alkali metal, the proportions of each being so adjusted that the tungsten oxide before reduction contains 1—0·5% of thoria and 0·3—0·03% of sodium chloride or 0·5—0·05% of cæsium chloride. The resulting filament when burnt in the form of a closely wound spiral in an inert gas develops crystals of tungsten that extend for several coils, thereby increasing the strength of the filament.—A. R. P.

III.—TAR AND TAR PRODUCTS.

Benzene from phenols; Experimental plant for producing ——. F. Fischer, H. Schrader, and K. Zerbe. Brennstoff-Chem., 1922, 3, 289—292.

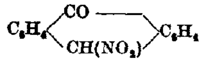
The apparatus was constructed to study on a larger scale the reduction of phenols by hydrogen to benzene and homologues (*cf.* J., 1920, 511 A, 740 A). The gas was saturated with vapour in passing through a vessel containing heated phenols and thence passed into an iron tube coated internally with tin. This tube was 3 m. long, 28 cm. diam., and could be heated in a special gas furnace to 800° C. The gas and vapour leaving the tube traversed two condensers cooled by water and a freezing mixture respectively and afterwards two vessels charged with activated carbon. The gas was metered before and after passing the apparatus, which was capable of dealing with 12 kg. of phenol per hour. The volatile reaction products were recovered from the carbon by a current of superheated steam. The results obtained are to be published separately.
—H. J. H.

Phenol; Action of sodium carbonate in promoting the hydrogenation of ——. Catalytic action at solid surfaces. E. F. Armstrong and T. P. Hilditch. Proc. Roy. Soc., 1922, A 102, 21—27.

Treatment of phenol at 180° C. with hydrogen under a pressure of 80 lb. per sq. in., in the presence of finely-powdered nickel and sodium carbonate gives a yield of 95% of cyclohexanol and some cyclohexanone. Sodium carbonate has an accelerating action on the change, which is dependent on the amount present, until an optimum quantity is reached amounting to about 25% of the weight of nickel used; an excess above the optimum retards the hydrogenation. This optimum quantity depends only on the relationship with the nickel catalyst. It is suggested that the stimulation of the reaction by sodium carbonate is not a true catalysis but the restoration of the nickel to its normal function by the suppression of a retardation which is probably of the nature of a poisoning of the nickel catalyst by the phenol.—J. F. S.

Nitration of hydrocarbons [anthracene and naphthalene] in a basic or neutral medium. M. Battegay and P. Brandt. Bull. Soc. Chim., 1922, 31, 910—915.

A mixture of 25 g. of pyridine and 100 c.c. of nitrobenzene is treated with 12 g. of nitric acid (sp. gr. 1·52) which has been freed from nitrous acid, the whole being cooled in ice. To this mixture 20 g. of finely divided anthracene is added and nitration is effected by heating to 125° C. for 4—5 hrs. The product is poured into 500 c.c. of water, which should remain neutral. After addition of alkali the pyridine and nitrobenzene are removed by steam-distillation, the liquid is filtered, and the residue freed from alkali by washing, then dried, and extracted with alcohol. On evaporation of the alcoholic extract, 9-nitroanthracene crystallises and is purified by recrystallisation. The filtrate contains nitroanthrone,



$$C_6H_4\left<\begin{matrix}CO\\CH(NO_2)\end{matrix}\right>C_6H_4$$

The nitration of naphthalene may be effected in a somewhat similar manner, zinc chloride being used as a dehydrating agent, with production of α-nitronaphthalene and also of nitrophthalic acid.
—H. J. E.

Patent.

Naphthalene; Process of purifying ——. D. F. Gould, Assr. to Barrett Co. U.S.P. 1,431,394, 10.10.22. Appl., 15.12.20.

See E.P. 172,937 of 1921; J., 1922, 662 A.

IV.—COLOURING MATTERS AND DYES.

Dyestuffs; Methods of determining the fastness of ——. B. Setlik. Chim. et Ind., 1922, 8, 541—543.

A résumé of the tests which are necessary and the methods to be followed in order to obtain a correct estimate of the fastness of a dyestuff under the conditions to which it is likely to be subjected. According to the material on which the dyestuff is used and the purpose for which the article is to be used, tests must be made (a) for wool, for fastness to light, to acids, to water, to washing, to fulling, to sulphur dioxide, to friction, to ironing, to hot water, to perspiration, and to mud and dust; (b) for cotton, for fastness to light and air, to washing, to chlorine and peroxides, to perspiration, to mercerisation, to ironing, and to dressing; (c) for silk goods, for fastness to light, water, washing, perspiration, and mud and dust. To test fastness to light, bands or skeins of material dyed different shades with the same dyestuff are exposed to sunlight with free access of air on both sides, one half being protected for comparison. Fastness to acid is tested by impregnating the material, alone or plaited with white material, with sulphuric acid of 5° B. (sp. gr. 1·036), drying at 80° C., rinsing with dilute soda and water and again drying; fastness to water by soaking for 3 hrs., or boiling for 10 mins., preferably in contact with white material; to washing by warming for ½ hr. in a solution of 10 g. of neutral soap and 1 g. of soda per litre; to perspiration by warming for 24 hrs. at 40° C., steeping in 5% acetic acid several times during this period, and wringing out the excess of acid each time before replacing in the warm water. Mud and dust are often alkaline, and their effect is simulated by making a splash on the material with milk of lime, drying, and brushing off.—G. F. M.

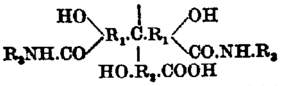
Sugar charcoal; Adsorption [of Methylene Blue] by activated ——. F. E. Bartell and E. J. Miller. J. Amer. Chem. Soc., 1922, 44, 1866—1880.

Ash-free sugar charcoal will completely adsorb a certain maximum amount of Methylene Blue and still leave the solution neutral. During this process of adsorption a considerable quantity of hydrochloric acid is set free but is readily and completely adsorbed by the charcoal. Adsorption of quantities of Methylene Blue greater than the above-mentioned maximum results in the liberation of more hydrochloric acid than can be removed from solution by adsorption.—J. F. S.

Patents.

Mordant-dyeing colouring matters; Manufacture of new ——. Durand & Huguenin, S.A. E.P. 166,530, 11.7.21. Conv., 15.7.20. (*Cf.* U.S.P. 1,403,888; J., 1922, 170 A.)

New mordant dyestuffs, having the probable general formula



(R_1 and R_2 are benzene nuclei which may be substituted by a CH_3 group, and R_2 is a benzene nucleus which may be substituted by NO_2, halogens, or CH_3 groups, and is also in every case preferably substituted by a sulpho group) are prepared by oxidising 1 mol. of a methylene-di-*o*-hydroxycarboxylic acid of the benzene series, substituted in each of its carboxyl groups by an arylamine or substituted arylamine containing nitro, halogen or methyl groups, with 1 mol. of the same or another *o*-hydroxycarboxylic acid. The methylenediarylido-*o*-hydroxycarboxylic acid is formed by condensing an *o*-hydroxycarboxylic acid with an arylamine either before or after condensation with formaldehyde. Oxidation is effected by means of nitrous acid, and anilidosalicylic acid, anilido-*o*-cresotinic acid, and *p*-nitroanilidosalicylic acid are suitable intermediates. The dyestuffs are suitable for dyeing chromed wool in red shades, but give dull and weak tints when used in printing. On sulphonation, however, the dyestuffs are improved in strength and fastness so that they are then suitable for printing together with a chromium mordant. A red dyestuff is prepared by the following method: 106·5 pts. of anilidosalicylic acid dissolved at 20°—25° C. in 700 pts. of sulphuric acid of 66° B. (sp. gr. 1·84) is stirred with 7·5 pts. of paraformaldehyde for several hours. 34·5 pts. of salicylic acid is added and the mixture is afterwards oxidised by the gradual addition, at 30°—50° C., of 30 pts. of sodium nitrite. The mass is then cooled, poured into ice water, and the dyestuff is filtered off, washed, and dried (yield 135—140 pts.). Sulphonation is effected by heating at 90°—95° C. for 1—2 hrs. a solution of the dyestuff in five times its weight of sulphuric acid of 66° B. —A. J. H.

Brown [*sulphur*] *dyestuffs.* Soc. Chim. de la Grande Paroisse. E.P. 169,687, 12.8.21. Conv., 30.9.20.

Brown dyestuffs having a reddish tinge are prepared by treating with alkali polysulphides the 2.4.8- and 2.4.5-trinitro-α-naphthols obtained by successive treatment of the corresponding isomeric dinitronaphthalene compounds with fuming sulphuric acid and dilute nitric acid. For example, 10 kg. of either or both of these trinitronaphthols, 40 kg. of crystalline sodium sulphide, 4 kg. of sulphur, and 8 l. of water are heated at 150° C. until the water has evaporated, whereby the mass thickens and a considerable amount of ammonia is evolved. The temperature is then raised to 170° C. and when evolution of hydrogen sulphide ceases, the product is dissolved in 300 l. of water and the dyestuff precipitated by addition of an acid. The dyestuff obtained from 2.4.8-trinitro-α-naphthol is redder than that produced from the 2.4.5-trinitro-derivative. The sulphur dyestuffs thus produced are fast to light and do not bleed.—A. J. H.

Yellow colouring matters for dyeing animal fibres; Manufacturing ——. F. Günther, Assr. to Badische Anilin und Soda Fabrik. U.S.P. 1,430,899, 3.10.22. Appl., 9.7.20.

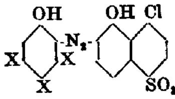
Yellow water-soluble dyestuffs, capable of dyeing wool in even shades of excellent fastness, are made from an aromatic aldehyde and a compound of *o*-nitraniline. The dyestuff molecule has the position para to the NH_2 group unoccupied and is substituted, in the aldehyde residue, by at least one sulphonic acid group.—A. J. H.

Brominated indigoes; Method of making ——. C. J. Strosacker and H. J. Rupright, Assrs. to The Dow Chemical Co. U.S.P. 1,431,606, 10.10.22. Appl., 1.9.20.

Dry indigo is treated, at 50°—90° C. and under approximately atmospheric pressure, in the absence of any diluent or any other reagent, with from 15 to 25% excess of bromine above that theoretically necessary to form the desired substitution product. —J. S. G. T.

[*o-Hydroxy-*]*azo dye.* W. Herzberg and O. Scharfenberg, Assrs. to Akt.-Ges. für Anilin Fabrik. U.S.P. 1,431,655, 10.10.22. Appl., 30.8.21.

o-Hydroxyazo dyestuffs of the general formula



capable of dyeing chrome-mordanted wool in blue shades of very good fastness and which by reduction yield 8-chloro-2-amino-1-hydroxynaphthalene-5-sulphonic acid, and 2-amino-3.4.5-trihalogenated-1-hydroxybenzene are claimed. The alkali salts of these dyestuffs are dark powders soluble in water to form blue solutions, which become violet and red by addition of sodium carbonate and caustic soda respectively and which yield a brownish-orange precipitate by addition of an organic or inorganic acid. —A. J. H.

[*Vat*] *dye.* W. Herzberg and G. Hoppe, Assrs. to Akt.-Ges. für Anilin-Fabrik. U.S.P. 1,431,656, 10.10.22. Appl., 30.8.21.

New dyestuffs, obtained by condensation of naphthosultam-3.4-phenazine with a halogenated quinone derivative, are capable of dyeing fibrous material in yellow to orange shades, fast to chlorine and soap, from an alkaline hydrosulphite vat. The dyestuffs are yellow to orange crystals or powders, slightly soluble in organic solvents but soluble in concentrated sulphuric acid with an orange-red colour.—A. J. H.

Colour lake. U.S.P. 1,431,081. *See* XIII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Clothes-moth (*Tineola biselliella, Hum.*)*; Researches on* ——. E. Titschack. Z. techn. Biol., 1922, **10**, 1—168. Chem. Zentr., 1922, **93**, III., 945—947.

A zoological study was carried out for F. Bayer u. Co. (*cf.* G.P. 347,723; J., 1922, 541 A) concerning the behaviour of moth toward fifty-two materials, and also the influence of chemical reagents in gaseous, liquid and solid form, temperature, light, moisture, reduced pressure and shaking on the eggs, larvæ and moth. The results obtained with various chemical reagents are tabulated.—A. J. H.

Cellulose. VII. Cellulose copper compounds. K. Hess, E. Mesmer, and E. Jagla. Ber., 1922, **55**, 2432—2443.

It is shown by interpretation of the effects of copper hydroxide and ammonia on the specific rotation of cellulose in the light of the law of mass action that the soluble complex copper compounds of cellulose probably contain the metal and carbohydrate in the ratio, $1Cu:2C_6H_{10}O_5$, but that a different multiple of the $C_6H_{10}O_5$ group is also possible. The isolation of the compound $Na_2[C_{12}H_{18}O_{10}Cu]$, formed by the action of caustic soda on a cuprammonium solution of the biose-anhydride from cellulose (*cf.* Hess, J., 1922, 9 A) or by the action of caustic soda and copper hydroxide on cellulose (*cf.* Normann, J., 1906, 652), considerably strengthens the first conception. (*Cf.* J.C.S., Nov.)—H. W.

Lignin; Reduction of —— and of carbohydrates with hydriodic acid and phosphorus. R. Willstätter, L. Kalb, and G. von Miller. Ber., 1922, 55, 2637—2652.

Lignin obtained from pine or red beech by treatment with hydrochloric acid (sp. gr. 1·21) in accordance with the method of Willstätter and Zechmeister (J., 1913, 822), is converted by hydriodic acid (sp. gr. 1·7) and red phosphorus under pressure at 250° C. into a product which is separated by ether into a non-homogeneous, insoluble portion of high melting point and a soluble portion which is further separated by means of alkali into a feebly acidic product (C 76·50, H 10·39%) and a mixture of hydrocarbons. The latter is separated by successive treatment with acetone and glacial acetic acid into a solid and a liquid hydrocarbon fraction, each of which is free from oxygen. The composition of the mixture approximates to a mean value corresponding with the formula, $CH_{1\cdot4}$; the liquid portion is somewhat richer, the solid somewhat poorer in hydrogen. The liquid hydrocarbons have sp. gr. 0·9 and 1·0 respectively for the fractions of lowest and highest boiling point. The lowest observed molecular weight is 167, the highest 842 (for the solid portion). The two mixtures are an interrelated analogous (not homologous) series, the properties of which are reminiscent of hydroaromatic hydrocarbons. Further treatment of the residue insoluble in ether (see above) with hydriodic acid and phosphorus yields almost exclusively solid hydrocarbons. The latter together with liquid hydrocarbons in the approximate ratio 3:1 are similarly derived from the acidic substance. The hydrocarbons are themselves practically unchanged by further treatment with hydriodic acid and phosphorus. Hexitol, dextrose, xylose, cellulose, and the humus-like substance obtained by the action of hydrochloric acid on dextrose, give mixtures similar to those obtained from lignin when treated with hydriodic acid and phosphorus under like conditions. *n*-Hexyl iodide is not an intermediate product of the change. It appears therefore that the constitution of lignin must be closely related to that of the carbohydrates. (*Cf.* J.C.S., Nov.)
—H. W.

Sulphite liquors; Analytical methods for ——. R. Sieber. Zellstoff u. Papier, 1922, 2, 199—201. (*Cf.* J., 1921, 382 A).

Good results for the free acidity are obtained by Höhn's method when methyl red is used instead of phenolphthalein as indicator. The combined sulphurous acid cannot accurately be calculated from a determination of the total calcium, because the suggested correction for SO_4 of 0·16% is not a reliable constant. The estimation of the sulphate cannot be omitted when carrying out Sander's method (J., 1921, 256 A), and it is necessary to work in an atmosphere of carbon dioxide. This can be generated in the reaction flask from sodium carbonate solution, the corked flask being provided with a small dropping funnel and a delivery tube dipping into a beaker of water. Hydrochloric acid is first introduced through the dropping funnel into the sodium carbonate, and when all the air has been expelled the sulphite liquor is introduced through the funnel. Oxidation of the sulphurous acid might be inhibited by a negative catalyst, such as stannic chloride, and the necessity of a carbon dioxide atmosphere might thus be avoided. The author has devised a method for the rapid filtration of barium sulphite by means of a filter-pump funnel. For this purpose the filter plate is covered with a thick paper filter and a measured quantity of a suspension of kieselguhr of exactly known concentration is first distributed over the filter with very gentle suction. This kieselguhr forms a filter bed which retains the barium sulphate completely even when freshly precipitated, and filters very rapidly. A correction is made for the weight of the dry ignited kieselguhr. In the spent liquors the completely free sulphurous acid is determined by distillation without acidification; this is better than the direct titration with iodine. Total sulphur in spent liquors is determined by a sodium peroxide method: 5 c.c. of the liquor is treated with concentrated sodium hydroxide solution in a nickel crucible and the alkaline liquid evaporated to dryness on an electric hot-plate. A mixture of 3 g. each of sodium carbonate and peroxide is mixed with the powdered residue and the whole is carefully heated over a small flame, combustion being avoided. Afterwards a further 0·5 g. of peroxide is added and the mass brought to fusion. Sulphate is then determined in the melt after dissolving in water and treating with bromine.
—J. F. B.

Sulphite wood pulp; Reddening of —— and its cure. E. Heuser and S. Samuelsen. Papierfabr., 1922, 20, 1249—1254, 1285—1288, 1321—1326.

The red coloration is liable to develop not only in underboiled sulphite pulps but also in easy-bleaching varieties. The presence of a certain amount of moisture is necessary for the development of the red colour, which then appears under the influence of light and air or other mild oxidising agents. It is destroyed by excess of oxidising agents and permanently disappears in the operation of bleaching. The action of reducing agents such as hydrosulphite, discharges the red colour, but this reappears on subsequent oxidation; similarly, the discharge which is effected by dilute mineral acids and by alkalis is only temporary and the red colour returns after the pulp is washed. It would seem that the substance which produces the red coloration is fixed on the original cellulose in the reduced form; none of the attempts to separate it by extraction were successful. Very similar reactions are shown by vanillin and protocatechuic aldehyde; these substances are allied to lignin, and the conclusion arrived at is that the chromogenic substance is derived from the lignin or lignosulphonic acid, possibly modified by the digestion process and fixed on the cellulose either by aldol condensation or after the manner of a dyestuff. The problem of destroying the tendency to reddening without having recourse to a definite bleaching of the pulp has been solved, by the observation that, whereas with the majority of oxidising agents a substantial quantity is required for the permanent destruction of the colouring matter, in the case of potassium persulphate in acid solution, 0·5% is sufficient. The pulp is treated with 0·5% of its air-dry weight of the persulphate and 0·5% of aluminium sulphate and left in the stuff-chest for 9 hrs. It is then ready for use by simple draining without washing. The treated pulp is in no sense bleached, but the lignin residues are so far changed that the tendency to subsequent reddening is completely eliminated.—J. F. B.

Solubility of sulphur dioxide in suspensions of calcium and magnesium hydroxides. Smith and Parkhurst. *See* VII.

Polysaccharides. Karrer and Fioroni. *See* XVII.

Patents.

Cellulose derivative [butyrate] and process of preparing same. A. D. Little, Inc., Assees. of G. J. Esselen and H. S. Mork. E.P. 182,820, 9.3.21. Conv., 10.4.20.

When butyric acid containing small quantities of water is used as the catalyst carrier (*cf.* U.S.P. 1,425,580; J., 1922, 748 A), the mixture separates into two layers, the lower of which contains practically the whole of the catalyst. This separation is prevented by the addition of small quantities of such substances as methyl, ethyl, or butyl alcohol, acetone or the like. A suitable impregnating bath has the following composition: sulphuric acid (sp. gr. 1·84) 0·5—0·6%, alcohol 5—7·5%, butyric acid 94·5—91·9%. The cellulose is soaked for 90 mins. in this solution, pressed until it contains 1¼ times its weight of solution, and esterified as described in E.P. 167,143 (J., 1922, 748 A).—D. J. N.

Cellulose ether solvent and composition. Composition containing cellulose nitrate and cellulose ether and solvent used therein. S. J. Carroll, Assr. to Eastman Kodak Co. U.S.P. (A) 1,431,905 and (B) 1,431,906, 10.10.22. Appl., 1.4.21 and 25.4.21.

(A) A viscous composition consists of an alkyl ether of cellulose dissolved in a solvent containing 90—10 pts. of xylene and 10—90 pts. of a lower monohydroxy aliphatic alcohol (*cf.* U.S.P. 1,429,188; J., 1922, 807 A). (B) The composition consists of nitrocellulose and cellulose ether dissolved in a mixture containing methyl alcohol, ethyl acetate, and chloroform.—A. J. H.

Asbestos paper, sheets and the like, and articles made therewith. N. Sulzberger. E.P. 186,409, 24.6.21.

Pure asbestos paper (containing no organic binders) is made by drying a pulp containing 50 pts. of long-fibre asbestos and 6 pts. of a colloidal solution of aluminium silicate prepared with the aid of tannic acid and ammonia. Alternatively, asbestos sheets containing an organic binder and preferably an oxidising agent such as sodium nitrate or nitrocellulose, are heated at a temperature sufficient to destroy the organic binder. Asbestos material prepared by this process is suitable for cigarette wrappers, insulating materials, and carriers for catalysts.—A. J. H.

Parchment paper or vulcanised fibre and process for making some [from nitrocellulose]. B. Herstein. U.S.P. 1,429,427, 19.9.22. Appl., 6.4.20.

Sheets of nitrocellulose paper containing not more than 4·5% of nitrogen are superimposed, and cemented together by the gelatinising action of an alkali.—D. J. N.

Flax fibre; Process for recovering [making high-grade paper pulp from] ——. R. E. Rindfusz and V. Voorhees, Assrs. to American Writing Paper Co. U.S.P. 1,430,115, 26.9.22. Appl., 15.11.19.

Flax tow is digested with alkaline solutions under pressure, washed, treated at the ordinary temperature with a solution containing an oxy-acid of nitrogen, and again subjected to an alkaline treatment to complete the removal of ligneous shive material.—D. J. N.

Metallised paper [for making electric cables]. M. Höchstädter. E.P. 186,363, 29.3.21.

Metallised paper, more especially for use in the manufacture of electric cables in accordance with E.P. 7766 of 1914, is prepared by spraying a continuous conducting layer of molten metal upon paper. The nozzles of the spraying apparatus are capable of oscillation transversely to the direction of motion of the paper during the spraying process. Preferably spelter is used as the sprayed metal, and after leaving the spraying apparatus the paper is passed between rollers to be smoothed and perforated. The resulting material is highly porous and cables constructed therefrom can be impregnated with liquids in the usual manner.—J. S. G. T.

Paper; Method of removing ink from print ——. H. R. Eyrich and J. A. Schreiber. E.P. 186,372, 17.5.21.

See U.S.P. 1,421,195 of 1922; J., 1922, 628 A. Bentonite is a very fine-grained clay and its action is apparently that of a protective colloid, which forms a fine suspension in the alkaline liquid and renders the particles of pigment capable of removal through the matted fibres on the surface of the drum washer.

Graphitised vulcanised fibre and methods in preparing the same. E. G. Acheson, jun. E.P. 172,924, 7.7.21. Conv., 14.12.20.

See U.S.P. 1,379,155 of 1921; J., 1921, 540 A.

[Paper;] Beater sizing [of ——]. H. M. Wheelwright. U.S.P. 1,430,045, 26.9.22. Appl., 6.5.19. Renewed 3.3.22.

See E.P. 175,034 of 1920; J., 1922, 248 A.

Waterproofing and gasproofing composition. J. D. Sée, Assr. to Soc. Anon. des Etabl. Hutchinson. U.S.P. 1,431,845, 10.10.22. Appl., 25.6.19.

See E.P. 129,630 of 1919; J., 1920, 482 A.

Sugar etc. from wood. E.P. 160,776. *See* XVII.

Glucose and dextrin from wood. E.P. 186,139. *See* XVII.

Mucic acid from wood. E.P. 160,777. *See* XX.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Cotton mercerised by means of sodium hydroxide or sodium chromite (alkaline chrome mordant); Some important but overlooked properties of ——. J. Pokorny. J. Soc. Dyers and Col., 1922, 38, 248—250.

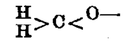
Mercerisation imparts to cotton slightly basic properties whereby it attracts acid dyestuffs (including direct cotton dyes) containing sulphonic or carboxylic groups, from cold or hot acidified solutions. Hanks of mercerised cotton dyed in acid and alkaline solutions of Benzopurpurine 4B acquired the same brightness and depth of shade. This property of mercerised cotton is diminished by treatment with hot dilute acids, so that it is probably due to the formation of an active but labile basic compound. The formation of this basic compound increases with the strength of caustic soda used in mercerisation. Cotton also obtains stronger basic properties when simultaneously mordanted and mercerised by means of Koechlin's alkaline chrome mordant, and is then capable of fixing from cold or hot dilute, neutral or slightly acid dye-baths, all kinds of acid colours in much deeper shades than those obtained by the usual direct dyeing methods. The more sulphonated the dyestuff, the easier is the dyeing, *e.g.*, dark indigo shades are obtained by dyeing alkaline chrome-mordanted cotton in cold or hot dilute solutions of Diamine Sky Blue. Under these conditions, Eriochrome Azurol B and Alizarin Saphirol B yield dyeings very fast to hot soaping, but the fastness of other dyestuffs varies considerably. In most instances, the dye-liquor, even in the cold, is easily exhausted. The shade of alkaline chrome-mordanted cotton dyed in the cold with dyestuffs containing hydroxyl groups in special positions (*e.g.*, Eriochrome Azurol B) is altered in tone and becomes much faster to soap when steamed without pressure. The mordanted cotton may be further mordanted by steeping it in solutions containing suitable metallic salts. Technically valuable shades have been obtained by impregnating alkaline chrome-mordanted cotton with diazo or tetrazo solutions and subsequently treating it with solutions (not alkaline) containing suitable naphtholic compounds. Alternatively the mordanted cotton may first be impregnated with intermediates such as H-acid, J-acid, and chromotropic acid and then treated with suitable diazo or tetrazo solutions. For example, an orange shade, fast to soap (faster after steaming), is produced on alkaline chrome-mordanted cotton when it is steeped in 50 c.c. of a solution (not alkaline) containing 1·38 g. of salicylic acid and 0·85 c.c. of caustic soda of 76° Tw. (sp. gr. 1·38), afterwards rinsed and then immersed in a solution of diazotised *p*-nitraniline and subsequently soaped. Under the same conditions, the colour is not retained by unmordanted cotton.—A. J. H.

Dyeing of woollen piece goods; New process for obtaining special effects in the ——. F. Münz and R. Haynn. Chem.-Zeit., 1922, **46**, 945—946.

When wool is treated with acetic anhydride in the presence of a catalyst, such as hydrochloric acid, phosphoric acid, organic sulphonic acids, and particularly sulphuric acid, it retains its physical properties (except that it can be more easily "milled") but permanently resists acid dyestuffs, so that the production of white effects in dyed piece goods is possible. The treated wool contains no sulphuric acid and when heated with 50% sulphuric acid yields no acetic acid by hydrolysis. The injurious action of the sulphuric acid on the wool may be diminished without reducing its catalytic action by neutralising a part of it with a weak organic base such as pyridine or dimethylaniline. The wool may also be padded with sulphate of aluminium or chromium, or other easily dissociated salts of sulphuric acid. Previously dyed wool may also be treated (only shades obtained by means of acid alizarin dyestuffs are considerably changed), but the consequent decrease in fastness to washing, milling, etc., must be corrected by an after-chroming treatment. The process is carried out in rotating water-jacketed closed aluminium drums. For 1 kg. of wool, 1 l. of acetic anhydride, 4 l. of acetic acid, 140 g. of sulphuric acid (monohydrate), and 77 g. of dimethylaniline are used, but for 1 kg. of dyed wool, the sulphuric acid and dimethylaniline are replaced by 60 g. of sulphuric acid (monohydrate). The wool is treated for 1½ hrs. at 57°—58° C., and is then washed and dried, but dyed wool, after washing, is treated with a solution containing 20% of chromium acetate of 20° B. (sp. gr. 1·16) and 4% of formic acid (85%) for ¾ hr. at 75° C. and is then washed and dried. Acetic acid used in the treatment is recovered as a 30% solution and is suitable for use in the mordanting and dyeing of wool.—A. J. H.

Dyed fabrics; Influence of gases on the fastness of ——. E. Ristenpart and P. Wieland. Textilber., 1922, **3**, 397. (*Cf.* Ristenpart, J., 1921, 505 A.)

Although Schiff's reagent is admitted to be suitable for use in the determination of formaldehyde in the distillate obtained by steam distillation of fibrous materials containing formaldehyde, the statement of Heermann (J., 1922, 290 A) that this reagent is at least as sensitive as Cohn's reagent (a mixture of sulphuric acid and resorcinol) is disputed. Moreover, in the testing of materials for formaldehyde, unreliable results may be obtained if the material is directly immersed in Schiff's reagent. The difficulty of producing dyed fabrics fast to formaldehyde is increased by the discovery that compound shades are not necessarily fast even when produced by means of dyestuffs which are individually fast to formaldehyde. In explanation of this fact, it is suggested that the formaldehyde molecule suffers internal rearrangement to form



$$\begin{matrix}\mathrm{H}\\\mathrm{H}\end{matrix}\!>\mathrm{C}<^{\mathrm{O}-}$$

and is thereby able to unite with two molecules of dyestuff. It is recommended that all packing materials for dyed goods should be free from formaldehyde.—A. J. H.

Fastness of dyestuffs. Setlik. *See* IV.

Patents.

Dyeing silk black. O. Y. Imray. From Gebr. Schmid. E.P. 174,947, 3.2.22.

In a rapid process for weighting silk which is to be dyed black, the silk is weighted by the usual tin-phosphate process and is then treated in a boiling foam bath containing hæmatein and silkworm chrysalides. For example, 100 kg. of tin-weighted silk is immersed for 15—30 mins. in a boiling foam bath containing 2000 l. of water, 70 kg. of hæmatein, and 20 kg. of silkworm chrysalides previously boiled in 50 l. of water. Alkaline substances such as soap, sodium carbonate, alkali silicate, soda-lye, or potash-lye may be added, and the exhausted bath may also be used, after addition of an aniline dyestuff, for dyeing the treated silk.—A. J. H.

Fixing of [*ice-*] *colours upon textile fibres.* G. Aris. E.P. 186,086, 24.3.21.

In the fixing of ice colours (*e.g.*, Para Red) on fabrics prepared with a phenolic salt (*e.g.*, sodium β-naphtholate), the addition to the diazo solution of 0·5—5% of a diazotisable azo derivative of the amine used as the diazo component, increases the affinity of the fibres for the ice colour subsequently formed. Hence, printing pastes to which this addition is made, can be diluted 16% and a corresponding reduction can also be made in the strength of the β-naphthol solution. For a developing solution containing diazotised aniline, aminoazobenzene is a suitable azo derivative to add.—A. J. H.

Dyeing; Fast ——. V. Villiger and H. Von Krannichfeldt, Assrs. to Badische Anilin- und Soda-Fabrik. U.S.P. 1,431,136, 3.10.22. Appl., 9.9.20.

See E.P. 168,447 of 1920; J., 1921, 730 A.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Nitric acid; Air-bleaching of ——. W. G. Whitman and L. Evans. Chem. and Met. Eng., 1922, **27**, 686—688.

The rate of removal of lower oxides of nitrogen existing in a concentration, N, in nitric acid solution, is given by the equation $-dN/d\theta = \beta N$, where β is a constant for a given temperature and rate of flow of air. The results of laboratory experiments are given confirming this equation and establishing that β varies directly with the rate of flow of air and with the temperature, being doubled with each rise of 5° C. The advantage of bleaching at a high temperature is thus very great, and there is also a saving of nitric acid, the vapour pressure of which rises much more slowly than does the partial pressure of the lower oxides existing in a 1% solution. Values for β, the "bleaching coefficient," for given conditions obtained in laboratory experiments were found to be within 10% of the results of plant practice.—C. I.

Ammonia; Oxidation of ——. The work of the Sheffield [U.S.A.] experiment station. H. A. Curtis. Chem. and Met. Eng., 1922, 27, 699—703.

An account is given of data obtained in 1918 on an experimental plant with a capacity of 500 lb. of nitric acid per day. The conclusions reached include the following:—An alloy of platinum with 1% of iridium is as efficient a catalyst as pure platinum. The optimum temperature for the reaction is higher than usually believed and, in the absence of heat exchangers, electrical heating of the gauze is indispensable. The highest oxidation efficiencies (above 90%) were obtained with a gauze temperature of about 800°—880° C. The improved efficiency obtained by using two gauzes electrically insulated from each other, of which the first only is heated, is partly but not entirely due to heat conservation. Ammonium nitrate solution cannot be substituted for water in the absorption towers, as it is decomposed. An activated charcoal catalyst placed in the absorption system after the first or second tower and maintained at a temperature above the dew point of the gas passing, increased the rate of oxidation of the nitric oxide fourteen times. This catalyst cannot be placed earlier in the system, as in concentrated nitric oxide (10%) it burns. A survey of future lines of advance in this process is given.—C. I.

Nitric oxide; Comparison of methods for the estimation of ——. A. Klemenc and C. Bunzl. Z. anorg. Chem., 1922, 122, 315—331.

Nitric oxide was prepared according to the method of Emich (Monatsh., 1892, 13, 73); the product contained about 1%of impurity and was purified by fractionation, using liquid air. The estimation of the gas by passing it over heated copper was found to give reliable results. Unreliable values were obtained by combustion with hydrogen in the Drehschmidt platinum capillary (Von Knorre and Arndt, J., 1899, 1156), by the method of Baudisch and Klinger (J., 1912, 1178), and by absorption with ferrous sulphate. Good results were obtained by absorption of the gas with acid bromate or *N*/5 permanganate and estimation of the excess of absorbent. The last-named method can also be used in the presence of carbon dioxide and other gases. —W. T.

Liquid sulphur dioxide; New system of making —— in South America. H. J. Paoli. Giorn. Chim. Ind. Appl., 1922, 4, 349—352.

Large quantities of liquid sulphur dioxide are used in South America, especially in Argentina, for making ice, for refrigerating machinery in the frozen meat industry, in the manufacture of wine, and for the disinfection and preservation of fruit. The method of manufacture used in the Sarandi (Buenos Ayres) works of Sociedad de Productos Quimicos "La Sulfurica," started in 1914, is described. Sulphuric acid being ruled out by its high price and pyrites by its inaccessibility, sulphur is used as raw material. The products of combustion of the sulphur are passed from the burners through a leaden pipe to the base of a packed tower, down which falls a fine water spray. The acid solution obtained passes into a coil enclosed in a heater through which steam circulates under pressure, and overflows into a gasifying tank heated by the furnace used for the sulphur burners, part of the sulphur dioxide being thus liberated. The liquid is then heated in a fire-heated boiler, into which the heater also may be discharged; here the last traces of sulphur dioxide are expelled. If the pressure in the heater is increased, the quantity of heat also increases, so that the spray descending the tower may be increased until the whole of the sulphur dioxide is absorbed and the liquid delivered into the gasifier almost at the boiling point. The rest of the plant consists of cooling coils for the gas, a coke tower, a sulphuric acid filter for drying the gas, and a compressor. With normal working 150 pts. of sulphur yields 270 pts. of the liquid anhydride. Details of the plant are given.—T. H. P.

Sulphur dioxide; Solubility of —— in suspensions of calcium and magnesium hydroxides. W. T. Smith and R. B. Parkhurst. J. Amer. Chem. Soc., 1922, 44, 1918—1927.

The solubility of sulphur dioxide in water, milk of lime, and milk of magnesia has been determined at partial pressures of sulphur dioxide up to 760 mm. and temperatures from 5° C. to 60° C. Varying proportions of calcium and magnesium hydroxide were used in suspensions of a total alkalinity of 1 g.-equiv. per l. The concentration of sulphur dioxide as sulphurous acid is proportional to its partial pressure. With solutions of the same alkali concentration the percentage salting-out effect (*i.e.*, 100 times the ratio of the difference between the solubility of sulphur dioxide in water and as free sulphurous acid in the solution under examination to the solubility of sulphur dioxide in water under the same conditions of temperature and pressure) increases with, but more than in proportion to, the temperature. With solutions of constant temperature the percentage salting-out effect increases with the alkali concentration but is less than proportional to it. Varying proportions of calcium and magnesium hydroxide have no effect on the equilibrium concentration of sulphur dioxide as sulphurous acid. —J. F. S.

Sulphur tetroxide; Existence of ——. F. Meyer, G. Bailleul, and G. Henkel. Ber., 1922, 55, 2923—2929.

When sufficient energy is imparted, the action of the silent electric discharge on a mixture of sulphur dioxide and oxygen leads to the formation of more highly oxidised substances than sulphur heptoxide. It is essential that a relatively large excess of oxygen or ozone should be present and that the temperature should be kept low. The most fully oxidised product yet obtained corresponds with the formula, $SO_3,2SO_4$, but it is improbable that the limits of oxidation have yet been reached. Berthelot's sulphur heptoxide (Comptes rend., 1878, 86, 20, 288) is probably a mixture of sulphur trioxide and sulphur tetroxide in equimolecular proportions. (*Cf.* J.C.S., Dec.)—H. W.

Ammonium carbonate-carbamate equilibrium. C. Faurholt. Z. anorg. Chem., 1922, 122, 132—134.

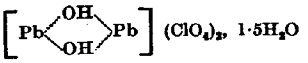
A reply to Wegscheider's theoretical paper (Z. anorg. Chem., 1921, 121, 110). The author shows that his results for the above equilibrium (*cf.* J., 1922, 292 A) are in fair agreement with those obtained by Burrows and Lewis and Fenton. The disagreement between Wegscheider's conclusions and those of the present author is largely due to different values for the ionisation-constant of carbamic acid. According to Wegscheider this acid is so weak that its ammonium salt is completely hydrolysed in aqueous solution, whereas the author found by colorimetric estimation of hydrogen ions that the ammonium salt is not hydrolysed to any appreciable extent.—W. T.

Calcite and aragonite; Solubilities of ——. H. L. J. Bäckström. Med. K. Vetenskapsakad. Nobelinst., 1922, 4, [11], 1—11.

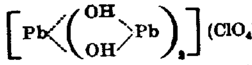
The solubilities of calcite in the form of Iceland spar and of synthetic aragonite in water in presence of carbon dioxide were determined at 9°, 25° and 35° C. As the point of equilibrium is approached, either from the supersaturated or from the undersaturated side, the reaction becomes very slow, especially in the case of calcite, but the following figures in g. p. l. are probably accurate to 0·1%: calcite, 1·30 at 9°, 0·943 at 25°, and 0·765 at 35° C.; aragonite, 1·46 at 9°, 1·066 at 25°, and 0·876 at 35° C. The most probable value of the transition temperature, calculated from these figures, is -43° C. (*Cf.* J.C.S., 1921, ii., 317).—E. H. R.

Basic lead salts; Constitution of ——. R. Weinland and R. Stroh. Ber., 1922, 55, 2706—2718.

The presence of polynuclear cations in several forms has been established by preparative substitution in the case of lead salts. Thus, in the basic perchlorates



$$\left[\mathrm{Pb}{<}\begin{matrix}\mathrm{OH}\\ \mathrm{OH}\end{matrix}{>}\mathrm{Pb}\right](\mathrm{ClO_4})_2,\ 1\cdot5\mathrm{H_2O}\quad \text{and}$$



$$\left[\mathrm{Pb}{<}\left(\begin{matrix}\mathrm{OH}\\ \mathrm{OH}\end{matrix}{>}\mathrm{Pb}\right)_2\right](\mathrm{ClO_4})_2,$$

the perchlorate residues could be replaced by other acid radicles by double decomposition. The stability of the metal-ol cations in aqueous solution is not comparable with that of the typical metallic ammines, since the above basic perchlorates are to some extent decomposed into new basic salts when their solutions are diluted. The presence of such lead-ol complexes in basic lead acetates has also been established by the substitution method in the case of the basic lead acetate of the German Pharmacopœia V.; one such ion is identical with that contained in the first perchlorate mentioned above. Lead acetate may be regarded as the acetate of a polynuclear lead acetato cation. In aqueous solution more than one such cation is undoubtedly present since the action of perchloric acid on lead acetate in neutral or acetic acid solution yields the perchlorates of four different acetato cations.
—H. W.

Rare earths; Separation of —— by basic precipitation. III. Quantitative separation of cerium from the other earths. W. Prandtl and J. Löschl. Z. anorg. Chem., 1922, 122, 159—166.

The separation is based on the fact that the ceric hydroxide is a weak base and its salts are largely hydrolysed. Cerous nitrate mixed with the nitrates of the other rare earths was oxidised by triammino-trinitrato-cobalt in acid solution and a quantitative precipitation of ceric hydroxide was obtained, $Ce(NO_3)_3 + [Co(NO_2)_3(NH_3)_3] + 4H_2O = Ce(OH)_4 + Co(NO_3)_2 + 3NH_4NO_3 + HNO_3$. The formation of free acid prevents the precipitation of the other rare earths.—W. T.

Rare earths; Separation of —— by basic precipitation. IV. W. Prandtl and J. Rauchenberger. Z. anorg. Chem., 1922, 122, 311—314.

The influence of cadmium nitrate on the equilibria between the nitrates of the rare earths and ammonia in ammonium nitrate solutions of various concentrations has been investigated. The conditions were the same as in previous investigations (J., 1922, 292 a). The presence of cadmium nitrate increased considerably the amount of rare earths, especially lanthanum, kept in solution, this increase being much more marked than in presence of zinc nitrate.—W. T.

Hydrogen gas; Spontaneous incandescence of substances in atomic ——. R. W. Wood. Proc. Roy. Soc., 1922, A 102, 1—9.

Metals, certain oxides, and other substances when introduced into a stream of atomic hydrogen are raised to incandescence, owing to the surface of the substance acting as a catalyst in bringing about the re-combination of the atoms. Fire-polished glass surfaces have a comparatively feeble catalysing power, but fractured surfaces cause the re-combination of the atoms, and are strongly heated.—J. F. S.

Sulphite liquors. Sieber. *See* V.

Decomposition of potassium ferricyanide in daylight. Baudisch and Bass. *See* XXI.

Sulphuric acid in presence of aluminium. Moser and Kohn. *See* XXIII.

Patents.

Green chrome oxide; Process of making ——. A. L. D. d'Adrian. U.S.P. 1,429,912, 19.9.22. Appl., 5.11.21.

Alkali chromate (100 pts.) is heated with ammonium sulphate (50 pts.) to 400° C. for from 15 mins. to 2 hrs. The product is lixiviated with water to remove the soluble constituents.—T. A. S.

Lithium and potassium [salts]; Process for extracting —— from lithium-potassium ores and also forming potassium alum from such ores. G. E. Bailey and A. E. Sedgwick. U.S.P. 1,430,877, 3.10.22. Appl., 14.2.21.

Lithium-potassium ore is mixed with potassium sulphate and heated to a temperature not exceeding 1500° F. (about 815° C.).—L. A. C.

Hydrogen peroxide; Method of producing solutions containing ——. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler, and O. Liebknecht. E.P. 186,871, 16.2.22.

See G.P. 355,866 of 1916; J., 1922, 754 a.

Separating hydrocarbon from aluminium chloride. U.S.P. 1,430,109. *See* IIa.

VIII.—GLASS ; CERAMICS.

Silica; Influence of heat on the microscopic properties of —— in its different mineral forms. J. T. Robson. J. Amer. Ceram. Soc., 1922, 5, 670—674.

The refractive indices of sand, quartz rock, chalcedony and flint alone and when used in a porcelain body of the composition felspar 20%, kaolin 45%, silica 35%, were determined before and after firing to cone 13 and 14. Flint and chalcedony were transformed into cristobalite before sand and quartz rock, which appeared to alter at about the same temperature.—H. S. H.

Porcelains; Talc as a flux for high-tension insulator ——. R. Twells, jun. J. Amer. Ceram. Soc., 1922, 5, 675—684.

A typical high-tension insulator body of the general formula 0·21 K_2O, 1·0 Al_2O_3, 4·45 SiO_2 was used as a standard, the K_2O being partially replaced by MgO and the RO content being varied between 0·14 and 0·30 equivalent, talc being used as the source of magnesia. The bodies were fired to temperatures below cones 9 and 13 and were tested for absorption and transverse strength. The results at cone 10½ showed that a small addition of talc greatly decreased the percentage of felspar necessary for vitrification, but additional small amounts of talc had much less effect than the first small addition. About 0·16 equivalent of RO was needed for vitrification at this temperature when small percentages of talc were used. The transverse strength in properly vitrified bodies was increased by the addition of MgO at the expense of K_2O. Vitrified bodies of this general type showed little improvement, if any, over regular triaxial porcelain. It is suggested that the effect of replacing the felspar entirely, or almost entirely, by talc, and the use of higher temperatures to obtain vitrification should be tried.—H. S. H.

Terra cotta; Data on viscosity of Indiana clay slip with electrolytes in regard to the casting of ——. H. E. Davis. J. Amer. Ceram. Soc., 1922, 5, 702—712.

Slips were prepared with Indiana clay, using as electrolytes sodium carbonate, sodium silicate, a mixture of sodium carbonate and silicate in equal proportions, gallic acid and tannic acid. The relative viscosities were determined with a flow viscometer and by measuring the thickness of wall cast in a given time. Sodium carbonate proved the most suitable electrolyte. It produced maximum fluidity in the slip, which did not settle out heavily, and on casting produced a uniformly thicker wall than that obtained by using other electrolytes. Tannic acid was very satisfactory, but so much was required that its use was not commercially practicable. —H. S. H.

Enamels; Wet process —— *for cast iron.* R. R. Danielson and H. P. Reinecker. J. Amer. Ceram. Soc., 1922, 5, 647—669.

The effect of varying composition and treatment on wet process enamels for cast iron has been studied, compositions used in dry process enamelling having served as the basis for the work. Sintering of most ground coat frits was found desirable in order to obtain the best adherence to the castings. Clay gave the best results as a mill addition for the ground coats, flint and felspar being less satisfactory. Excessive additions of clay or flint produced flaking, while felspar tended to develop blistering. About 15% of clay or 10% each of clay and flint are recommended for mill additions for the ground coats. Excessive additions of any one flux were not desirable and the best results were obtained when sodium, lead, and boric oxides were combined in more or less definite proportions. Sodium oxide in excess of about 10% gave rise to blistering. Boric oxide increased the firing range of the ground coats and was preferable to lead oxide on that account, although it tended to promote crawling of ground coats high in boric oxide if they were applied somewhat heavily. The composition of the best ground coats developed are given. Cover enamels were smelted in the usual way. The mill additions consisted of 5% of clay, 8% of tin oxide, 45% of water, all based on the weight of the dry frit. For the best results the cover enamel must be adapted to the ground coat in refractoriness. Boric acid increased the firing range of the enamels but tended to promote crawling, although this was less pronounced in the case of the more fusible compositions. Boric oxide improved the opacity when substituted for such fluxes as sodium and lead oxides. Cryolite increased the opacity but additions above 10%, based on the melted weight, tended to promote crawling. The compositions of the best cover enamels developed are given. —H. S. H.

Patents.

Annealing [glass, porcelain, metals], and apparatus used therein. A. Hilger, Ltd., and F. Twyman. E.P. 186,160, 21.6. and 14.11.21.

A process of annealing depending on the deformation of a rod of the substance to be annealed when maintained under stress has been described (E.P. 114,183; J., 1918, 242 A). The time of relaxation of a substance is determined by subjecting a piece of the same substance as that to be annealed to heat, maintaining the piece under sufficient stress to deform it a determined amount, and either periodically removing the stress or applying a further stress tending to increase the deformation so that the piece ceases to support the stress at any desired degree of annealing before the annealing process is completed. An apparatus is described for ascertaining the time of relaxation of a substance maintained under stress a definite amount, means being provided for adding additional stress. (*Cf.* J., 1921, 468 A.)—H. S. H.

Glass-tank furnace. J. E. Hurley. U.S.P. 1,390,614, 13.9.21. Appl., 15.6.20.

The walls of a glass-tank furnace are composed of tanks containing water. The inner walls of the tank are lined with fibrous material (wood) spaced from the walls by means of corrugated wire mesh or the like, and the space so formed between the lining and the wall communicates by suitable openings with the interior of the tank. With this arrangement there is a continuous circulation of water from the interior of the tank through the space between the walls and the wooden lining, and the latter is protected against the action of the heat of the furnace.—A. C.

Glass; Process of, and mixture for making ——. A. L. D. d'Adrian. U.S.P. 1,430,725, 3.10.22. Appl., 21.7.21.

A bromine salt is added to the mixture usually employed for making glass.—J. S. G. T.

Plastic moulding material [clay]; Process of preparing ——. O. Gerlach and C. B. Lihme, Assrs. to The Industrial Research Laboratories. U.S.P. 1,390,435, 13.9.21. Appl., 15.12.17.

The necessity for ageing clay mixtures, in order to attain the requisite plasticity, prior to moulding, is obviated by addition of sulphite-cellulose waste liquor to the mixture. The tendency of the plastic mixture to tear or break when being forced into the mould, owing to adhesion to parts of the moulding apparatus, is overcome by addition of a small quantity of ground petroleum coke to the clay mixture.

Metallic [zirconium] oxide; Article of fused —— *and process of producing the same.* A. L. D. d'Adrian, Assr. to A. L. Duval d'Adrian Chemical Co. U.S.P. 1,430,724, 3.10.22. Appl., 25.2.21.

Fused zirconium oxide is ground, mixed with a suitable binder, and moulded to shape. The moulded article is heated to a dull red heat between spaced carbon electrodes, and finally to a temperature of about 2500° C. by passing current through it, whereby the particles of oxide become fused together.—J. S. G. T.

Kiln for burning refractory bricks (silica etc.), particularly those with a lime bond. H. Koppers. G.P. 356,037, 6.7.21. Addn. to 347,672.

In a kiln of the type described in the principal patent (J., 1922, 548 A), the firing chamber is operated on the intermittent principle and the preheating and cooling chambers continuously. The preheating and cooling chambers slope down towards the cool ends so that by means of the natural upward draught the air and the waste gases form layers of uniformly decreasing temperature. The heating and cooling processes are thus completely under control and a high degree of efficiency is obtained.—G. F. M.

Sheet glass; Apparatus for drawing ——. W. J. Mellersh-Jackson. From Libbey-Owens Sheet Glass Co. E.P. 186,479, 28.7.21.

Tank furnaces principally for use in glass manufacture; Bridge walls for ——. R. Haddan. From Corning Glass Works. E.P. 186,547, 24.12.21.

IX.—BUILDING MATERIALS.

Patents.

Impregnation of wood. Soc. de Recherches et de Perfectionnements Industriels. E.P. (A) 168,048, 26.7.21, and (B) 179,129, 27.7.21. Conv., 20.8.20 and 19.4.21.

(A) By mixing an ionised non-colloidal solution with the emulsion to be injected into wood for its preservation, a state of deferred precipitation of the antiseptic from the emulsion is obtained. (B) The degree to which precipitation of the antiseptic is retarded is regulated by varying the quantity and concentration of the ionised solution.—J. B. P.

Bricks; Process for making —— and their products. G. B. y Hernandez. U.S.P. 1,430,991, 3.10.22. Appl., 27.9.20.

Cement, fine gravel or sand, and coal scoria are added to a pasty mixture of quicklime and an astringent solution, and the mixture finely pulverised, moulded to shape, and dried.
—J. S. G. T.

Asphalt or like hydrocarbonaceous material; Fire-resisting ——. J. H. Young, and H. H. Robertson Co. E.P. 186,861, 6.12.21.

See U.S.P. 1,398,991 of 1921; J., 1922, 48 A.

Insulating and building material, and method of producing same. T. A. Eklund and C. G. Löfveberg. U.S.P. 1,392,127, 27.9.21. Appl., 11.3.20.

See E.P. 140,431 and 142,111 of 1920; J., 1921, 149 A.

Paint for use with magnesium oxychloride cements. E.P. 186,231. *See* XIII.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron-bearing materials; Sintering ——. R. L. Lloyd. Min. and Met., Oct., 1922, 17—19.

Iron blast-furnace flue dust, owing to its carbon content, on sintering in a Dwight-Lloyd furnace usually gives sinter of a very good quality; but if the carbon (coke) content is too high the sinter becomes very friable. The furnace works at its maximum capacity and the product is strongest and most massive when the fines contain 8% of coke; dust containing larger percentages should be mixed with pyrites cinders or fine ores to reduce the carbon to 8% For fine iron-ore concentrates from 8 to 3% of coke fines is sufficient according to whether the ore is magnetic or non-magnetic. The product in all cases is a coke-like mass of ferrosoferric oxide, Fe_3O_4, which is exceedingly porous and eminently suitable for blast-furnace work, being very quickly and smoothly reduced by the gases; in addition practically all the sulphur in the ore is removed in the process.—A. R. P.

Cast-iron; Modification of —— by heat treatment. J. Durand. Comptes rend., 1922, 175, 522—524.

An attempt to determine the conditions which cause the increase in volume of castings and to estimate the degree of importance of the various factors affecting it. The experiments were carried out by means of a dilatometer and the samples used measured 50 mm. in length and 8 mm. in diameter. A diagram is given which shows the growth of a specimen of known composition which was submitted to 5 cycles of temperature change (between 600° and 900° C.), and the author points out its agreement with the results obtained by Charpy (Soc. Chim. de France, May 16, 1908). The increase becomes smaller on each successive heating, as the amount of free graphite deposited, which is the cause of the increase in volume, has increased at each stage. As the growth varies inversely with the rate of heating and directly as the silicon content, it is only of importance when the silicon is high and the casting is heated slowly. It follows that stresses will be set up in the material if the temperature varies from one point to another during heating.—H. J. E.

Graphitisation in a carbon tool steel. H. S. Rawdon and S. Epstein. Chem. and Met. Eng., 1922, 27, 650—651.

A peculiar type of black fracture in an annealed tool steel (*cf.* Green, J., 1922, 713 A) was examined. Three distinct zones, a light-coloured casing, a black interior, and a light-coloured pencil of material at the axis were evident even in the sawn face of the bar. Under progressive hardening treatments, the light-coloured layer showed a martensitic structure, and globular cementite, which later dissolved in the matrix. In the dark-coloured area, each black spot acted as the centre for the formation of martensite in the ferrite matrix, and after severe treatment the black nuclei (graphite?) persisted. A troostitic structure was shown in the centre portion after mild hardening, changing to martensite under more severe conditions. In the initial state of the material all the carbon in the black zone was in the graphitic form, and no other feature of composition pointed to the unusual behaviour of the specimen.—C. A. K.

Alloys of electrolytic iron with carbon and manganese; Preparation and mechanical properties of vacuum-fused ——. R. P. Neville and J. R. Cain. Trans. Amer. Electrochem. Soc., 1922, 203—218. [Advance copy.]

Alloys containing 0—1·6% C and 0—1·6% Mn were prepared from electrolytic iron by melting in a magnesia crucible *in vacuo*. The ultimate strength was increased by carbon up to 1% but not uniformly with the carbon content. The presence of manganese in the carbon steels increased the strength. The addition of carbon rapidly and progressively decreased the reduction in area and elongation to a value little above zero when the carbon content was 1%, but the value of the proportional limit was influenced to a less degree. Manganese had only a slight effect on the properties of iron in the absence of carbon, but the effects of manganese and carbon were each influenced by the presence of the other. The first addition of manganese served to deoxidise the metal, forming oxides which separated the grains and tended to decrease the strength.—C. A. K.

Blister copper bars and pigs; Water in ——. A. R. Ledoux. Min. and Met., Oct., 1922, 7—9.

The upper surface of pigs of blister copper is generally very porous, and attention is drawn to the possibility of shipments that have been exposed to rain containing considerable quantities of water which does not dry out after exposure to sun. In some shipments examined, the water content amounted to between 4 and 16 lb. per ton. The moisture content of a shipment is determined by drying a selected number of bars at 300°—600° F. (150°—315° C.), in a small gas- or oil-fired furnace.
—A. R. P.

Copper-nickel ores of the Rustenburg district (South Africa). J. A. Ortlepp. J. Chem. Met. Soc., S. Afr., 1922, 23, 23—31.

Microscopical examination and photomicrographs of polished specimens showed the ore to have been formed by magmatic differentiation, and to be composed of pyrrhotite, pentlandite, chalcopyrite, maucherite, an unidentified mineral, and a pyroxene gangue. Tests on ore containing 3·7% of nickel, 0·48% of copper, 26% of sulphur, and 39% of iron, showed that physical methods of concentration, including magnetic concentration and flotation, are unsuitable, but concentration of nickel in the form of matte is economically possible.—J. B. P.

Lead blast-furnace; Powdered coal in the ——. E. H. Hamilton. Min. and Met., Oct., 1922, 25—27.

The working of a lead blast-furnace fired by means of powdered coal fed through the tuyères has been examined, and tables are given showing the heat distribution and output of metal and matte compared with the ordinary method of working. While the new process of firing slows down the output by about 6%, a greater recovery of metal is effected, together with a slight saving of fuel.—A. R. P.

Metals; Action of nitric acid on ——, *and an example of a periodic reaction. Catalysis. XIV.* B. C. Banerji and N. R. Dhar. Z. anorg. Chem., 1922, **122**, 73—80.

The rate of solution of copper, silver, lead, nickel, brass, mint silver, and of copper-nickel alloy in nitric acid in the presence of various salts was studied. The rate was found by direct weighing of the strip of metal or alloy before and after immersion in the acid. Ferrous salts acted as catalysts in all cases; this is explained by the fact that nitrous acid is formed by the action of nitric acid on ferrous salts, and the solution of metals is accelerated by nitrous acid. Ferric salts also act as catalysts, as a result of reduction to ferrous salts by the action of such metals as copper, silver, etc. Oxidising agents, such as potassium permanganate and chlorate, act as negative catalysts, because they prevent the formation of nitrous acid. The action of nitric acid on a 50% alloy of nickel and copper takes place in reaction periods of diminishing lengths, each followed by a period of no reaction. —W. T.

Metallic bodies formed from powdery material by pressure or sintering and not previously subjected to cold work; Grain growth in ——. F. Sauerwald. Z. anorg. Chem., 1922, **122**, 277—294.

The application of pressure did not increase the size of the grains, but with increasing temperature an increase in the size of the grains was observed in the cases of iron, nickel, cobalt, tungsten, and copper. There was a limit of temperature, which could be determined within 100° C., beyond which further increase in temperature resulted in a rapid increase in the size of the grains. This limiting temperature is independent of the pressure applied in compressing the metal and has a characteristic value for each metal. Increase in the size of grains was not observed in the case of zinc and aluminium. These results are discussed in the light of Tammann's theory of crystallisation (Z. anorg. Chem., 1920, **113**, 163).—W. T.

Gold solidified from the melt; Recrystallisation of pure, mechanically unworked ——. W. Fraenkel. Z. anorg. Chem., 1922, **122**, 295—298.

Pure mechanically unworked gold showed no change in size or form of crystals on heating to 1000°—1045° C. The purity of the metal, however, was not of such a high degree that the possibility of the crystallites being surrounded by thin films of impurity is excluded (*cf.* Tammann, Z. anorg. Chem., 1920, **113**, 163).—W. T.

Silicon; Modifications of ——. *Silicon from copper silicide.* W. Manchot and H. Funk. Z. anorg. Chem., 1922, **122**, 22—26.

Specimens of silicon obtained from a copper silicide regulus were similar to those obtained from aluminium and silver reguli (*cf.* J., 1922, 251 A). Conditions which favour the formation of crystalline silicon gave a form which reacted but slowly with hydrofluoric acid. Crystalline silicon very soluble in this acid could not be obtained.—W. T.

Tungsten; Attempts to decompose —— *at high temperatures.* G. L. Wendt and C. E. Irion. J. Amer. Chem. Soc., 1922, **44**, 1887—1894.

When tungsten wires, 4 cm. long and 0·035 mm. diam., are exploded at a temperature of 20,000° C. by discharging a condenser at 30,000—45,000 volts through them (*cf.* Anderson, Astrophys. J., 1920, **51**, 37—48), either in a vacuum or in an atmosphere of carbon dioxide, the metal is entirely dissipated, no smoke, dust, or residue being found after the explosion. Abundant quantities of gas are produced, and this gives a spectrum showing the yellow helium line and several other unidentified lines but no hydrogen lines. The volume of gas unabsorbable by potassium hydroxide produced from 0·713 mg. of tungsten varied between 3·62 and 0·30 c.c. Had the tungsten been converted entirely into helium the volume of gas would have been 4·0 c.c.—J. F. S.

Hardness of solid substances. Reis and Zimmermann. *See* I.

Patents.

Puddling [iron; Furnace for and] art of ——. H. D. Hibbard. E.P. 179,888, 26.9.21. Conv., 11.5.21.

A puddling furnace consists of a cylindrical reaction vessel, lined with neutral or basic bricks, mounted on hollow trunnions, and provided with an interior longitudinal dam, a movable block, having a passage through which fuel is charged to the furnace, near to one trunnion, and a smoke stack near the other. The furnace is coupled to a reversible motor for imparting an oscillatory movement by devices that allow of exact control. The furnace is charged with pig iron and an oxidising agent, *e.g.*, ferric oxide, and the molten charge is vigorously oscillated so that it flows back and forth over the dam, thereby ensuring efficient mixing. When the iron has balled together, the first slag is tapped and a second charge of oxidising agent together with fluxes, *e.g.*, silica or fluorspar, is introduced. After tapping the second slag the ball is worked into a symmetrical form by disengaging the reversing gear of the motor and operating control levers in such a way that the ball is rolled between the dam and the discharging door.—A. R. P.

Iron deposits; Process for the production of electrolytic ——. M. Schlötter. G.P. 305,156, 4.8.17.

By using ferrous perchlorate instead of ferrous chloride as electrolyte, a deposit of iron is obtained which, even under strong magnification, shows no crystalline structure, and is therefore suitable for galvano-plastic reproductions.—A. R. P.

Steel; Method of manufacturing ——. J. C. Beneker, Assr. to F. F. McIntosh and W. B. Skinkle. U.S.P. 1,431,621, 10.10.22. Appl., 1.3.21.

Steel containing not more than 0·35% C and not less than 1% Mn is prepared by adding to a bath of molten steel covered with a slag high in manganese oxide, sufficient of a silico-manganese alloy to reduce the desired quantity of manganese from the slag while, at the same time, oxidising and slagging the silicon.—A. R. P.

Metals [e.g., iron]; Production of glossy metallic coatings [e.g., of zinc] on ——. A. Classen. E.P. 186,459, 14.7.21.

Glossy metallic coatings, which do not require polishing, may be electrolytically deposited on metals from plating baths containing organic or inorganic colloids or substances producing them, together with hydrogen peroxide or its derivatives, such as per-acids, per-salts, or organic substitution products, capable of preventing the generation of hydrogen from the cathode, and not powerful enough to decompose the colloids. Thus, a bath for galvanising iron consists of 10 kg. of zinc sulphate, 2·5 kg. of ammonium sulphate, 120 c.c. of sulphuric acid, 100—120 g. of alum, starch, albumin, or gelatin, and 120 g. of potassium persulphate per 100 l., and is operated at a current density of 5 amps. per sq. dm. at 3 volts. Deposits from this bath are characterised by a high density, brilliant istre, and great durability.—A. R. P.

opper alloys; Treatment of ——. Isabellen-Hütte Ges.m.b.H. E.P. 161,537, 9.4.21. Conv., 10.4.20.

HE mechanical properties of copper alloys containng manganese, aluminium, zinc, tin, or silicon ay be improved by annealing the alloy below red eat. The hardness and elastic limit of most copper lloys are increased by this treatment. In certain ases the alloys are heated to a temperature above 50° C., depending on the particular composition, ooled, and reheated. The presence of other metals n the alloy affects only the temperature of treatnent.—C. A. K.

opper; Process of and apparatus for precipitating —— from solutions. F. S. Adams. U.S.P. 1,430,140, 26.9.22. Appl., 20.7.20.

Sulphur dioxide is passed repeatedly through the solution to precipitate the copper.—C. A. K.

Magnesium foil; Method of manufacturing ——. W. Boehm. E.P. 186,253, 19.9.21.

The metal is heated to a temperature just below its melting point previous to rolling.—A. R. P.

Platinum and similar metals; Extraction of —— from their sands and ores. R. Thayer. U.S.P. 1,429,378, 19.9.22. Appl., 23.1.20.

Superheated steam is passed through a mass of finely-divided ore maintained at a temperature below the melting point of the constituent metals, which are recovered from the collected fume.
—C. A. K.

Alloy for repair purposes. P. O. Melton. U.S.P. 1,429,959, 26.9.22. Appl., 6.9.21.

An alloy for repair work contains Zn 11 oz., Pb 1¼ lb., Sn 1¾ lb., and Cu 1 oz.—C. A. K.

Zinc; Extraction of —— [from materials containing lead and zinc]. W. G. Waring, Assr. to G. Battelle. U.S.P. 1,430,269, 26.9.22. Appl., 17.8.21.

The process of separating zinc from materials containing lead and zinc by extraction with a hot solution of ammonium sulphate, with subsequent crystallisation of zinc sulphate, is supplemented by treating the separated zinc salt with ammonium carbonate, whereby zinc carbonate and ammonium sulphate are formed.—C. A. K.

Chloridising process and apparatus. F. S. Low, Assr. to Niagara Alkali Co. U.S.P. 1,430,454, 26.9.22. Appl., 27.12.20.

Hydrogen and chlorine are burned together in proximity to the heated material to be chloridised.
—C. A. K.

Precious metals; Cyanide process for treating ores of ——. D. L. H. Forbes. U.S.P. 1,430,635, 3.10.22. Appl., 3.4.22.

Small quantities of dry sodium peroxide are injected below the surface of a mixture of comminuted ore and cyanide solution.—A. R. M.

Vanadium; Process of recovering ——. K. B. Thews, Assr. to Colorado Vanadium Corp. U.S.P. 1,430,864, 3.10.22. Appl., 29.10.20.

Vanadium is precipitated as calcium vanadate by the addition of a soluble calcium salt to an acid solution of soluble vanadates contaminated with iron or aluminium compounds.—A. R. P.

Ores; Electric furnace for treating ——. A. Counas. U.S.P. 1,430,948, 3.10.22. Appl., 21.8.20.

An electric furnace for treating ores consists of a rectangular chamber provided with a central hopper and a series of inclined electrodes on either side thereof, together with a return electrode forming part of the hearth of the furnace and arranged directly below the hopper.—A. R. P.

Ores; Method and means for reducing —— in electric blast furnaces. E. Fornander. U.S.P. 1,430,971, 3.10.22. Appl., 14.4.22.

The furnace consists of a reducing shaft opening out at the bottom into a melting chamber with a conical hearth. The ore and fluxes are charged into the shaft and gradually descend into the chamber, where a supply of reducing material is introduced in such a way that it forms a covering layer on the sloping walls of the chamber and leaves a free space between itself and the roof. A portion of the gases evolved from the reduction is removed from the shaft and pumped back through the reducing layer into the heart of the charge, which is maintained at a suitable temperature by means of an arc.—A. R. P.

Tungsten ores; Method of treating tin-bearing ——. F. M. Becket, Assr. to Electro Metallurgical Co. U.S.P. 1,431,559, 10.10.22. Appl., 26.5.20.

Tin-bearing wolframite ores are ground and roasted, and treated with an alkaline solvent to extract the tungsten as alkali tungstate.—A. R. P.

Alloy. J. O. Whiteley, Assr. to The Dentists' Supply Co. U.S.P. 1,431,713, 10.10.22. Appl., 29.6.20.

A gold-platinum alloy containing 20—35% Au is claimed.—A. R. P.

Metals; Process for the separation and purification of —— by treatment with gases. L. Schertel and H. Arnold. G.P. 357,448, 31.5.19.

The molten metal mixture is treated with gases or vapours that form salt-like compounds with one of the metals, the quantity of gas or vapour used being in stoichiometric relation to the amount of that metal present. The charge is kept at a sufficiently high temperature to melt the salt formed, which then acts as a protective coating to the metal from the excess of gas. In this way a very complete purification is effected without serious loss of metal.
—A. R. P.

Ferrochromium alloys; Manufacture of ——. W. B. Ballantine. U.S.P. 1,430,878, 3.10.22. Appl., 2.2.22.

See E.P. 179,992 of 1921; J., 1922, 554 A.

Copper; Process for obtaining the —— from lyes resulting from the treatment of cupriferous pyrites. H. P. Soulie-Cottineau. U.S.P. 1,431,130, 3.10.22. Appl., 5.4.20.

See E.P. 141,290 of 1919; J., 1920, 414 A.

Metals; Coating of —— with metals of a lower fusing point. H. G. Grinlinton. U.S.P. 1,431,395, 10.10.22. Appl., 14.6.20.

See E.P. 146,830 of 1920; J., 1921, 776 A.

Ores or the like; Smelting ——. L. H. Diehl. U.S.P. 1,431,877, 10.10.22. Appl., 6.8.20.

See E.P. 170,100 of 1920; J., 1921, 854 A.

Steel ingots and method of and apparatus for producing [casting] same. Valley Mould and Iron Corp., Assees. of J. E. Perry. E.P. 171,352, 18.3.21. Conv., 11.11.20.

Melting pot. U.S.P. 1,423,501. *See* I.

Tungsten. E.P. 186,497. *See* IIB.

Annealing. E.P. 186,160. *See* VIII.

XI.—ELECTRO-CHEMISTRY.

PATENTS.

Electric gas-generator. R. Rosner. U.S.P. 1,390,646, 13.9.21. Appl., 28.1.21.

THE patent relates principally to means for regulating the admission of air to the apparatus described in U.S.P. 1,374,237 (J., 1922, 380 A).

Promoting chemical reactions between gases; Method of and apparatus for ——. S. Ruben. U.S.P. 1,431,047, 3.10.22. Appl., 16.4.20.

A HIGH-FREQUENCY current is passed through a conducting liquid in which the reacting gases are brought into contact with one another.—J. S. G. T.

[Electric induction] furnace linings; Method of preparing ——. M. Unger, Assr. to General Electric Co. U.S.P. 1,429,909, 19.9.22. Appl., 13.10.20.

AN induction furnace is started by placing in the heating space a number of closed conductors, melting respectively at different temperatures. A heating current is then induced therein of sufficient power to melt the conductors successively.
—T. A. S.

Electric furnace. E. A. Hauff, Assr. to Pittsburgh Engineering Works. U.S.P. 1,430,987, 3.10.22. Appl., 27.3.20.

THE electrically-conducting bottom of an electric furnace is connected with one end of the secondary winding of a transformer. A switch is arranged to connect selectively any one of a number of tappings on the secondary winding with an arcing electrode in circuit with an adjustable reactance.
—J. S. G. T.

Electric furnace. I. Rennerfelt. U.S.P. 1,431,424, 10.10.22. Appl., 10.8.21.

AN electrode projects downwards from the furnace roof so that its end is close to a mass of carbonaceous powder placed upon a central hearth, which is surrounded by a rotary annular hearth.—J. S. G. T.

Electric resistance heater. H. G. Lemoine. U.S.P. 1,431,825, 10.10.22. Appl., 18.7.21.

A METAL of the tungsten group is embedded in a refractory mass consisting of a mixture of an oxide of the zirconium group and magnesia.—J. S. G. T.

Dry cells; Manufacture of ——. H. de Olaneta, Assr. to Winchester Repeating Arms Co. U.S.P. 1,430,726, 3.10.22. Appl., 24.2.20.

RECOVERED manganese dioxide employed as the depolariser in a primary cell is leached with a neutral solution of the electrolyte used in the cell, prior to assembling the cell.—J. S. G. T.

Electrolytic cell. E. A. Le Sueur. U.S.P. 1,431,014, 3.10.22. Appl., 23.10.20.

THE bottom of an electrolytic cell, serving as cathode, is provided with one or more conducting projections which may take the form of annuli surrounding the anode.—B. M. V.

Agitating apparatus for tanks [for electrolytic cells]. T. H. Mumford, jun. U.S.P. 1,431,022, 3.10.22. Appl., 2.3.21.

THE electrolyte is delivered under pressure through openings or jets in pipes which can be reciprocated within the tank or cell.—B. M. V.

Electrolytic apparatus. H. Y. Eagle. U.S.P. 1,431,574, 10.10.22. Appl., 12.11.20.

ELECTROLYTE flows continuously through a tank in which a number of groups of electrodes, each comprising anodes and cathodes, is arranged, each group of anodes receiving current from a different conductor.—J. S. G. T.

Electrolysis; Art of ——. C. G. Spencer. U.S.P. 1,431,602, 10.10.22. Appl., 15.1.21.

THE intake of a gas washer is connected with an electrolyser, and porous mineral matter is interposed between the intake and outlet of the washer.
—J. S. G. T.

Induction [electric] furnace. W. Rohn. U.S.P 1,431,686, 10.10.22. Appl., 21.12.20.

SEE E.P. 163,276 of 1920; J., 1922, 179 A.

Utilising surplus electric power for preparing pea fuel. E.P. 186,137. *See* IIA.

Electrical dehydration of emulsions. U.S.P 1,430,245–6, 1,430,294–6, and 1,430,301–2. *Se* IIA.

Metallised paper. E.P. 186,363. *See* V.

XII.—FATS; OILS; WAXES.

Oils and fats from the seeds of Indian forest tree M. G. Rau and J. L. Simonsen. Indian Fore Records, 1922, **9**. Part III. 15 pages.

THE seeds of *Chloroxylon Swietenia* yield 16% of non-drying oil consisting of glycerides of steari palmitic, myristic, oleic, and linolenic acids. The seeds of *Calophyllum Wightianum* yield 34% of an oil closely resembling that obtained from the seeds of *C. inophyllum*, and containing about 10% of resin, and glycerides of stearic, palmitic, oleic, and linolic acids. The seeds of *Mimusops Elengi* yielded 16% of oil consisting of glycerides of stearic, palmitic, and oleic acids, and of an unidentified saturated acid which was possibly behenic acid. The seeds of *Shorea robusta* yield 16·4% of a fat resembling Borneo tallow and consisting of glycerides of stearic and oleic acids. *Garcinia Cambogia* seeds yield 31% of a fat resembling the fats from the other species of *Garcinia*, which should prove an excellent edible fat. It consists of glycerides of stearic and oleic acids.—H. C. R.

Liver oil; Sulphuric acid reaction for ——. H. D. Richmond and E. H. England. Analyst, 1922, **47**, 431.

CONSTANT results were obtained in testing cod liver oil by the dilution method (Drummond and Watson, J., 1922, 718 A) by adding 1 c.c. of the cod liver oil to 10 c.c. of liquid paraffin B.P., mixing, and transferring 10 drops of this to a white porcelain basin, adding 1 drop of sulphuric acid (B.P.) and stirring with a glass rod. If a transient purplish colour developed, liquid paraffin was added in successive quantities of 5 c.c. until no purple colour was given, and the dilution at which a faint transient purple colour was seen was recorded. If no purple was seen, successive additions of 1 c.c., 1 c.c., 2 c.c., and 5 c.c. of cod liver oil were made. The authors were unable to obtain good results when instead of liquid paraffin petroleum spirit was used, as recommended by Drummond and Watson.—H. C. R.

Copper; Action of —— in promoting the activity of nickel catalyst [*in hydrogenation of oils*]. E. F. Armstrong and T. P. Hilditch. Proc. Roy. Soc., 1922, A 102, 27—32.

A copper-nickel catalyst may be produced in hydrogen when mixed compounds of copper and nickel distributed on suitable carriers are heated to 180° C., whereas nickel compounds alone under such conditions are not reduced by hydrogen below 300° C. and not rapidly below 350°—400° C. For the reduction of nickel at this low temperature an intimate mixture of the copper and nickel compounds must be used, which must be more intimate than can be obtained by mechanical mixing. Coprecipitation is not always sufficient to obtain the desired degree of intimacy, for a comparison of the activity of the catalysts with the nature of the nickel cupric carbonates from which they are produced shows that both the nickel and the copper must be in the same complex molecule to obtain any marked degree of catalytic activity. It is suggested hat the necessary local heat to provide a sufficiently high temperature for the reduction of the nickel is urnished by the reduction of the copper, provided he latter is in sufficiently close proximity to the nickel.—J. F. S.

Japanese tung oil. Gardner and Reilly. *See* XIII.

Drying of fatty oils. Slansky. *See* XIII.

Butter. Fascetti. *See* XIXa.

Patents.

Coconut butter; Process for the extraction of ——. E. E. R. Gaudart. U.S.P. 1,431,519, 10.10.22. Appl., 10.9.18.

See E.P. 117,819 of 1918; J., 1919, 155 a.

Soap; Apparatus for moulding ——. American Cotton Oil Co., Assees. of C. O. Phillips. E.P. 164,341, 6.6.21. Conv., 5.6.20.

Increasing the consistency of oils. E.P. 185,782. *See* IIa.

Antiseptic soap. E.P. 186,078. *See* XIXb.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Reflection factors of industrial paints and pigments. H. A. Gardner. Circ. 133, U.S. Paint Manufacturers' Assoc., Sept., 1921. 8 pp. (*Cf.* J., 1916, 263.)

The previously recorded figure of 0·88 for the reflecting power of the magnesium carbonate adopted as a standard has been found to be low, recent measurement having given a value of 0·98. Examination of some panels of tinted and shaded flat wall lithopone paints after storage for five years in the dark showed no falling off in reflecting power in the case of light green, yellow, and terra-cotta tints, and an increase in the case of light buff; light cream, light pink, and light blue had suffered 6% loss, but dark blue and dark green had lost 30% of their original values. Very little loss also was recorded on certain industrial white paints, any loss being attributed to the well-known yellowing which develops on storage in the dark. Light and medium grey paints showed an increase in reflecting value attributed to slight fading of the tints. Among modern industrial white paints examined in May, 1921, one specimen showed a reflecting value of 82%, calculated on the corrected basis, thus showing a marked improvement on commercial paints of earlier manufacture. A laboratory method of obtaining comparative reflecting powers consists in applying two coats of constant weight of flat paint of uniform composition to white bond paper, the medium used being an ethyl acetate solution of nitrocellulose plasticised with castor oil. When such paints are applied to glass plates in place of paper and the coatings are viewed on black and white backgrounds respectively, figures are obtained showing both reflecting values and relative opacities. The coefficient of reflection modified by the relative opacity is obtained by applying flat oil paints to iron panels previously coated with a flat black having a very low reflecting power. Such examination shows transparent pigments to possess very low coefficients of reflection. Very small differences in reflecting power between various pigments are shown when the dry compressed powders are examined. When various commercial pigments are examined for brightness by the Pfund colorimeter, zinc oxide heads the scale with a relative brightness of 92·5 as compared with two grades of white lead having values of 80·7 and 60·5 respectively.—A. de W.

Fire-resisting paints and varnishes. H. A. Gardner. Circ. 121, U.S. Paint Manufacturers' Assoc., April, 1921. 2 pp.

The use of ammonium phosphate in large proportion as a constituent of fire-resisting paints for exterior work is not recommended on account of its solubility in water. Addition of 5% of ammonium phosphate to varnishes, although productive of a somewhat sandy film, is suggested in view of the transparency of this material in varnish. Zinc borate, which fuses to a glass-like sealing film under the action of heat, is likely to prove of use as a constituent of fire-resisting paint. —A. de W.

Paint and varnish; Physical testing of ——. H. A. Gardner. Circ. 122, U.S. Paint Manufacturers' Assoc., April, 1922. 13 pp.

The behaviour of varnish and paint films on bending and exposure to the weather may be conveniently determined by applying the coating under test to a sheet of high-grade bond paper previously rendered impermeable, if necessary, by coating with paraffin or parchmentising. Other tests include the determination of the bursting strain, tensile strength, resistance to bending, elongation, etc., before and after exposure, the figure for the uncoated paper being also determined. The hiding power of liquid paints is most conveniently determined by the Pfund cryptometer (J., 1920, 34 a), but the author has devised a simpler form of the apparatus in which the critical thickness of complete obscuration is read on a broad longitudinal band etched on the upper surface of the base plate. Rough comparisons of hiding power of liquid or dry paint films can be made by applying these over a sheet of bond paper on which are printed squares of black, dark grey, light grey, etc., and comparing with a standard. The behaviour of varnishes under different conditions of application on ageing can be observed by coating on paper sheets printed with square blocks of red, yellow, etc., exposures being made in the open or in the rays of a mercury arc lamp.—A. de W.

Pfund paint gauge; Discussion of the ——. H. A. Gardner and P. C. Holdt. Circ. 132, U.S. Paint Manufacturers' Assoc., Aug., 1921. 4 pp.

The spreading rate of paints as determined from the figure obtained for the thickness of wet paint films measured by the Pfund paint gauge (J., 1921, 356 a) agreed to within 3·5% with that obtained by weighing the paint coating in a test when finely-ground paint was applied to a smooth surface (glass). In spreading tests (both hand brushing and spraying) on clean black iron and on dressed timber that had been primed, and measurements by the Pfund instrument, although fairly close agreement was obtained in the repeat determinations of thickness by the gauge, the agreement between the spreading rate thus determined and that determined by weighing the paint leaves the value of the instrument as a check on actual practice open to considerable criticism.—A. de W.

White and tinted paints; Storage conditions in —— with reference to soap formation. H. A. Gardner. Circ. 143, U.S. Paint Manufacturers' Assoc., Jan., 1922. 19 pp.

The formation of granular or flaky soap in lead-zinc paints which have been stored for 3—5 years manifests itself as the separation of a soft, granular, or sometimes firm, shell-like mass at the junction of settled pigment and medium, or sometimes distributed throughout the settled pigment or adhering to the sides of the can. The soap usually contains 88% of organic matter, the metal consisting of about 85% of zinc and 15% of lead. The effect upon the paint is to give a gritty appearance to the coating after application. The formation of such soaps appears to be entirely due to interaction between basic lead or zinc pigments and an acid constituent of the medium, zinc pigments being more fruitful in forming separated soaps owing to their lesser solubility. Whilst raw linseed oil with an acid value not exceeding 5 does not promote any marked soap formation, the hydrolysing effect of "foots," causing as it does development of free fatty acid, stimulates the reaction, as also does water containing an ionisable salt or emulsifying liquid. Acid refined linseed oil (acid value 8—10), and media containing small amounts of rosin are very productive of the formation of soap granules with basic pigments, but high percentages of free fatty acids or large proportions of rosin, although liable to "liver" basic pigments, exert such a powerful solvent action on heavy metal soaps that precipitation does not take place. Similarly, while petroleum spirit as a thinner favours the separation of granular soap on account of its poor solvent power, pine oil and coal tar solvents prevent precipitation. Paints showing soap formation may sometimes be made satisfactory by straining out the separated soap or re-grinding. Tables are appended showing the results of examination of stored paints for soap formation together with their composition.
—A. de W.

Paint and varnish films; Speed of evaporation of thinners from ——. H. A. Gardner, P. C. Holdt, and E. Bielouss. Circ. 141, U.S. Paint Manufacturers' Assoc., Dec., 1921. 16 pp.

From a series of experiments in which two types of varnish ("short" and "long") and both gloss and flat paints were thinned with different varieties of volatile solvents, *e.g.*, turpentine, mineral hydrocarbons of varying boiling-points, coal-tar naphtha, etc., and films therefrom weighed every 15 mins., it is shown that the rate of evaporation is inversely proportional to boiling-point and independent of the type of hydrocarbon. The hygrometric state of the surrounding atmosphere has no influence on the rate of evaporation from either paint or varnish films, excepting in the extreme case of a possible deposition of dew on the film. The highest viscosity of the finished product is obtained by the use of turpentine, petroleum hydrocarbons giving the lowest values, roughly proportional to their boiling-points. This is attributed to turpentine and solvent naphtha merely acting as diluents without effecting any changes in dispersity of the varnish medium, whilst petroleum hydrocarbons produce an alteration in structure by causing coalescence.—A. de W.

Japanese tung oil. H. A. Gardner and A. Reilly. Circ. 138, U.S. Paint Manufacturers' Assoc., Nov., 1921. 7 pp.

The seed of the Japanese tung tree (*Aleurites cordata*) is smaller than that of the Chinese variety (*A. fordii*) and is claimed in Japan to yield an oil which does not gelatinise on heating. The seed when shelled yielded 63% of pulp, from which 51% of a light golden yellow oil was obtained by extraction, the residue being a dry white powder of high nitrogen content. The oil had the following characters: iodine value (Wijs) 150·2, (Hübl) 154·4; saponif. value 193·2; acid value 0·9; sp. gr. at 15·5°/15·5° C., 0·9342; n_D^{25}=1·4981. Under the A.S.T.M. standardised heat test for tung oil, the oil yielded a viscous liquid in one hour. The viscosity was intermediate between that of Chinese tung oil and raw linseed oil. On exposure to the air, the oil yielded an opaque soft film in 43 hrs., whilst with 10% of lead-manganese drier, it dried in 10 hrs. Oils which had been blown at 150° C. and at 200° C. for 5 hrs., and then thinned with an equal volume of mineral spirit, dried in 34 and 81 hrs. respectively, an opaque film being formed in each case. On heating the oil for one hr. to 315·5° C., the colour of the oil became pale yellow, the acid value 0·8, the sp. gr. 0·964, and the viscosity 78 poises (original oil 1·25 poises), whilst drying took 80 hrs. On heating another sample to the same temperature for 20 mins. and thereafter maintaining at 250° C. for a further 2 hrs., the colour was observed to darken after one hour, whilst after 2 hours the oil was slightly darker than the original oil, had a viscosity exceeding 78 poises, acid value 0·6, and sp. gr. 0·975. Without a drier the oil dried to a clear film in 43 hrs., whilst with the addition of 10% of lead-manganese drier it dried hard and clear in 10 hrs. This latter heat treatment is interesting in that it was the only one of the series yielding an oil which gave a clear film without driers and that the time of drying compared favourably with that of heavy bodied linseed oil (58 hrs.).—A. de W.

Fatty oils; Drying of ——. P. Slansky. Z. angew. Chem., 1922, 35, 389—391.

The drying of linseed oil is due to oxidation and gelatinisation (*cf.* J., 1921, 817 A), the latter being accelerated by increase of temperature. Linseed oil fatty acids absorb oxygen more rapidly than does linseed oil itself, and the rate of oxidation of the oil is increased by the addition of linolic or linolenic acid; gelatinisation, which is caused by coagulation of the oxidised glycerides, is increased by the addition of oleic acid to the oil. Linoxyn, the solid substance produced by the drying of linseed oil, is capable of absorbing 15% of its weight of water.
—W. P. S.

Dekalin; Properties and composition of ——. J. B. Coleman and P. Bilham. Chem. Age, 1922, 7, 554—555.

An investigation of the physical and chemical properties of dekalin was undertaken in order to determine its suitability as a turpentine substitute. Dekalin has the following physical characters:—sp. gr. at 20° C. 0·8947, n_D^{20}=1·4815, flash point 51·6° C., viscosity at 40° C. (100η)=0·675, b.p. 180°—197° C., relative rate of evaporation compared with American turpentine 1:2·89, percentage residue on evaporation 0·001935, compared with 0·1516 for turpentine. Chemically dekalin consists primarily of a mixture of tetrahydronaphthalene 20%, and decahydronaphthalene 80%. On treatment with fuming sulphuric acid the tetrahydronaphthalene is absorbed, and the residual oil is almost pure decahydro-compound. On oxidation of dekalin with permanganate the deca-compound was unattacked and the presence of the tetrahydro-compound was proved by the formation and isolation of *o*-carboxyhydrocinnamic acid. The presence of the tetrahydro-compound accounts for the oxygen-carrying properties of dekalin, which may be demonstrated by shaking a dekalin-water emulsion with an acidified solution of potassium iodide, iodine being immediately liberated. The high flash point of dekalin as compared with turpentine enables higher temperatures to be employed in varnish making; the viscosity indicates a superior thinning power. The high boiling point prohibits its use for quick-drying varnishes, but for paints and slow-drying varnishes it is no disadvantage, as the drying action continues all the time the dekalin is evaporating owing to its oxygen-carrying properties.—G. F. M.

Varnish; Measurement of the consistency of ——. H. A. Gardner and P. C. Holdt. Circ. 127, U.S. Paint Manufacturers' Assoc., June, 1921. 51 pp.

A general introduction to the principles underlying viscometry is given, and the development of the measurement of plasticity of plastic solids as investigated by Bingham and his co-workers (J., 1920, 292 B, 495 A) is described. The various types of viscometers, *i.e.*, air-bubble, falling sphere, torsional, and efflux, are described, and the accuracy of the results therefrom is discussed. A very full resumé of the subject matter of Bingham's papers on the use of the plastometer is given and its applicability to the study of possible plasticity in varnishes is considered. An investigation undertaken to show a possible connexion between viscosity and durability of varnishes gave a negative result. The authors conclude that the plastometer and the MacMichael and Doolittle torsional viscometers are the only reliable instruments for determining viscosities of varnishes, the first-mentioned instrument possessing the advantage of higher accuracy and greater ease in furnishing absolute results.—A. de W.

Varnish; Standardised apparatus for determining the consistency of —— by the air-bubble test. H. A. Gardner and P. C. Holdt. Circ. 128, U.S. Paint Manufacturers' Assoc., June, 1921. 7 pp.

Twenty tubes (110 mm. long by 13·3±0·05 mm. diam.) are filled with various mixtures of mineral oils free from fatty oils giving a range of absolute viscosities from 0·50 to 5·50 poises at 25° C., care being taken that an air bubble of uniform size is left in each tube. The closed tubes are mounted in a case and serve as standards to give a fairly rough but rapid determination of viscosity of any varnish which is similarly filled into a tube of the same dimensions as the standard tubes.—A. de W.

Bordeaux turpentine. Dupont. *See* XX.

Patents.

White lead; Manufacture of ——. A. E. White. From National Lead Co. E.P. 186,114, 14.6.21.

An apparatus for the continuous manufacture of white lead from granular metallic lead comprises a rotary horizontal chamber, about 96 ft. long and 6 ft. in diam., constructed of heat-insulating material, *e.g.*, wooden staves lined with stout paper and faced internally with match-boards. The chamber is fitted at one end with an inlet pipe and hopper for granular lead and an inlet for a gaseous reagent, and at the other end with an extension of reduced diameter, to which the corroded lead is transferred by means of vanes. This extension is provided with a reticulate or lattice-work end portion to prevent the discharge of lumps therefrom. A conveyor is provided under the extension, the latter being housed in an enclosure connected to devices for maintaining a reduced pressure within the chamber. The granular lead is fed into the chamber at a rate controlled by the rotation of the latter, and the inlet pipe for the metallic lead is so constructed that its surface temperature is maintained above the dew point of the gases in the chamber in order to avoid collection of masses of wet metallic lead. The corroding mass in its passage through the chamber is maintained at a moisture content between 2% and 5% by spraying with regulated quantities of a liquid reagent (acetic acid and water) at intervals along the chamber by non-axial nozzles projecting inwards from the chamber wall to a degree exceeding the depth of the tumbling mass of material and so arranged that the lead is sprayed without wetting the chamber wall; the spraying nozzles are automatically supplied by the rotation of the chamber and their surface temperature is maintained above the dew point of the gases in the chamber.—A. de W.

Magnesium oxychloride cements; [Paint for use in] laying of —— on metallic surfaces. J. Davies and W. H. Miles. E.P. 186,231, 24.8.21.

A paint for coating metallic surfaces before the application of magnesium oxychloride cement is prepared by mixing equal parts of powdered fluorspar, whiting, and china clay, with 1·8 times (by weight) of a solution of sodium silicate of 33° B. (sp. gr. 1·296). A hard coating is formed which is quick-drying and not liable to crack.—J. B. P.

Resins; Production of artificial ——. R. Pummerer. E.P. 165,408, 22.6.21. Conv., 25.6.20.

By moderated oxidation of phenol or its homologues with alkaline potassium ferricyanide solution, with glacial acetic acid and lead dioxide, or with ferric chloride, substances of higher molecular weight are obtained exhibiting the properties of artificial resins. Treatment with alkalis or acids, or heating causes polymerisation of these primary products and makes them partially soluble in alkalis. The colour of the products can be improved by reduction and also by acylation. Acylation or alkylation also renders them insoluble in alkali.—D. F. T.

Resins; Manufacture of ——. O. Y. Imray. From Soc. of Chem. Ind. in Basle. E.P. 186,107, 9.6.21.

An aromatic hydroxy-compound, such as phenol, resorcinol, cresol, or naphthol, is heated with sulphur in the presence of a basic substance in a proportion of not more than one-fifth of that necessary for the neutralisation of the hydroxy-compound. The end of the reaction is indicated by the cessation of evolution of hydrogen sulphide. A suitable proportion of sulphur is 2—3 atoms per molecule of phenolic compound. As catalyst a halogen, *e.g.*, iodine, may be employed. The addition of a small proportion of formaldehyde or of some compound yielding this substance is advantageous. The products are light-coloured resinous substances, obtainable in a fusible and soluble condition but convertible, by heat under pressure, into a hard infusible condition.—D. F. T.

Coating compositions; Manufacture of ——. *Manufacture of plastic material for flooring and other purposes.* Imperial Trust for the Encouragement of Scientific and Industrial Research, and S. B. Schryver. E.P. (A) 186,156 and (B) 186,157, 21.6.21.

(A) The proteins separated from castor beans or other oil seeds (*cf.* E.P. 140,911; J., 1920, 419 A) when mixed with alkalis or alkali carbonates, or with combinations generating these, together with slaked lime or magnesia, yield cement-forming materials. These on admixture with alkali-resistant pigments form powders which on treatment with water become successively gelatinous and semifluid. In the latter condition the products can be applied as distemper. (B) The isolated proteins or the whole residues of the oleaginous seeds are mixed with an alkali and alkaline earth as in (A), but filling material is then introduced, *e.g.*, powdered slate, sawdust, or asbestos powder. Plastic products are obtained from this dry material by mixing with water to a paste and allowing to dry slowly or by moistening with water and subjecting to pressure. —D. F. T.

Paint composition. Mineral oil [composition]. W. N. Blakeman. U.S.P. (A) 1,430,881, and (B) 1,430,882, 3.10.22. Appl., 16.4.21.

(A) A PAINT composition comprises tung oil, a non-drying fatty oil, a mineral oil of the Pennsylvania type, hydrogenated and oxidised, and a pigment. (B) An oil vehicle comprises tung oil, a non-drying oil, and a hydrogenated and oxidised mineral oil of the Pennsylvania type.—L. A. C.

Pigment oil composition; Method of preparing ——. Method of preparing varnishes. [Colour] lake and method of preparing same. G. W. Acheson, Assr. to Acheson Corp. U.S.P. (A) 1,431,079, (B) 1,431,080, and (C) 1,431,081, 3.10.22. Appl., 7.8.22.

(A) AN emulsion of an oil and dilute ammonia solution containing a deflocculated pigment in suspension is treated with an electrolyte to precipitate the oil and pigment together as a curd, which is separated from the aqueous liquor and dried. (B) Varnish stock containing pigment material is prepared by precipitating simultaneously resinous, oily, and pigment components by the addition of an electrolyte to a mixture containing a colloidal suspension of a resin, an emulsified oil, and a deflocculated pigment, and separating the precipitate from excess water. (C) A lake comprising reflocculated clay particles carrying an adsorbed dyestuff is prepared by deflocculating clay material, separating the finer particles, and subsequently reflocculating the material in the presence of a dyestuff.—L. A. C.

Green chromium oxide. U.S.P. 1,429,912. *See* VII.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Lampblack in rubber mixings. E. Marckwald and F. Frank. Gummi-Zeit., 1922, 36, 1459—1462, 37, 5—8.

A COMPARISON of several grades of German lampblack with a sample of gas black from America, showed that the latter gave vulcanised mixings with higher breaking strength and elongation, but that the former yielded products with a higher degree of elasticity or resilience. A mixture of rubber (55), lampblack or gas black (25), sulphur (5), litharge (5), and zinc oxide (10) was found particularly useful for revealing the differences; comparative experiments with this type of mixture also demonstrated the greater resistance to tearing and lower resistance to destruction by repeated application of a load, imparted by gas black. Microscopical examination of the samples of lampblack and gas black revealed their very fine state of division but did not supply any satisfactory explanation of the difference in their specific characteristics when embodied in vulcanised rubber.—D. F. T.

PATENTS.

Hydrocarbon [vulcanisable] product and process of making same. H. H. Culmer. U.S.P. 1,430,538, 3.10.22. Appl., 1.3.17.

OLEFINE hydrocarbons are treated with ozone at a temperature below that at which the hydrocarbons distil, until a solid or semi-solid, elastic product capable of vulcanisation is obtained.—L. A. C.

Binding and waterproofing material; Plastic —— and process of making the same. H. E. Brown and J. H. Stover, Assrs. to Sona Corp. U.S.P. 1,431,455, 10.10.22. Appl., 24.6.21.

A BINDING and waterproofing material comprises a natural vulcanisable gum combined with sufficient cellulose xanthate to furnish the necessary sulphur to secure the desired degree of vulcanisation in the finished product, and inorganic or organic filling material.—L. A. C.

Rubber articles; Process for the manufacture of —— [by moulding rubber gel]. F. C. Jones. E.P. 186,691, 1.7.21, 17.8.21, and 7.11.21.

XV.—LEATHER; BONE; HORN; GLUE.

Tannins and similar compounds. X. Tannin of the German oak. K. Freudenberg and E. Vollbrecht. Ber., 1922, 55, 2420—2423.

THE tannin of the oak, isolated from the fresh leaves by means of the lead salt, is purified from free ellagic acid and admixed quercetin glucosides by vacuum extraction with ethyl acetate; it is accompanied by its own condensation products from which it is freed by fractional precipitation from its alcoholic solution with ether. It is an amorphous, reddish-yellow, acidic material, $[\alpha]_D$ about −35°, freely soluble in water, alcohol, and acetone. It contains 23—25% of combined ellagic acid and 5% of combined dextrose; the remainder of the molecule in an amorphous acid, designated quercussic acid. Hydrolysis of the tannin by acids and alkalis indicates that it is a glucoside of quercussic acid which is esterified to a depside with ellagic acid. Hydrolysis in acid or alkaline solution is accompanied by considerable destruction of quercussic acid, but the latter can be liberated slowly but uniformly from the tannin by means of tannase. It resembles the original material closely in its physical properties but is optically inactive and not hydrolysed by acid or alkali. It appears to be a dibasic acid of molecular weight about 800. The preparation of the acid is rendered comparatively easy by the observations that under definite conditions *Aspergillus niger* grows on the tannin solutions and thereby completes the degradation without destroying the quercussic acid and that the galls of *Quercus pedunculata* contain the same tannin as the leaves. Fusion of the acid with potassium hydroxide has not led to the isolation of definite products. Phloroglucinol is not formed; its isolation by earlier workers from oak tannin is probably attributable to the presence of quercetin.—H. W.

Tannins and similar substances. XI. Chinese tannin. K. Freudenberg and W. Scilasi. Ber., 1922, 55, 2813—2816.

DOUBTS as to the homogeneity of Chinese tannin have been strengthened by the observation of Iljin (J., 1914, 431) that it can be separated by repeated precipitation with zinc acetate into fractions having $[\alpha]_D = +137{\cdot}85°$ and $+5{\cdot}16°$ in aqueous solution. A repetition of Iljin's experiments with commercial tannin and with a specimen isolated by the authors from Chinese galls has confirmed the accuracy of his observations but has also shown that the specific rotations of the various fractions, although differing so widely in aqueous solution, are identical when the products are dissolved in formamide, acetone, alcohol, glacial acetic acid, or pyridine. The apparent anomaly is due to the fact that tannin forms a colloidal solution only in water, in which therefore the magnitude of the specific rotation depends greatly on the degree of dispersion of the particles; this is greatly influenced by the presence of minute quantities of impurity which are gradually removed by precipitation in Iljin's experiments and can also be coagulated and rendered insoluble in ethyl acetate by heating the tannin at 100° C. Chinese tannin may be regarded as fundamentally homogeneous. Highly active specimens of the tannin are prepared by extracting the galls with cold water, neutralising the extract with sodium carbonate, and treating it with ethyl acetate. The product obtained after removal of the solvent has $[\alpha]_D = +90°$ in aqueous solution and the specific rotation is nearly independent of the concentration. A more active product cannot be obtained by means of inorganic adsorbents (kaolin etc.) or organic precipitants (starch, albumin, casein). If, however, the substance is dried in a vacuum at 100° C. and treated subsequently with anhydrous ethyl acetate, a small amount of highly coloured impurity remains undissolved and the activity of the dissolved tannin is increased to +116° in aqueous solution (1%). Two further treatments in the same manner give a product which is completely soluble in ethyl acetate and has the constant specific rotation, $[\alpha]_D = +138°$, in aqueous solution (1·5%).—H. W.

Tannase; A new —— from Aspergillus Luchuensis, Inui. M. Nierenstein. Biochem. J., 1922, **16**, 514—515.

Paullinia tannin (from the seeds of *Paullinia cupana*, H.B. and K.; *cf.* J., 1922, 184 A) is not hydrolysed by tannase prepared by growing *Aspergillus Luchuensis* in a solution of gallotannin, although the latter is hydrolysed by this enzyme. Apparently the hydrolysing properties of tannase depend on the medium in which the fungus by which it is produced is grown, for when *Aspergillus Luchuensis* is grown in a medium containing catechutannin from cube-gambia (*Ourouporia Gambier*, Baill) a new tannase is obtained which hydrolyses paullinia tannin but not gallotannin. The two tannases are named gallotannase and catechutannase respectively.—E. S.

Sundri bark; Determination of optimum temperature for maximum extraction of tannin from ——. B. B. Dhavale and S. R. Das. J. Soc. Leather Trades' Chem., 1922, **6**, 311—315.

The optimum temperature for the maximum extraction of tannin from sundri (*Heritiera minor*) bark "of official size" is 65°—70° C.—D. W.

Tannin test; A qualitative ——. E. Atkinson and E. O. Hazleton. Biochem. J., 1922, **16**, 516—517.

A piece of gold-beater's skin is pinned on a surface of paraffin wax, soaked in water, and then covered with an aqueous extract of the material to be tested. After about 15 mins. it is washed, treated with a 1% solution of ferric chloride, and again washed. If the skin is stained, the presence of tannin is indicated.—E. S.

Synthetic tannins; Notes on ——. U. J. Thuau and A. T. Hough. J. Soc. Leather Trades' Chem., 1922, **6**, 308—311.

Synthetic tannins act as accelerators of tanning by vegetable tannins; they produce a softer grain, tan the pelt and thus economise vegetable tannins. They may be used to clarify vegetable tanning materials, exerting a decolorising action and preventing fermentation and mould formation. They may also be used for preliminary tanning before tanning with vegetable tannins, chrome, alum, etc. Their properties are due to the colloidal nature and to their power of peptising. They peptise insoluble tannins, they transform non-tans and phlobaphenes into tannins, and they combine with the tannin in tanning extracts forming a more soluble tannin complex.—D. W.

Chrome tanning. Properties of the common chrome [tanning] liquors. D. Burton, R. P. Wood, and A. Glover. J. Soc. Leather Trades' Chem., 1922, **6**, 281—287.

Chrome tanning liquors prepared by the reduction of bichromate with glucose, sulphur dioxide, and sawdust, give no precipitate on dilution; a liquor reduced with spent tan is not so bright; bichromate reduced with whey does not remain clear and bright when diluted, and it gives precipitates after standing overnight. A neutralised chrome alum liquor remains bright on dilution, but it is the least stable on boiling. The amount of alkali required to give a precipitate with a measured quantity of each liquor increases with the age of a solution of bichromate reduced with sulphur dioxide and of neutralised chrome alum liquors, and decreases with the age in the case of liquors reduced with glucose, sawdust, spent tan, and whey. The amount of alkali required to produce a precipitate with the liquors at equilibrium falls in the following order: Reduced with glucose, with sulphur dioxide, with sawdust, with spent tan, with whey; neutralised chrome alum. Probably more of the chromium exists in a negatively charged form in the glucose and sulphur dioxide liquors than in the other liquors. Applying the law of mass action to the equilibrium, the amount of negatively charged chromium compound will be decreased if the hydrion concentration of the solution be increased by the addition of acid and increased if the hydrion concentration be decreased by the addition of alkali.—D. W.

Leather analysis; Simple apparatus for the extraction of water-soluble matter from leather, and notes on ——. A. T. Hough. J. Soc. Leather Trades' Chem., 1922, **6**, 302—307.

Five grams of the leather is placed in a Gooch crucible, closed by a porous plate and suspended in the bottom of a cylinder containing 250 c.c. of distilled water at 15°—25° C. After ½ hr. the leather is raised 3—4 cm., and again three times in 1½ hrs. It is finally raised to just below the surface of the water, left overnight, and 50—100 c.c. of the liquid is evaporated to dryness and the residue weighed to obtain the water-soluble matter. In determining the soluble ash the dry water-soluble matter should be treated with sulphuric acid, the excess driven off by ignition, and the sulphated residue weighed and reported as such. The figure obtained is larger than the soluble ash, and more correctly represents the soluble mineral matter.—D. W.

Leather; Influence of atmospheric humidity on strength and stretch of ——. F. P. Veitch, R. W. Frey, and L. R. Leinbach. J. Amer. Leather Chem. Assoc., 1922, **17**, 492—508.

The tensile strength and stretch of lightly tanned unloaded, and unstuffed leather was determined on a series of test pieces under conditions of different atmospheric humidity. An increase of relative humidity from 35% to 55% caused an increase of 12·9% in the tensile strength, 15·7% in the stretch, and 1·9% in the moisture content. An increase from 35% to 75% relative humidity caused an increase of 42·3% in tensile strength, 53·1% in stretch, and 8·2% in the moisture content. The increase in strength is not proportional to the increase in relative humidity, but would seem to be directly related to the moisture content of the leather. This confirms the results of Rudeloff (J., 1904, 992) and Roys (Hide and Leather, Jan. 1, 1921, 21), who found that the effect of a change in the relative humidity is greater at high than at low humidities.—D. W.

Gelatin; Some properties of dialysed ——. D. J. Lloyd. Biochem. J., 1922, **16**, 530—540.

The influence of hydrochloric acid, sodium hydroxide, and sodium chloride on the gelling power of gelatin purified by dialysis at the isoelectric point has been followed. For comparative purposes, the minimum concentration of gelatin necessary to produce a gel after standing for 48 hrs. at 15° C. has been taken as an inverse measure of the gelling power. Under these conditions, pure gelatin requires a minimum concentration of 0·8% to form a gel. Hydrochloric acid decreases the gelling power, the diminution passing through a maximum at p_H 2—3 and again beyond p_H 0·7. Sodium hydroxide slightly decreases the gelling power between p_H 10—12 and completely prevents gelation above p_H 12. Neutral salts diminish the influence of hydrogen ions on gelling power; no other simple relationship between sodium chloride content and gelling power appears to exist. The influence of hydrochloric acid, sodium hydroxide, and sodium chloride on the production of turbid gels, and the effect of temperature on the optical rotation of gelatin have also been studied. The theory of gelation is discussed.—E. S.

Gelatin jellies; Elasticity of purified —— as a function of the hydrogen ion concentration. S. E. Sheppard, S. S. Sweet, and A. J. Benedict. J. Amer. Chem. Soc., 1922, 44, 1857—1866.

THE rigidity of demineralised gelatin jellies, which have been purified from the products of hydrolysis, is not much affected by changes of the hydrogen ion concentration except at very high ($>p_H$ 2) and very low ($<p_H$ 11) hydrogen ion concentrations. The addition of quantities of potassium-alum equivalent to 0·01—0·1% Al_2O_3 based on the dry gelatin brings about considerable changes in the rigidity-p_H curve, and markedly increases the rigidity. This may account for the somewhat anomalous effects observed when the rigidity of jellies prepared from commercial gelatins and containing different concentrations of acid and alkali was determined (*cf.* J., 1921, 313 A).—J. F. S.

PATENT.

Gelatin; Treatment of ossein for the production of ——. C. Collard. U.S.P. 1,431,217, 10.10.22. Appl., 23.8.21.

SEE E.P. 166,896 of 1921; J., 1922, 869 A.

XVI.—SOILS; FERTILISERS.

Sulphate reduction; Occurrence of —— in the deeper layers of the earth. C. A. H. van Wolzogen Kühr. Proc. K. Akad. Wetensch., 1922, 25, 188—198.

THE reduction of sulphate which occurs in the deeper clay strata and sand is brought about by *Microspira desulfuricans.* The life of this organism, which is adapted to anaerobic conditions, accounts for the common occurrence of sulphate reduction in the deeper layers of the earth and especially in the clay, which generally has a higher content of organic matter.—J. F. S.

Nitrogen-fixing bacillus; A new ——. G. Truffaut and N. Bezssonoff. Comptes rend., 1922, 175, 544—546.

THE bacillus, which is found in the soil, fixes nitrogen at the expense of various sugars. Measurements of the increase of nitrogen content of the nutritive medium show that the gain varies from 1·8 mg. per g. of dextrose consumed to 4·7 mg. in the case of lactose, when the carbohydrate concentration is 10 g. per litre this ratio is considerably increased with lower concentrations of the carbohydrate. Ethyl alcohol and acetic acid are also formed and, in addition, the bacillus reduces nitrates to ammonia derivatives. In appearance the organism somewhat resembles *Proteus vulgaris* but may readily be distinguished by characteristics which the authors describe. The name proposed is *Bacillus Truffauti.*—H. J. E.

Manganese content and proportion of ash in old and young leaves; Relation between ——. F. Jadin and A. Astruc. Bull. Soc. Chim., 1922, 31, 917—921.

WHEN the quantity of manganese present in leaves is considered with reference to the fresh material, young leaves contain less manganese than old, and the same result is obtained if the dry material is considered, but in this case the variation is not so great. When manganese content is compared with weight of ash, however, the ash from young leaves yields the higher percentage.—H. J. E.

Plant growth; Effect of the reaction of a nutritive solution on germination and the first stages of ——. R. M. Hixon. Med. K. Vetenskapsakad. Nobelinst., 1922, 4, [9], 1—28.

THE germination of seeds and growth of young plants as water cultures are considerably influenced by the hydrogen ion concentration of the nutritive solution. Experiments were made in which seeds were germinated in Tollens' solution, the p_H value of which was modified by addition of hydrochloric acid or sodium hydroxide, in tap water, and in sterilised agar with similarly adjusted p_H values. Germination took place over the wide range of p_H 4 to 7·6 with only slight variation at the two extremes, but in the middle part of the range there was a point where the rate of germination was a minimum. This point was at p_H 5 for two varieties of pea, p_H 6 for maize, wheat, and oats, and p_H 5·5 for carrots. On the other hand, the root growth of carrots was a maximum at this point on the tenth day. The critical point is probably the point of greatest efficiency and of normal growth. The greater rate of germination on either side of the critical point is probably due to the stimulating effect, in small concentration, of the toxic $H^{\cdot}$ and $OH^{\prime}$ ions. There is always a tendency for the p_H value, when this lies towards one or other extreme of the range in which a plant will grow, to become modified by the growing plant towards a value lying between p_H 5 and 6·8. When carrot plants 39 days old, grown in soil, were suspended in solutions of different p_H values, root excretions of a gelatinous nature (not protein) were observed, the quantity being greatest at extreme p_H values and least at the critical value p_H 5·5. These and other observations by different authors indicate an ionic equilibrium between the roots of the plant and the salts in solution.—E. H. R.

Fertilisers containing nitrites; Determination of total nitrogen in —— and of nitrite nitrogen in the presence of nitrates. F. Mach and F. Sindlinger. Z. angew. Chem., 1922, 35, 473—474.

Total nitrogen: 25 c.c. of an aqueous solution of the sample (the 25 c.c. should contain not more than 0·05 g. of nitrogen) is added slowly to a boiling mixture of 30 c.c. of saturated potassium permanganate solution and 5 c.c. of dilute sulphuric acid (1:2); after the addition of a further 10 c.c. of the sulphuric acid the mixture is cooled, treated with 10 g. of *ferrum reductum*, boiled gently for about 10 mins., and the resulting ammonia determined by distillation in the usual way. *Nitrate nitrogen:* 25 c.c. of the solution of the sample is boiled for 10 mins. with 30 c.c. of $N/3$ sulphuric acid and 10 c.c. of methyl alcohol. The nitrous acid is thus expelled in the form of its volatile methyl ester. After cooling, the mixture is neutralised and the residual nitrate determined as described by reduction with *ferrum reductum*. *Nitrite nitrogen:* The difference between the total nitrogen and the nitrate nitrogen gives the amount of nitrite nitrogen present. Allowance must be made for ammonia nitrogen if the fertiliser contains ammonium salts.—W. P. S.

Patents.

Phosphorus compounds; Process for treatment of —— suitable for manurial purposes. R. W. James. From Eisenwerkges. Maximilianshütte. E.P. 186,223, 9.8.21.

Insoluble phosphates, such as Florida phosphate, bone meal, or phosphatic slag, are intimately ground with salts of the alkalis, alkaline-earths, or magnesium, without heating. This treatment renders the phosphoric acid present soluble in citric acid and partly soluble in citrates. [Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 6429 of 1906 and 151,024; J., 1906, 647; 1920, 759 a.] —C. I.

Superphosphate masses; Process of and apparatus for ageing and disintegrating ——. A. Bruhn, Assr. to F. Krupp A.-G. U.S.P. 1,430,621, 3.10.22. Appl., 19.11.20.

See E.P. 147,134 of 1920; J., 1921, 863 a.

XVII.—SUGARS; STARCHES; GUMS.

White sugar manufacture; Process of —— employed at the Oxnard beet sugar factory, California. A. Vasseux. Bull. Assoc. Chim. Sucr., 1921, 38, 409—435.

In spite of the purity of the juice being as low as 80°, an extraction of 97% of the sugar present in the beets is realised at the Oxnard factory, the procedure being as follows: Diffusion juice is limed with the calcium saccharate from the Steffen process of desaccharifying molasses, using 5·25% CaO (calculated on the roots), carbonated to 0·93, heated to 92° C., filtered twice, treated with sodium carbonate, carbonated (without further addition of lime) to 0·26, heated to boiling, and the alkalinity lowered by sulphitation to 0·16 before passing to the multiple-effect supply tanks. The evaporator syrup (to which the second sugar has been added) is heated, sulphited to an alkalinity of 0·23, mixed with kieselguhr, and pumped successively through filter-presses and Danek filters, thus giving a "first liquor," which is very light in colour and low in viscous substances. This liquor serves for the boiling of the first crop of crystals, a small amount of white sugar grain of uniform size being added just at the moment when the grain is about to form, which addition not only facilitates boiling, but obviates the formation of false grain, gives a sugar of better colour, and improves the extraction (*cf.* J., 1919, 48 a). The molasses from the first sugar is sulphited, treated with kieselguhr, and filtered before being boiled for the production of the second sugar, the molasses from which is sent to the Steffen plant for the extraction of the sugar still remaining in it. In the 1919 season the total sugar in the roots was 18·71; that actually recovered was 18·21 (or 97·35%); that remaining in the pulp was 0·11; in the diffusion waste waters, 0·03; in the scums, 0·08, and in the Steffen waste waters, 0·17%. Altogether about 40,000 tons of white granulated sugar was produced at the Oxnard factory during 1920.—J. P. O.

Cane juice; Influence of the non-sugars of —— in inhibiting inversion. C. Lourens. Archief Suikerind. Nederl.-Indië, 1922, **30**, 562—564. Int. Sugar J., 1922, **24**, 552.

The author agrees with van Ligten (J., 1922, 776 a) that amino-acids are capable of exerting an influence in retarding the inversion of sugar solutions, but suggests that a more likely explanation of the slow rate of inversion observed when sulphiting cane factory syrups and molasses (as compared with pure solutions of the same density treated under the same conditions) is that salts forming part of the non-sugars are decomposed, the sulphur dioxide combining with the alkalis and liberating organic acids. These organic acids have an inversion constant which is only about 0·5, as compared with one of 40 for sulphur dioxide.—J. P. O.

[*Sugar factories;*] *Significance of the presence of oxalates in evaporator incrustations* [*in* ——]. [*Detection of oxalic acid.*] C. Müller. Int. Sugar J., 1922, 24, 523—524.

Analyses of the incrustations scraped from the heating surfaces of a quadruple effect evaporator used for the concentration of cane juice showed, when operation was normal, the presence of a comparatively considerable amount of oxalic acid in that taken from the first vessel, traces only in that from the second, and none in that from the third and fourth. On the other hand, in the case of a similar apparatus, the operation of which was less efficient (the second vessel hardly operating at all), the presence of much oxalic acid was established in the incrustation taken from both the first and the second vessels, while there was also a trace in that from the third. The presence of oxalic acid in the second or subsequent vessels of the evaporator may be taken as an indication of the irregular operation of the apparatus, the concentration of the syrup in these vessels being insufficient to cause the complete precipitation of the calcium oxalate in the juice, this substance being almost insoluble in concentrated syrup. In testing for the presence of oxalic acid, 100 g. of the incrustation (freed from traces of sugar by repeated washing with water) is treated with 300 c.c. of dilute sulphuric acid (1:10), and the liquid filtered and evaporated to about 50 c.c.; then 10 c.c. is further concentrated in a test-tube, a little resorcinol added, and 2 c.c. of concentrated sulphuric acid poured down the side of the tube. On agitation, a fine azure blue colour turning violet on heating is formed. Tests with fourteen other organic acids showed that the reaction is characteristic of oxalic acid.—J. P. O.

Decolorising carbon [*for use in the sugar industry*]; *Essential qualities of an efficient ——.* W. H. Dunstone, jun. Facts about Sugar, 1922, 14, 416.

An efficient decolorising carbon after having been used for the adsorption of impurities from sugar liquors must be capable of readily being separated by filtration. The optimum size of particle depends on the porosity and adsorbing quality of the carbon. Frequently extremely fine carbon becomes so "slimed" by the accumulation of organic colloidal impurities that it cannot be filtered off. Another important quality is a sufficiently hard structure, otherwise the attrition occurring in revivifying results in the formation of such a quantity of very fine grain as seriously to impede filtration. —J. P. O.

Decolorising carbons; Experiments with various ——. E. Saillard. Suppl. Circ. Syndic. Sucre de France, Nos. 1724, 1726, 1728, 1730, and 1734 of 1922.

To 50-c.c. portions of a 20% solution of beet molasses, 0·5 g. of decolorising carbon, or 0·5 g. of finely ground animal charcoal, was added, the temperature being maintained at 78°—80° C. during 20 mins. After cooling, and filtering, the colour removed, expressed as percentage of original colour, was found to be as follows: Animal charcoal, 27;

"Norit," 43; "Darco," 44; and "Carboraffin," 75. Practically the same results were obtained when the treatment was carried out at the ordinary temperature. Other experiments led to the following conclusions: A better decolorisation results when the treatment is effected under pressure at 110° C. than at 78°—80° C.; the finer the state of division of the carbon the better its action in adsorbing colour; animal charcoal adsorbs about twice the amount of calcium salts from solution in comparison with "Carboraffin," and three times that retained by "Darco." On the other hand, animal charcoal takes up less free alkali than "Darco."—J. P. O.

Decolorising carbon ("Norit"); Technical application of ——. W. H. Dunstone, jun. La. Planter, 1922, 68, 254—256.

Washed white sugar of 99° purity was melted to a syrup of 56° Brix, strained, heated to 200° F. (93° C.), and discharged into mixing tanks in which a determined amount of "Norit" (about 1·5% of the weight of melted sugar) had been placed in the form of a paste. After filtration through plate-and-frame presses, a practically colourless liquor was obtained from which a "standard granulated, the equal in every way of the best boneblack sugar," could be boiled. After being used in this manner three times in succession, the "Norit" was washed with water in filter-presses to eliminate its sugar content, dried, and heated in the "Norit" kiln to about 1100° F. (660° C.), after which it was used again three times. When the ash content of the carbon had reached such a degree as to hinder filtration, it was reduced by boiling with a 2% solution of hydrochloric acid, this treatment at intervals being followed by boiling with a 5% solution of sodium hydroxide. It is stated that a recovery of 93 lb. of standard granulated sugar per 100 lb. of 96° raw sugar can be obtained, and that the process can be conducted on a commercially profitable scale.—J. P. O.

Decolorising carbon ("Norit"); Cost of revivification of ——. R. G. Tillery. La. Planter, 1921, 66, 411—414; 1921, 67, 9—14.

Revivification by acid treatment was found to cost 0·8 cent per lb. of decolorising carbon; by caustic alkali treatment, 1·75 cent; and by re-burning, 0·61 cent. Not only is re-burning cheaper (its cost amounting to $0·01 per 100 lb. of granulated sugar produced), but it gives a material which decolorises better, and filters faster, the loss during the process of revivification also being less. Re-burning, however, should be combined with an occasional acid and alkali treatment.—J. P. O.

Sugars; Chemistry of the ——. H. Kiliani. Ber., 1922, 55, 2817—2826. (*Cf.* J., 1921, 315 A; 1922, 188 A.)

The technique of the oxidation of sugars and polyhydroxy acids by nitric acid at the atmospheric temperature is further improved by removing any excess of nitric acid by shaking the solution, after dilution if necessary, with five or six portions of ether (each one and a-half times the volume of the solution). The sixth extract is generally free from nitric acid. The aqueous solution may still contain nitric esters. It is allowed to remain exposed to the air for 12—24 hrs. to permit the dissolved ether to evaporate and is then concentrated if necessary in a vacuum over sulphuric acid. During this period the nitric esters become hydrolysed gradually and the liberated nitric acid causes a fresh oxidation. For reasons of safety, the ethereal extracts are immediately brought into contact with sodium hydroxide solution (1 in 3). The efficiency of the process is illustrated by the identification of *l*-trihydroxyglutaric acid as a by-product of the preparation of ketorhamnonlactone and by the preparation of *r*-pentahydroxypimelic acid from α-glucoheptoni acid. The strongly reducing acid obtained by th oxidation of dextrose or *d*-gluconic acid with nitri acid is identified as 5-keto-*d*-gluconic acid. Th ketorhamnonic acid described previously as th 2-keto- is shown to be the 5-keto-compound. (C J.C.S., Dec.)—H. W.

Carbohydrates. II. A new anhydride (1.2) *of dextrose.* P. Brigl. Z. physiol. Chem., 1922, 122, 245—262.

By the elimination of hydrogen chloride from 1-chloro-3.5.6-triacetylglucose, the 1.2 anhydride has been prepared and its properties examined. 1-Chloro-3.5.6-triacetylglucose is treated in benzene solution with ammonia whereby 3.5.6-triacetylglucose-1.2-anhydride, white prisms m.p. 59·5° C., $[\alpha]^{18}_{D}+106·5°$, is obtained. This substance reacts with great ease with acetic anhydride, water, or methyl alcohol. (*Cf.* J.C.S., Nov.)—W. O. K.

Polysaccharides. XVI. P. Karrer and W. Fioroni. Ber., 1922, 55, 2854—2863.

Re-determination of the heats of combustion of the amyloses gives results which indicate that polymerisation proceeds exothermally from diamylose to α-tetra-amylose and then strongly endothermally to octa-amylose. The observed values for the heats of combustion of a sugar of the general formula, $(C_6H_{12}O_6)_n-(n-1)H_2O$, agree excellently with the calculated values. The heats of combustion of a number of polysaccharides and their derivatives are given. The close agreement between the observed values for the acetyl compounds of cellulose, starch, and inulin, and those calculated on the hypothesis that the heat of acetylation (known to be small) is relatively negligible indicates that acetylation is not accompanied by depolymerisation, since in the case of the amyloses it has been shown that the heat of combustion varies considerably with the degree of polymerisation. In reply to the recent criticism of Pringsheim (J., 1922, 513 A) the author maintains that triamylose and β-hexa-amylose are identical.—H. W.

Adsorption by sugar charcoal. Bartell and Miller. *See* IV.

Reduction of carbohydrates. Willstätter and others. *See* V.

Patents.

Sugar and other products; Method of converting wood into ——. S. F. Acree. E.P. 160,776, 18.3.21. Conv., 25.3.20.

Cellulosic material containing galactan, such as Western larch, is subjected to hydrolysis, a hydrolysing agent, such as nitric acid, nitrous acid, or a mixture of both, or sulphurous acid, or various acidic liquors recovered in subsequent manipulations, being used. The quantity of hydrolytic agent is preferably less than 6% of the dry weight of the raw material employed. The wood, preferably as chips or sawdust, is mixed with three times its weight of water, the acid added, and the whole heated either at ordinary pressure to 70°—100° C., or under increased pressure to 110°—140° C., until hydrolysis is complete. The resulting sugar solution is removed and may be treated for the separation of galactose and other sugars as such, or may be fermented by means of special yeasts to give alcohol. The process is rendered continuous by the use of batteries of hydrolysing and extraction vessels.—W. H. G.

Glucose and dextrin; Process of, and apparatus for obtaining —— from wood. H. Terrisse and M. Levy. E.P. 186,139, 20.6.21. Addn. to 143,212.

The process described in the former patent (J., 1921, 405 A) has been simplified to allow of continuous working. Cellulosic material, such as wood shavings, sawdust, etc. is dried to a moisture content of not more than 5%. Ten parts of the dried material is mixed with about 7—11 pts. of 40% hydrochloric acid and simultaneously treated with about 2 pts. by weight of gaseous hydrogen chloride, the temperature being kept low throughout. The mass is then digested in thin layers at 12°—50° C. under slight pressure. When conversion is complete the hydrochloric acid is removed and recovered and the product boiled with water to convert dextrin into glucose, which may e separated as such or fermented. Apparatus, onsisting of a mixing vessel, a digesting installaon, and a plant for the recovery of the acid, ranged to allow of the continuous working of the rocess, is described.—W. H. G.

ugar solutions; Purification of —— by filtration and decantation. F. Tiemann. G.P. 355,231, 17.12.20. Addn. to 354,076 (*cf.* E.P. 161,987; J., 1921, 633 A).

N the process described in the chief patent, the ose, granular filter medium is supported on a ieve constructed of elastic material, and by setting he sieve in motion, fine sand is readily separated rom coarser particles and can be washed away. —L. A. C.

XVIII.—FERMENTATION INDUSTRIES.

Malt analysis; Standard methods of ——. Report of Standing Committee on Analysis. J. Inst. Brewing, 1922, 28, 775—786.

HE revised methods of analysis of malts and aramel differ in details from those recommended n the reports of 1906 and 1910 (*cf.* J., 1906, 236; 910, 1323). The methods being entirely empirical, niform results can be obtained only by strict bservance of the details laid down. In addition o the Seck laboratory mill, a mill made by Messrs. R. Boby, Ltd., of Bury St. Edmund's, is now ccepted as standard, and for grinding the grist a oller setting of 0·5 mm.—as determined by a feeler gauge—is prescribed. In determining the extract of pale malts, the mash is kept at 150° F. (65·5° C.) for 1 hr., the practice of heating to 158° F. (70° C.) for the last 5 mins. being abandoned. The conditions of filtration of the worts are standardised; the first 50 c.c. is to be returned to the funnel and 250 c.c. finally collected. For reading the tint of worts any recognised "daylight" lamp may be used. Covered dishes are prescribed for moisture determinations, and various precautions to be observed are enumerated. The "tube" method of estimating diastatic activity has been re-introduced as an official method, in addition to that previously given; and more exact details for the preparation of soluble starch are laid down. No alterations have been made in the methods of analysis of coloured malts and caramel. —W. H. G.

Hop bitters; Nomenclature and analysis of ——. P. Kolbach. Woch. Brau., 1922, 39, 233—235.

The lack of uniformity in the nomenclature of hop constituents is emphasised and the question of the possibility of valuing hops on the basis of a chemical analysis is discussed.—W. H. G.

Physico-chemical methods in brewery laboratories. W. Dietrich. Woch. Brau., 1922, 39, 232—233.

The limitations of purely chemical methods are pointed out, and stress is laid on the value of the information given by modern methods of physical chemistry. The determination of p_H values, nephelometric experiments, determination of viscosity and surface tension and studies of colloidal state, ultrafiltration, and the use of the ultramicroscope and microchemical methods are instanced as examples of physical methods of value for supplementing chemical methods of examination. —W. H. G.

Colour in beers and worts; Standard solution for the estimation of ——. B. Lampe. Woch. Brau., 1922, 39, 235—236.

A mixture of solutions of cobalt nitrate and potassium bichromate is suggested as a standard. It has the advantage over the standards now in use —ferric alum, iodine, and aniline dye solutions— that it is stable for a considerable period and that the salts required can be obtained readily in a pure condition.—W. H. G.

Saccharase [invertase]; Inactivation of —— by iodine. H. von Euler and S. Landergren. Biochem. Zeits., 1922, 131, 386—389.

Addition of iodine in potassium iodide to two invertase preparations of different activity reduced the activity in each case to one half. Sodium thiosulphate cannot re-activate the invertase.—H. K.

Saccharase [invertase]; A silver compound of ——. H. von Euler and K. Josephson. Ber., 1922, 55, 2416—2420.

A brown compound of silver and invertase is precipitated by the addition of alcohol to a solution of invertase (1%) which has been treated with silver nitrate. The compound still contains approximately 50% of carbohydrates which are derived mainly from the original yeast. The atomic ratio of phosphorus to silver in the compound is 1:1. (*Cf.* J.C.S., Nov.)—H. W.

Lactic acid fermentation of dextrose by peptone. G. Schlatter. Biochem. Zeits., 1922, 131, 362—381.

Dextrose is converted quantitatively into inactive lactic acid by peptone at 37° C., sodium bicarbonate being used as buffer. This buffer substance may be replaced by sodium acetate, but not by phosphate mixtures owing to flocculation of the peptone. During the fermentation amino-acids appear and fermentation ceases with flocculation of the peptone. Peptones free from phosphates, as, for example, Witte peptone, give no fermentation; most of the observations recorded were made with Siegfried's peptone. The solutions were not completely sterile, although no known bacteria capable of forming lactic acid were found.—H. K.

Peptone fermentation. E. Baur and E. Herzfeld. Biochem. Zeits., 1922, 131, 382—385.

The authors draw an analogy between the glycolytic action of plant and animal juices and the fermentation of dextrose by peptone as revealed by their own experiments and those of Schlatter (*cf. supra*). The latter are moreover an effective reply to Bau's criticism (J., 1922, 189 A) of their own experiments on fermentation without yeast (J., 1921, 900 A). —H. K.

Wines containing sulphurous acid; Determination of the volatile acidity of ——. R. Marcille. Ann. Falsif., 1922, 15, 269—274.

When an aqueous solution of sulphurous acid is treated with iodine, the increase in the acidity is a measure of the quantity of sulphurous acid present: $SO_2+2H_2O+2I=H_2SO_4+2HI$. In the case of wines containing sulphurous acid, combination of the latter with aldehydic substances takes place and the sulphurous acid thus combined is not oxidised by iodine; its acidity is also reduced. Based on these facts, the following method of correcting the volatile acidity of wines in order to ascertain the quantity of volatile organic acids is suggested. From the total volatile acidity is deducted a quantity equal to the sum of the amount of the sulphurous acid oxidisable by iodine *plus* 70% of the combined sulphurous acid. The combined sulphurous acid is the difference between the total sulphurous acid and that portion which is oxidisable by iodine.—W. P. S.

Citric acid; Detection of —— in wine and musts. C. von der Heide and H. Straube. Festschr. Jubiläum höheren staatl. Lehranst. Wein-, Obst-, u. Gartenbau, 336—369. Chem. Zentr., 1922, **93**, IV., 803.

Methods depending on the separation of citric acid in the form of its salts are unreliable on account of possible contamination with malic acid. Stahre's reaction (J., 1896, 53) or the modifications of it proposed by Kunz (J., 1915, 974; 1919, 435 A), and Krug and Rettinger (Arbb. Kais. Gesundh.-Amt, **49**, 28), are recommended. The authors precipitate the barium salts of the acids in wines and musts by means of alcohol, and examine the precipitate for citric acid. Contrary to Kunz' assumption, it has been shown that natural wines and musts may contain citric acid. In nine Rhenish natural wines of the 1921 vintage, citric acid was found in quantities of 85—164 mg. per l. Whether citric acid is a normal constituent of German wines is uncertain.
—W. H. G.

Rum; Testing —— by the odour developed on treatment with sulphuric acid. E. Schäffer. Chem.-Zeit., 1922, **46**, 934.

If 10 pts. of rum is mixed with 4 pts. of sulphuric acid (sp. gr. 1·84) an aroma is at first developed which differs with different samples, but when this has disappeared it is followed by a characteristic odour somewhat resembling that of petroleum. The same odour was obtained with 15 different samples of genuine rum from Jamaica, Cuba, Martinique, and Guadeloupe, even when adulterated to the extent of 1 part in 10. The odour lasted at least 24 hrs. The so-called German rum (*cf.* J., 1922, 73 A) and an artificial rum prepared from essences did not give this characteristic odour. The test would therefore be useful for distinguishing these. Genuine rum containing a large amount of ethyl acetate only gives the characteristic odour after removal of the ethyl acetate by distillation.
—H. C. R.

Tannase. Nierenstein. *See* XV.

Nitrogen-fixing bacillus. Truffaut and Bezssonoff. *See* XVI.

PATENTS.

Brewing of malt liquors. C. F. Hyde. E.P. 186,161, 22.6.21.

In nearly all malt samples the growth is somewhat uneven and there is in consequence a proportion of unmodified or poorly modified corns. These "riceyended" corns in the usual mashing operation yield little or no extract and are thus waste. A modified process consists in separating the unmodified grits from the remainder of the grist by mechanical means, and treating these separately by suitable methods to render this unaltered starch soluble, or, by a further crushing, to expose a greater surface to the action of the malt enzymes. The whole or nearly the whole of the available extract is thus obtained. In one modification the solution obtained by converting the grits is diluted and used as mashing liquor. [Reference is directed, in pursuance of Sect. 7, Sub-sect. 4, of the Patents and Designs Acts, 1907 and 1919, to E.P. 13,838 of 1906; J., 1907, 162.]—W. H. G.

Beverage-making material and process of producing the same. G. K. Mayer, W. C. Andrews, and A. V. Colby. U.S.P. 1,391,557, 20.9.21. Appl., 14.7.20.

Malt, corn (maize) or other cereal is moistened and heated to 120° F. (49° C.) in a steam-heated cylinder, then stored for ¼ hr., and treated with live steam for 1—5 mins. in a cylinder, which it leaves at a temperature of 200° F. (93° C.). The material is then cooled, crushed between flaking rolls, passed through a jacketed heater wherein it is heated to 140° F. (60° C.), cooled, and then passed through several dryers of progressively rising temperature, the final temperature being 190° F. (88° C.). By suitably regulating the time and temperature it is possible to obtain products giving beverages of any desired low alcohol content (down to zero) on subsequent brewing by the usual lager beer process.

Sugar etc. from wood. E.P. 160,776. *See* XVII.

Glucose and dextrin from wood. E.P. 186,139. *See* XVII.

Food product from yeast. U.S.P. 1,391,561-2. *See* XIXA.

Yeast food. U.S.P. 1,431,448. *See* XIXA.

Yeast-tannin compounds. G.P. 357,140. *See* XX.

XIXA.—FOODS.

Meats; Pickling —— in solutions containing potassium nitrate and sodium nitrite. L. Pollak. Z. angew. Chem., 1922, **35**, 392. (*Cf.* J., 1922, 606 A.)

A reply to Auerbach and Reiss (*loc. cit.*); the differences between the results found by these observers and those obtained by the author appear to be due to differences in the pickling operations.—W. P. S.

Butter; Acetic index [improved Valenta test] in detecting adulteration of ——. G. Fascetti. Giorn. Chim. Ind. Appl., 1922, **4**, 352—355.

Butter, margarine, and coconut butter are readily differentiated by means of the acetic index, determined as follows. Through the stopper of a stout test-tube 18 cm. long and 1·8 cm. bore, a thermometer, 8 mm. in diameter, reaches to 0·5 cm. from the bottom of the tube. The test-tube is fitted, by means of a rubber ring, in a second tube of the same length and 3 cm. in diameter, this being filled to the extent of one-half either with water or, for temperatures above 100° C., with glycerin. A large beaker standing on an asbestos gauze and half filled with water or glycerin, serves as the heating bath. The butter or fat is melted in a small beaker and filtered through a dry filter, the oily layer being then accurately decanted from the lower milky layer. Exactly 1 c.c. of the fat is then introduced from a slightly heated pipette on to the bottom of the small test-tube, this being followed by exactly 4 c.c. of pure acetic acid (as sold for molecular weight estimations) which has been diluted to the specific gravity 1·062, corresponding with 98·5% of acetic acid. The thermometer is fixed in position and the tube fitted to the larger one, the whole being swung gently to and fro in the heated bath until the turbid mixture becomes clear. The tubes are then withdrawn from the bath and the agitation continued until the solution turns cloudy, the temperature (t° C.) being then read. If the butter is not quite fresh or exhibits a rancid taste, 2 g. of the fat, separated as above, is dissolved in a mixture of ether and alcohol and the solution titrated with $N/20$ aqueous alcoholic sodium hydroxide solution in presence of phenolphthalein. The number of c.c. of the alkali solution required is added to the temperature *t* to obtain the "acetic index" of the fat. For fresh butter this was found to have the value 64—68, for rancid butter 63·4—65, for coconut fat 29—34, and for margarine 113·5—118. Addition to fresh butter of 5% of coconut fat lowers the index by 3—4, whilst the same proportion of margarine raises it by 4—5. In the rare cases in which butter is adulterated with both coconut fat and margarine, the test loses its value.—T. H. P.

Margarine; Water-content of ——. A. Gronover and F. Bolm. Chem.-Zeit., 1922, **46**, 933—934.

Tests with samples taken out of a margarine mixing machine and from packages containing from 30 to 130 lb. showed that the margarine was in all cases perfectly homogeneous as regards water content throughout the mass. It is therefore considered reasonable to expect manufacturers to guarantee each package of margarine to contain less water than the percentage allowed by law. In the case of pound packets the outer layers lose some water by evaporation, but in the cases examined the outer layers did not show more than about 1% less water than the centre of the packets.—H. C. R.

Vitamin A; Synthesis of —— by a marine diatom (Nitzschia closterium, W. Sm.) growing in pure culture. H. L. Jameson, J. C. Drummond, and K. H. Coward. Biochem. J., 1922, **16**, 482—485.

The marine diatom, *Nitzschia closterium*, is able to synthesise large amounts of vitamin A when grown in Miquel's solution or in sterilised sea water.
—E. S.

Vitamin A; Origin of the —— in fish oils and fish liver oils. J. C. Drummond, S. S. Zilva, and K. H. Coward. Biochem. J., 1922, **16**, 518—522.

The vitamin A contained in the liver oils from the cod and other fishes is probably derived through the smaller fishes and the plankton from marine algæ, which have been shown to be capable of synthesising this vitamin (*cf. supra*).—E. S.

Lemon-juice; Growth-promoting factor [vitamin] of ——. B. Leichtentritt and M. Zielaskowski. Biochem. Zeits., 1922, **131**, 499—512.

The growth-promoting factor of lemon-juice has been submitted to a variety of conditions. Lemon-juice heated to 100° C., either in acid or alkaline solution, is practically unaltered in its growth-promoting factor for bacteria. Even hydrolysis with 2—3% hydrochloric acid is without influence, although sodium hydroxide is inimical. Exposure to ultraviolet light or Röntgen rays is without action whatever the reaction of the media, and aeration in boiling solution is also without action. Adsorbents weaken the activity, and the bacterial growth-promoting principle is dialysable, independently of the reaction of the medium.—H. K.

Lemon-juice; Growth-promoting factor of ——. B. Leichtentritt and M. Zielaskowski. Biochem. Zeits., 1922, **121**, 513—524.

There is little parallelism between the effect of external conditions and reagents on the bacterial growth-promoting factor and the anti-scorbutic factor C of lemon-juice as tested on guinea pigs and children. Lemon-juice contains an anti-scorbutic factor C and a factor which promotes growth of bacteria. This latter factor is termed vitamin D. Further experiments are necessary to determine whether D is not identical with vitamin B.—H. K.

Pepper substances. Ott and others. *See* XX.

Patents.

Food product obtained from brewers' yeast. J. C. Miller, Assr. to The Evaporating and Drying Machinery Co. U.S.P. 1,391,561—2, 20.9.21. Appl., 19.3.18.

Waste brewers' yeast is supplied to a rapidly rotating cylinder from the end of which it is discharged by centrifugal force as an annulus of fine spray, in which form it is rapidly dried by means of a current of heated air blown across it. (a) If the air be heated to 155° F. (68° C.) or above, the peptones present in the protoplasm of the yeast cells are liberated and the product, in the form of a dry flour, is suitable as a partial or complete substitute for wheat flour for human consumption. (b) If the temperature of the air be kept at 110°—120° F. (43°—49° C.), the yeast cells are not disintegrated, and the product is practically free from peptones, contains the active ferments of the yeast present as in the original material, and forms a valuable force feed for animals.

Yeast food; Production of ——. A. H. Gallagher, Assr. to National Retarder Co. U.S.P. 1,431,448, 10.10.22. Appl., 15.5.20.

The protein of chrome-tanned leather is hydrolysed by treatment with lime at a high temperature. The product contains amino-acids and proteoses, and is suitable for use as a yeast nutrient in growing bakers' yeast, yielding a yeast of good colour, odour, and keeping qualities, and which has good baking strength in the manufacture of leavened bread.
—L. A. C.

Bread; Manufacture of leavened ——. C. Hoffman, H. D. Grigsby, and N. M. Cregor, Assrs. to Ward Baking Co. U.S.P. 1,431,525, 10.10.22. Appl., 1.10.21.

A bread loaf equal in colour and texture to that made from highly milled bolted flour contains added water-soluble B vitamin and soluble nitrogen compounds extracted from vegetable material, in addition to the usual constituents.—L. A. C.

Yeast; Composition of matter for increasing growth of —— when mixed with dough. W. A. and E. W. Geere. U.S.P. 1,431,156, 10.10.22. Appl., 23.2.21.

See E.P. 143,938 of 1917; J., 1920, 556 A.

Fish and the like; Cooling and freezing of ——. J. J. Piqué. U.S.P. 1,431,328, 10.10.22. Appl., 21.5.20.

See E.P. 154,250 of 1919; J., 1921, 94 A.

XIXb.—WATER PURIFICATION; SANITATION.

Water supplies; Chlorine treatment of ——. Vollmar. Gas und Wasserfach, 1922, **65**, 649—654.

For the disinfection of town water supplies the author recommends the preparation of a concentrated chlorine solution which is allowed to flow into the water main at a point just before the pump intake. The amount of chlorine which flows into the mixing chamber is determined by means of a differential manometer, and can be accurately controlled in conformity with the character of the water under treatment. The amount required per litre of Elbe water at Dresden varied from about 0·16 to 0·34 mg., with which quantity the bacterial content of the water was reduced from several thousand to an average of 4—20 per c.c., consisting mostly of harmless spore-forming bacteria. The quantity of chlorine was daily so adjusted that directly behind the pumps chlorine could not be detected chemically in the water. At this point it was usually perceptible to the taste, but at the outflow of the reservoir the water had no undesirable taste whatever. The addition of a sufficiently effective quantity of chlorine was assured by bacteriological control.—G. F. M.

X-rays; Action of secondary radiation of —— on microbes. J. Cluzet, A. Rochaix, and T. Kofman. Comptes rend., 1922, 175, 546—548.

Numerous experiments showed that neither hard nor soft X-rays destroy bacteria or even retard their growth, but when cultures are exposed to the secondary radiation development ceases. The latter result was obtained by using radiators of heavy metals of low atomic weight, but very penetrating primary radiation apparently excites the radiating material unsuitably, so that bacteria remain unaffected.—H. J. E.

Patent.

Soap or compound; Antiseptic and insecticidal ——. R. Macpherson and W. E. Heys. E.P. 186,078, 15.3. and 30.9.21.

The compound comprises a mixture of sodium or potassium soap, an alkali benzoate, and tar. Birch tar is preferred, but any other vegetable or mineral tar may be used. The ingredients may be thoroughly incorporated by mixing, or the compound produced by saponifying a mixture of fatty acids, benzoic acid, and tar.—H. C. R.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Paniculatine, the alkaloid of Aconitum paniculatum, Lam. G. E. Brunner. Schweiz. Apoth.-Zeit., 1922, **60**, 357—358. Chem. Zentr., 1922, **93**, III., 1007.

The alkaloid isolated from the tubers of the paniculated aconite is not identical with aconitine. It has the molecular formula, $C_{29}H_{35}O_7N$, and crystallises from methyl alcohol in small rhombic prisms, m.p. 263° C.—G. F. M.

Digitalis leaves; Extraction of the active principles from ——. E. Mameli. Giorn. Chim. Ind. Appl., 1922, **4**, 355—358.

Prolonged extraction of dried digitalis leaves with absolute alcohol in a Soxhlet apparatus, followed by concentration and purification of the united extracts and separation of the different active principles by means of various solvents, yields a total quantity of these principles greater than is obtained when the water and alcohol are used under other conditions. Details of the method of extraction and separation are given.—T. H. P.

Ergot. A. Stoll. Schweiz. Apoth.-Zeit., 1922, **60**, 341—346, 358—364, 374—383. Chem. Zentr., 1922, **93**, III., 1007.

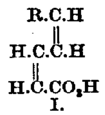
The improbable assumption that simple amines of the tyramine type are the active principles of ergot is refuted by the fact that even by the most careful manipulation only the merest traces of such substances can be isolated from the fungus. A hitherto unknown amine of high molecular weight having the characteristic therapeutic action of ergot was however isolated from the drug. After the addition of acid reagents, such as aluminium sulphate, to the powdered ergot, about 350—400 g. of ergot oil free from alkaloid was obtained from 1 kg. of material by exhaustive extraction with ether and benzene. From the acidified cell material a crystalline alkaloid, ergotamine, $C_{33}H_{35}O_5N_5$, crystallising from acetone with 2 mols. $(CH_3)_2CO$ and 2 mols. of water, was obtained in a yield of 0·1—2·0 g. per kg. of ergot. The crystals effloresce when exposed to the air and soon decomposition sets in accompanied by discoloration. On standing, or more rapidly on boiling a methyl alcoholic solution, ergotamine is converted into an isomeride of feebly basic properties, termed ergotaminine, which crystallises in leaflets from the solution. Both ergotamine and ergotaminine give in acetic acid solution in presence of ethyl acetate a blue coloration with sulphuric acid. Therapeutically ergotamine exhibits the typical action of ergot up to dilutions of 1 in 10 million. Ergotamine is a very unstable mon-acid base, having $[\alpha]_D^{20} = -155°$ in 0·6% chloroform solution. Ergotaminine under similar conditions has $[\alpha]_D^{20} = +381°$.—G. F. M.

Artemisia Afra, Jacq.; Constituents of the flowering tops of ——. J. A. Goodson. Biochem. J., 1922, **16**, 489—493.

The following substances have been isolated: camphor, a wax-like ester, probably ceryl cerotate, tricontane, scopoletin, and quebrachitol. The camphor had $[\alpha]_D^{20} = +9·7°$ and was evidently a mixture of the two enantiomorphs. No compounds were found which could be regarded as related to santonin.—E. S.

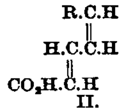
Pepper substances; Natural and artificial —— II. Chavicine from pepper-resin, the primarily active constituent of black pepper. E. Ott, F. Eichler, O. Lädemann, and H. Heimann. Ber., 1922, 55, 2653—2663.

The isolation of pepper-resin from *Piper nigrum*, Singapore, is described in detail, the product ultimately consisting of chavicine containing appreciable quantities of wax. The former is shown to be a piperidide of chavicinic acid, I.,



$$\begin{array}{c} R.C.H \\ \| \\ H.C.C.H \\ \| \\ H.C.CO_2H \end{array}$$

I.



$$\begin{array}{c} R.C.H \\ \| \\ H.C.C.H \\ \| \\ CO_2H.C.H \end{array}$$

II.

it is very resistant to hydrolysis by alcoholic sodium hydroxide solution and its acid constituent becomes isomerised during the process to isochavicinic acid, II., a yellow amorphous solid, m.p. 200°—202° C., which resembles piperic acid very closely. It is catalytically hydrogenated in alcoholic solution in the presence of palladinised animal charcoal to tetrahydropiperic acid. (*Cf.* J.C.S., Nov.)—H. W.

Betulin. H. Schulze and K. Pieroh. Ber., 1922, 55, 2332—2346.

Betulin, isolated from birch bark, crystallises from alcohol with 1 or 0·5 molecule of solvent which has been overlooked by previous investigators. It has the composition, $C_{31}H_{52}O_2$ or $C_{32}H_{54}O_2$, as established by the analyses of the compound itself, its hydrogen phthalate and succinate, and its diacetate. It is converted by boiling formic acid (90%) into an isomeric substance, allobetulin, which contains one hydroxy group, the other oxygen atom being contained in an ether-like group. Allobetulin and its derivatives have higher melting points and are less soluble than betulin and its compounds and are more stable towards chemical reagents. Apparently betulin and allobetulin belong to the dextrorotatory phytosterols. (*Cf.* J.C.S., Nov.)
—H. W.

Aromatic arsenious acids; Synthesis of ——. H Bart. Annalen, 1922, **429**, 55—103.

Details are given for the preparation of the following arsenious acids by the interaction of a diazonium solution with acid or alkaline arsenit solution:—phenylarsenious acid, *o*-, *m*-, and tolylarsenious acids, *p*-ethoxyphenylarsenious aci p-acetylaminophenylarsenious acid, o-, m-, and p-chlorophenylarsenious acids, o-, m-, and p-carboxyphenylarsenious acids, p-phenylenediarsenious acid, o- and p-hydroxyphenylarsenious acids, o-, m-, and p-nitrophenylarsenious acids, op-dinitrophenylarsenious acid, 5-nitro-2-hydroxyphenylarsenious acid, o-nitro-p-hydroxyphenylarsenious acid, and m-nitro-p-hydroxyphenylarsenious acid. Diphenylhypoarsenious acid is obtained from benzenediazonium chloride and phenylarsine oxide, p-nitrophenylhypoarsenious acid by reduction of p-nitrophenylarsenious acid, and di-p-nitrophenylhypoarsenious acid by treatment of the preceding compound with diazotised p-nitroaniline.—C. K. I.

Aromatic arsenious acids; Synthesis of —— by the interaction of isodiazo-compounds with the arsenite ion. H. Bart. Annalen, 1922, **429**, 103—113.

The same end product is obtained if in the general reaction referred to in the preceding abstract the diazonium solution is replaced by alkaline isodiazotates. Details are given for the preparation by this method of the following substances: o-, m-, and p-nitrophenylarsenious acids, phenylarsenious acid, o-carboxyphenylarsenious acid, and p-carboxyphenylarsenious acid.—C. K. I.

Salvarsan base (mml-diamino-pp'-dihydroxyarsenobenzene); Two new syntheses of ——. H. Bart. Annalen, 1922, **429**, 113—122.

The first synthesis consists in converting 3-amino-3-hydroxyazobenzene into 4-hydroxy-3-phenylazophenylarsenious acid, which on reduction yields the required substance. The second synthesis starts with p-nitro-o-aminophenol, which is condensed with chlorocarbonic ester, and the urethane so obtained reduced to give p-amino-o-carbethoxyaminophenol. This is readily converted into m-carbethoxyamino-p-hydroxyphenylarsenious acid, which on reduction gives the urethane of the required base.—C. K. I.

Gallaldehyde and its derivatives. K. W. Rosenmund and E. Pfannkuch. Ber., 1922, **55**, 2357—2372.

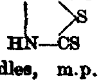
Reduction of gallaldehyde by hydrogen in the presence of spongy platinum or palladium gives an amorphous product of high molecular weight instead of gallyl alcohol. Gallaldoxime is reduced mainly to digallylamine $NH[CH_2.C_6H_2(OH)_3]_2$. Triacetylgallaldoxime acetate, on the other hand, gives triacetylgallylamine from which gallylamine is obtained by hydrolysis. Unexpectedly, the bases and their acetyl derivatives excite a powerful contractile action on the isolated uterus of the guinea-pig. (*Cf.* J.C.S., Nov.)—H. W.

Dulcin; Derivatives of ——. P. Herrmann. Annalen, 1922, **429**, 163—174.

The preparation of a number of derivatives and analogues of dulcin is described. None of them however possess sweetening properties. (*Cf.* J.C.S., Dec.)—C. K. I.

Diethylrhodanine. C. S. Leonard. Med. K. Vetenskapsakad. Nobelinst., 1922, **4**, [14], 1—13.

Diethylrhodanine was prepared with the object of determining the effect of ring sulphur on a substance which might be expected to have narcotic properties. It was obtained by condensing α-bromodiethylacetic acid, $(C_2H_5)_2CBr.CO_2H$, with ammonium dithiocarbamate in alcohol. Diethylrhodanine (5-diethyl-2-thioketo-4-thiazolidone)



$$\begin{matrix} OC—C(C_2H_5)_2 \\ | \quad \quad > S \\ HN—CS \end{matrix}$$

crystallises in needles, m.p. 107·5° C. When injected into a rabbit intramuscularly dissolved in oil or intravenously dissolved in sodium bicarbonate solution it had a narcotic effect slightly greater than that of veronal, with a quicker recovery; given by the mouth it was inactive but when injected intravenously as an emulsion with gum arabic it immediately caused death from respiratory failure. On account of its low solubility in water it can have no practical therapeutic value.—E. H. R.

Ketones; Decomposition of aliphatic ——. A. Mailhe. Bull. Soc. Chim., 1922, **31**, 863—867.

The decomposition of mixed ketones in contact with copper-aluminium at 600° C. (*cf.* J., 1922, 727 A) was studied, the substances dealt with being methyl isopropyl ketone, methyl isobutyl ketone, methyl butyl ketone, methyl isoamyl ketone, isobutyrone, isopropyl isobutyl ketone, and œnanthone,

$$C_6H_{13}.CO.C_6H_{13}.$$

In each case the CO group is liberated almost entirely as carbon monoxide and the residues transformed into ethylenic or saturated hydrocarbons by loss or gain of hydrogen. In the case of butyl, isobutyl and heavier residues further decomposition occurs, wholly or in part, into simpler groups. Analyses of the products are given in each case and show that the substances obtained on decomposition are mainly gaseous; small changes in temperature are sufficient to affect considerably the nature of the products.—H. J. E.

Bornylene; Preparation of ——. H. Meerwein and J. Joussen. Ber., 1922, **55**, 2529—2533.

Nearly pure bornylene, solidifying point 108°—107° C. instead of 113° C. as recorded in the literature for the homogeneous substance, is prepared by the action of a 10% solution of potassium amyl oxide in amyl alcohol on bornyl chloride at 230° C. or on bornyl bromide at about 190° C. (*Cf.* J.C.S., Nov.) —H. W.

Oil of maritime pine [Bordeaux turpentine]; Constituents of ——. G. Dupont. Chim. et Ind., 1922, **8**, 549—554.

By slow fractionation of Bordeaux turpentine in a vacuum through a specially constructed column, 2 m. high, a very considerable separation into α- and β-pinene was effected. The column was provided with numerous cups of nickel gauze, each carrying a glass overflow tube of sufficiently large diameter to allow a plentiful reflux. By one fractionation a separation of 50% of α-pinene of 90% purity was achieved, and the same amount of almost pure α-pinene having α = −39·5° compared with −40·1° for the pure substance was isolated by a second distillation of the fractions first obtained by operating in such a way that a new fraction was added as soon as the calculated rotation of the residue was equal to that of the fraction about to be added. Although no break whatever was observed in the boiling point curve, a notable inflexion was obtained in the curve for the rotation when about 55% had passed over, and a fairly constant value at α = −21° was given between the approximate limits of 73 to 80%, the distillate then consisting mainly of β-pinene (nopinene). From the values obtained it was calculated that the original entire fresh turpentine contained 63% of α-pinene and 26·5% of β-pinene. The remaining 10% was represented by the last fractions boiling above 60° C. at 15 mm. pressure. The presence of these higher fractions cannot be attributed entirely to oxidation of the turpentine, and they must be regarded as normal constituents of the oil. By fractionation three main fractions were isolated. The fraction boiling at 77°—80° C. at 15 mm. was strongly dextrorotatory, and dipentene, sobrerol, and an at present unidentified strongly dextrorotatory hydrocarbon were detected in it. The fractions boiling at about 100°

—120° C. at 15 mm. appeared to consist of oxidation products, among which were a ketone, pinol, and traces of an alcohol and ester. The highest fraction consisted of a new dextrorotatory sesquiterpene, giving a crystalline nitrosite, m.p. 109°—110° C. —G. F. M.

Turpentine; Rôle of the various constituents of —— in industrial syntheses. G. Dupont. Chim. et Ind., 1922, **8**, 555—558.

In the syntheses of terpin, terpineol, and borneol from pinene the presence of nopinene (β-pinene) is actually an advantage, as it gives exactly the same products in these cases as does α-pinene, and in general in better yield and with a greater reaction velocity. The presence of the last runnings in the pinene used, is, on the other hand, very disadvantageous, and all fractions boiling higher than nopinene should therefore be eliminated. The presence of fenchol in crude synthetic terpineol and borneol is probably to be ascribed to the higher boiling constituents of the turpentine used in the synthesis, as it is nearly or entirely absent when rectified pinene is used. The formation of fenchol is certainly not due to the presence of nopinene in the starting material, as was asserted by Barbier and Grignard (J., 1909, 672). The identity of the products obtained from α- and β-pinene depends, however, on one of the two atoms or groups which are added on to the pinene molecule being a hydrogen atom; in all other cases the products would be different, and a separation of the two isomerides would be necessary in order to obtain satisfactory yields of an individual product.—G. F. M.

Silver; Oligodynamic effect of ——. R. Doerr and W. Berger. Biochem. Zeits., 1922, **131**, 351—361.

The active agent in all oligodynamic effects is the silver ion. Silver surfaces lose their activity by treatment with potassium cyanide, and water activated by silver is inactivated by potassium cyanide. The inactivation is due to conversion of the active silver ion into inactive $Ag(CN)_2$ ions. Carbon dioxide and oxygen are the constituents of the air which activate silver surfaces, each being more potent in developing activity than air itself. —H. K.

Patents.

Methane; Chlorination of ——. Holzverkohlungs-Ind. A.-G., and K. Róka. E.P. 186,270, 22.11.21.

The chlorine used in the chlorination of methane at 400°—500° C. is diluted with 2—5 vols. of steam. The degree of chlorination can be very largely controlled by varying the proportions of the reacting gases and of the steam, and catalysts, such as the chlorides of copper, iron, calcium, or magnesium can be advantageously employed. Using a quartz tube 70 cm. long and 40 mm. diam., filled with pieces of firebrick, and passing 25 l. of methane, 38 l. of chlorine, and 100 g. of steam per hour the chlorine is distributed in the reaction products as follows: 53% as HCl, 8% as CH_3Cl, 13% as CH_2Cl_2, 20% as $CHCl_3$, and 5% as CCl_4. The same amount of steam and 37 l. of both methane and chlorine give 52% as HCl, 12% as CH_3Cl, 21% as CH_2Cl_2, 14% as $CHCl_3$, and 1% as CCl_4. 41 l. of methane, 20 l. of chlorine, and 70 g. of steam give 51% as HCl, 26% as CH_3Cl, 20% as CH_2Cl_2, 1% as $CHCl_3$, and no CCl_4. —G. F. M.

Mucic acid and other products; Method of converting wood into ——. S. F. Acree. E.P. 160,777, 18.3.21. Conv., 25.3.20.

Mucic acid is produced by the oxidation of galactose, obtained from larch wood or other cellulosic material containing galactan by hydrolysis as described in E.P. 160,776 (p. 910 A). The oxidation is carried out at 50°—85° C. by means of nitric acid containing nitrogen oxides. Suitable proportions are 10% of galactose and 25% of nitric acid oxidation mixture. The crude mucic acid is purified by dissolving in ammonia to form the di-ammonium salt, clarifying the solution with animal charcoal, and re-precipitating with acid. The mother liquors from the crude acid can be used to oxidise further quantities of galactose or to hydrolyse more wood to galactose, or may be worked for other by-products such as oxalic, gluconic, and saccharic acids.—W. H. G.

Alkali salts of oxidised protalbinic acid and of oxidised lysalbinic acid as stable protective colloids for mercury compounds. M. E. Wolvekamp. U.S.P. 1,391,154, 20.9.21. Appl., 27.3.20.

The action of the alkali salts of protalbinic and lysalbinic acids (Paal, J., 1909, 996) as protective colloids is considerably improved by oxidising them with a mixture of alkali hydroxide and mercuric oxide. For the oxidised acids the names protoxalbinic acid and lysoxalbinic acid (or oxalbinic acid for a mixture of both oxidised acids) are proposed. Stable colloidal preparations of mercuric oxide, sulphide, and salicylate can be prepared with the aid of the alkali salts of the oxidised acids; these preparations can be evaporated to dryness, and the residues on treatment with water yield colloidal solutions which may be boiled without precipitation of free mercury.

Montan wax; Chlorination of ——. A. Deschauer. U.S.P. 1,429,932, 26.9.22. Appl., 22.5.22.

Chlorination is effected in an aqueous medium. —T. A. S.

Acetic anhydride; Manufacture of ——. H. Dreyfus. U.S.P. 1,430,304, 26.9.22. Appl., 24.5.21.

Acetic anhydride is prepared by treating an acetate with a pyrosulphate.—T. A. S.

Arsenobenzene derivatives; Stable —— and process of making same. W. Kolle and A. Binz, Assrs. to Farbw. vorm. Meister, Lucius, und Brüning. U.S.P. 1,431,671, 10.10.22. Appl., 20.10.21.

Arsenical preparations which are stable in solution are prepared by mixing water-soluble arsenobenzene compounds of the type, $R.NHR_1$, where R is an arsenobenzene residue and R_1 a sulphoxylate or carbamate residue, with other water-soluble arsenobenzene compounds.—G. F. M.

Acetylsalicylic acid; Proce[illegible] for obtaining the calcium salt of ——. J. Altwegg, Assr. to Soc. Chim. des Usines du Rhône. U.S.P. 1,431,863, 10.10.22. Appl., 11.1.22.

Calcium acetylsalicylate is prepared by neutralising acetylsalicylic acid with the calculated amount of calcium hydroxide in presence of a solution of sodium chloride.—G. F. M.

Lecithin; Recovery of —— from organs of cold-blooded animals. J. Grossfeld. G.P. 357,081, 6.7.18.

Dried, finely-powdered fish roe or the like is treated with organic solvents capable of extracting fat and cholesterol, *e.g.*, ether, and the residue is treated for about 3 hrs. with boiling methyl alcohol. The solution is evaporated to dryness, yielding a brown, highly viscous, colloidal product which is soluble in fats and oils, and in ethyl acetate and acetone, and which, either alone or dissolved in oils, readily forms emulsions with water. The product absorbs up to 150% I, and is suitable for the preparation of solutions of lecithin in cod-liver oil, for injection, and for use as an ointment base.—L. A. C.

Yeast and tannin; Production of compounds of ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 357,140, 4.1.21.

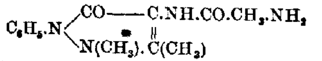
Pressed beer-yeast mixed with water or liquefied with sodium chloride is digested with tannin or its aqueous tannin solution for several hours at 40°—50° C. After neutralisation with sodium hydroxide, the product is filtered, and the residue is washed, dried, ground, and heated to 110°—125° C. for several hours. The astringent properties of the product render it of therapeutic value.—L. A. C.

Material for the serodiagnosis of syphilis; Purification of ——. A. von Wassermann. G.P. 357,244, 27.4.20.

ANTIGENS such as alcoholic or aqueous extracts of yphilitic organs and normal organs, or lipoids, are added to human or animal blood serum which has been rendered inactive by heating to 55° C., and which shows a positive Wassermann reaction. After interaction between the antigens and material present in the serum, the product is subjected to ultra-filtration, the filtered liquid being practically ree from impurities. A normal solution for Wassermann's reaction is prepared by adding the desired quantity of the liquid antigens to a measured uantity of the liquid obtained as above, the mallest quantity which gives a complete Wassermann's reaction being a normal solution. A quantitative estimation of antigens, *i.e.*, a quantitative ontrol of the Wassermann reaction, is thus possible.—L. A. C.

4-Amino-1-phenyl-2.3-dialkyl-5-pyrazolone; Preparation of N-aminoacetyl compounds of ——. Farbw. vorm. Meister, Lucius, und Brüning. G.P. 357,752, 1.3.18.

THESE compounds are obtained by the action of aqueous ammonia on chloroacetyl-4-amino-2.3-dialkyl-1-phenyl-pyrazolones, or by the action of acids on the addition compounds of these substances with hexamethylenetetramine. For example 4-chloroacetylamino-2.3-dimethyl-1-phenyl-5-pyrazolone, m.p. 187° C., obtained by the action of chloroacetyl chloride on 4-amino-2.3-dimethyl-1-phenyl-5-pyrazolone in aqueous solution in presence of an acid-fixing substance, is mixed in chloroform solution with hexamethylenetetramine, and the addition compound which is precipitated after standing for several days is dissolved in alcohol and the solution mixed with concentrated hydrochloric acid. 4-Aminoacetylamino-2.3-dimethyl-1-phenyl-5-pyrazolone



$$C_6H_5.N\left\langle\begin{array}{l}CO——C.NH.CO.CH_2.NH_2\\ N(CH_3).\overset{\|}{C}(CH_3)\end{array}\right.$$

s thereby obtained as its dihydrochloride, an acid reacting substance which is converted into the neutral monohydrochloride by treatment with sodium ethoxide. This substance decomposes without melting at 260°—265° C. The corresponding 2-ethyl-3-methyl compound may be similarly obtained, or by the action of ammonia on 4-chloroacetylamino-2-ethyl-3-methyl-1-phenyl-5-pyrazolone, m.p. 186° C. The free bases are more soluble in water than pyramidone (dimethylaminoantipyrine). They are useful therapeutically as febrifuges.
—G. F. M.

Mercury compounds; Process of extending the catalytic activity of —— [in oxidation of acetylene]. N. Grünstein and P. Berge. U.S.P. 1,431,301, 10.10.22. Appl., 21.5.19.

SEE E.P. 143,891 of 1920; J., 1921, 368 A.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

ron as a photochemical catalyst. I. Decomposition of potassium ferrocyanide in daylight. O. Baudisch and L. W. Bass. Ber., 1922, 55, 2698—2706.

THE photochemical decomposition of alkaline solutions of potassium ferrocyanide on exposure to light may be considered to occur in two phases. The first is the change in colour from pale yellow to lemon yellow, which is reversed in the dark and which occurs in a vacuum; it is accompanied by development (reversible) of alkalinity in the solution in which the presence of active oxygen cannot be detected. The change, if protracted, leads to the separation of small quantities of colourless ferrous hydroxide. The change is represented by the scheme:—

$$\left[Fe\ \begin{array}{c}NC\\(NC)_5\end{array}\right]\begin{array}{l}K\\K_3\end{array}\xrightarrow{+H_2O+\text{light}}\left[Fe\ \begin{array}{c}NC.H\\(NC)_5\end{array}\right]\begin{array}{l}K.OH\\K_3\end{array}$$

The second phase is the hydrolytic elimination of the potassium cyanide group, which is enormously accelerated by oxygen.

$$\left[Fe\begin{array}{c}NC.H\\(NC)_5\end{array}\right]\begin{array}{l}K.OH\\K_3\end{array}\xrightarrow{H_2O}\left[Fe\begin{array}{c}OH_2\\(NC)_5\end{array}\right]K_3+HCN+KOH.$$

(*Cf.* J.C.S., Nov.)—H. W.

PATENTS.

Photographic film; Antistatic ——. A. S. McDaniel, Assr. to Eastman Kodak Co. U.S.P. 1,431,894, 10.10.22. Appl., 26.3.21.

THE photographic film consists of a support, *e.g.*, of nitrocellulose, carrying a layer of sensitive material and a layer of material, *e.g.*, cellulose acetate, which is not softened by photographic baths and which contains a hygroscopic material.—W. C.

[Photographic] antistatic films; Base for —— and compositions for making the same. P. C. Seel, Assr. to Eastman Kodak Co. U.S.P. 1,431,900, 10.10.22. Appl., 16.4.21.

A FLEXIBLE transparent support which is suitable for the production of antistatic film when coated with a photographic emulsion, consists of molecularly intact nitrocellulose together with an inert metallic salt, an inert hygroscopic organic compound of low volatility, and water.—W. C.

Film for the episcopic projection of photographs and cinematographs. Akt.-Ges. für Anilin-Fabr. G.P. 357,010, 7.11.20.

A FILM for episcopic projection consists of cellulose ethers or esters with particles of finely divided metals embedded therein as image carriers.
—L. A. C.

Photographic transfer film. Farbenfabr. vorm. F. Bayer und Co. G.P. 357,011, 19.10.20.

A FILM consisting of cellulosic compounds and gelatin is formed, without an intermediate layer, on a suitably prepared carrier, and can be stripped from the carrier when dry.—L. A. C.

Colour photography; Negative material for ——. E. Wolff. E.P. 168,035, 21.4.21. Conv., 14.8.20.

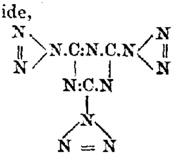
SEE G.P. 345,734 of 1920; J., 1922, 567 A.

XXII.—EXPLOSIVES; MATCHES.

PATENTS.

Explosive and process of making same. E. Ott, Assr. to E. H. Faust. U.S.P. 1,390,378, 13.9.21. Appl., 25.5.20.

CYANURIC triazide,



prepared by the action of aqueous solutions of sodium azide on cyanuric halides, is claimed as an explosive. It forms colourless crystals, m.p. 94° C., is not volatile, not changed by cold water, but slowly decomposed by hot water, explodes when subjected to violent concussion, when heated to 170° C., or when heated suddenly. It is not poisonous, does not attack metals, is superior as a priming agent to mercury fulminate, lead azide, and silver azide; is suitable for the preparation of Flobert ammunition and ammunition for other small fire-arms; and in the molten state is a good solvent for most of the organic substances usually employed as explosives for grenade loadings, torpedoes, etc.—H. C. R.

Nitrating apparatus. G. Juer. U.S.P. 1,431,161, 10.10.22. Appl., 1.7.20.

The apparatus consists of a series of 16 or more nitrating pots arranged around the periphery of a rotary table to which regular increments of movement can be imparted. A centrifuge is placed adjacent to the table so as to receive the contents of the nitrating pot opposite to it when the table is at rest. An acid filling tank is also situated adjacent to the path of movement of the pots and at a distance from the centrifuge equal to the increment of movement of the table. A mechanical agitator is arranged above the path of movement of the pots with the table at a distance from the acid tank equal to a multiple of the increment of movement of the table.—G. F. M.

Explosive having liquid air as a base. G. Weber, Assr. to Soc. Les Petits Fils de F. de Wendel et Cie. U.S.P. 1,431,711, 10.10.22. Appl., 25.8.21.

An explosive is composed of liquid air, calcium silicide, and a combustible organic substance. —A. R. P.

XXIII.—ANALYSIS.

Specific gravity of small amounts of liquid; Apparatus for the rapid determination of the ——. E. Wiedbrauch. Z. anorg. Chem., 1922, 122, 167—170.

Water and the liquid in question are contained in two U-tubes which are in communication with one another and with a manometer, the heights of the liquids which balance various pressures are measured, and the specific gravity then calculated. —W. T.

Artificial daylight (Sheringham system); Application of —— to laboratory purposes. S. H. Groom. Analyst, 1922, 47, 419—423.

The correction of the light given by a gas-filled electric lamp to that of north sky light involves the elimination of progressively more energy from the blue to the red end of the spectrum. This may be accomplished either by passing the light through a suitably coloured glass screen, or by reflecting the light from a suitably coloured reflector. The latter method has been employed for the first time in the Sheringham Daylight lamp. The change produced in the appearance of coloured objects under different illuminants varies widely in different cases. If the object is one which transmits or reflects only a small portion of the spectrum, the change in colour is comparatively small. The greatest change is shown in the case of an object which reflects two widely different portions of the spectrum more strongly than the intervening portions, as in the case of a purple pigment.—H. C. R.

Daylight lamp; Use of the —— in volumetric and colorimetric analysis. W. Singleton. Analyst, 1922, 47, 424—426.

Titrations were carried out using $N/50$ solutions and a large number of the more common indicators by natural daylight, artificial daylight from an Osram "daylight" glass lamp, and the light of an ordinary vacuum electric lamp. In most cases the degree of accuracy possible in the determination of the end-point was at least as great with artificial daylight as with natural daylight. Ordinary artificial light gave uniformly less accurate titrations except when thymol blue was used as the indicator. The use of the daylight lamp also greatly increased the ease with which great accuracy could be obtained.—H. C. R.

Mixed indicators; Use of ——. A. Cohen. J. Amer. Chem. Soc., 1922, 44, 1851—1857.

The differences of subjective colour are enhanced when two indicators are partially transformed at the same hydrogen ion concentration. The colorimetric estimation of hydrogen ion concentration may, therefore, be rendered more precise by the use of suitable mixed indicators and in certain titrations sharper end points may be obtained, particularly in coloured liquids. Thus with bromothymol blue as indicator the value p_H 6·8 is indicated by a pure green colour, but in a yellow medium the colour is yellowish-green and difficult to observe; if, however, an indicator is added which is violet at this concentration, then the total effect of the mixed indicators will be a green end point. This may be achieved by adding equal quantities of bromothymol blue and bromocresol purple. Several examples of the use of mixed indicators are described.—J. F. S.

Sulphuric acid; Estimation of —— as barium sulphate in the presence of aluminium. L. Moser and P. Kohn. Z. anorg. Chem., 1922, 122, 299—310.

The results of the estimation of sulphuric acid as barium sulphate in the presence of aluminium are too low, owing to the adsorption of aluminium sulphate by the barium sulphate. The amount adsorbed increases at first with the concentration of the aluminium salt but soon reaches a limit. The error is only one-tenth of that observed in corresponding determinations in the presence of ferric salts. The best results were obtained in hydrochloric acid solutions, where the maximum error was found to be −0·15%.—W. T.

Calcium; Estimation of small quantities of ——. P. P. Laidlaw and W. W. Payne. Biochem. J., 1922, 16, 494—498.

The method described is suitable for estimating calcium in amounts of the order of 0·1 mg., and gives results accurate to about 0·002 mg. The calcium is precipitated as oxalate (in the case of blood serum, this may be done directly from the serum without previous incineration). After separation, the precipitate is dissolved in hydrochloric acid and the calcium re-precipitated in the form of calcium alizarinate by the addition of excess of alizarin in alcoholic solution, and, after warming, of a few drops of strong ammonia. When crystalline, the precipitate is collected in a Gooch crucible, washed with dilute ammonia, and decomposed with a solution of oxalic acid in 50% alcohol. The liberated alizarin is dissolved in 95% alcohol, made just alkaline with ammonia, and estimated colorimetrically by comparison with a standard solution of ammonium alizarinate.—E. S.

Copper; Microchemical estimation of ——. G Spacu. Bul. Soc. Stiinte Cluj, 1922, 1, 296—301 Chem. Zentr., 1922, 93, IV., 737—738.

The green compound described previously (J., 1922 881 A) is precipitated in a double separating funne in which the upper and lower compartments hol 35 c.c. and 5 c.c. respectively. After precipitation, the solution is shaken three times with 2 c.c chloroform in the upper compartment, and the loroform, after settling, is run into the lower npartment, whence it is drained into a porcelain ucible. The chloroform is evaporated *in vacuo* in lesiccator, and the precipitate is either weighed $CuPy_2(CNS)_2$, or is converted into cupric oxide sulphide before weighing.—L. A. C.

ductions with cadmium in volumetric analysis. II. W. D. Treadwell, M. Blumenthal, M. Stärkle, M. Hooft, M. Dreifuss, and A. Bossi. Helv. Chim. Acta, 1922, 5, 732—743.

NTINUING previous work (J., 1921, 605 A) it is own that when uranyl salts are reduced with ely divided zinc or cadmium, reduction is inclined go beyond the uranous stage to the U''' stage. is may be corrected by allowing the solution from e reduction tube to fall drop by drop into a vessel posed to the air, when the trivalent uranium is idised to the uranous stage. It can then be trated accurately with permanganate. To prent oxidation of the uranous salt to the uranyl age by air, the solution should be fairly strongly id, about 3·0 N sulphuric acid being convenient. the electrometric method of titration is used, er-reduction can be ignored, since the distance tween the two breaks in the curve gives the titre. or technical purposes the over-reduction is so ight when cadmium is used that, for estimating all quantities of uranium in very dilute solution, can be ignored. Titanium and uranium can be timated together in dilute solution by reduction ith cadmium and electrometric titration with peranganate in an atmosphere of carbon dioxide. By e same method small quantities of titanium can determined in presence of large quantities of on, using potassium bichromate for the titration. anadic acid is reduced quantitatively to the V'' age if air is carefully excluded, and the reduced lution can be titrated with permanganate. It is st to run the reduced solution direct into the idified permanganate (a quantity within 0·5 c.c. that necessary) previously freed from air. ndigo can be estimated by dissolving in sulphuric cid monohydrate at 70° C., cooling and diluting ith water to give a solution 0·05 to 0·01N with espect to indigo and 0·2 to 0·5N with respect to lphuric acid. The solution is then reduced to the uco stage by running through a reduction ube (about 7—8 cm. by 1·8 cm.) filled with nely divided cadmium. The reduced solution is llected in an atmosphere of carbon dioxide and trated with ferric chloride electrometrically. The egree of accuracy is very high. Thioindigo and ethylene Blue can be estimated in a similar maner. (*Cf.* J.C.S., Nov.)—E. H. R.

eductions with cadmium and lead in volumetric analysis. III. W. D. Treadwell, P. Hristic, L. Egger, P. Sturzenegger, A. Freuler, A. Weber, and R. F. Edelmann. Helv. Chim. Acta, 1922, 5, 806—818.

HE cadmium reduction tube previously described ., 1921, 605 A) can be used for the reduction of lorate in dilute sulphuric acid solution. The sulting solution of chloride is then titrated with ver nitrate by the Volhard method. Perchlorate not reduced under these conditions, consequently lorate can be determined in presence of perlorate. The latter can be reduced to chloride by iling in sulphuric acid solution (about 10 c.c. of ncentrated acid to 50 c.c. of $N/10$ perchlorate soluon) in presence of titanium sulphate with finely vided cadmium for ½ to 1 hr. A small amount cadmium sulphide which is formed does not terfere. After cooling, the solution is diluted d the titanous sulphate present is oxidised with rmanganate. The chloride is then titrated with ver nitrate either electrometrically or by the Volhard process. For the reduction of niobic acid, followed by titration with permanganate, Metzger and Taylor reduced with amalgamated zinc a sulphuric acid solution of niobic acid stabilised with succinic acid (*cf.* Taylor, J., 1909, 818). It is shown that this solution is far from stable; it gradually becomes opalescent and in course of time its reducibility diminishes. The reducibility of a niobic acid solution depends on the degree of dispersity of the colloidal particles of the acid. The most consistent results were obtained with a solution of the fluoride in concentrated hydrochloric acid. After removal of hydrofluoric acid the solution was passed through a cadmium reduction tube, and then titrated electrometrically with ferric chloride. Although the results were consistent, it does not appear that reduction was carried completely to the Nb''' stage. Molybdate can be reduced quantitatively to the Mo''' stage in hydrochloric acid solution, and stannic chloride to the stanous stage, by finely divided lead. The reduced solutions were titrated with permanganate after addition of manganous sulphate. The lead was prepared by immersing a zinc rod in acidified lead acetate solution, washing the lead crystals formed with alcohol and ether and drying in a vacuum. The material so obtained was used in a reduction tube.—E. H. R.

Manganese; New method for the estimation of ——. S. Minovici and C. Kollo. Chim. et Ind., 1922, 8, 499—500.

MANGANESE may be accurately estimated, even when present in very small quantities, by precipitation as iodate by means of iodic acid, according to the equation

$$MnSO_4+2HIO_3=Mn(IO_3)_2+H_2SO_4.$$

A solution of about twice the theoretical quantity of iodic acid is added to the manganese solution, and after warming for 10 mins. on a water bath, twice the volume of alcohol is added. After a short time the precipitate settles down, and is collected on a filter or Gooch crucible and washed with 70% alcohol, preferably saturated with manganous iodate. The washed precipitate is dried at 100° C., and weighed. The mother liquors contain no trace of manganese, as the iodate is insoluble in 70% alcohol in presence of excess of iodic acid. In water at ordinary temperatures the solubility of the iodate is 0·195%, and in 70% alcohol 0·005%. The absolute percentage error in the examples given varied from 0·16 to 0·63% when quantities of the order of 0·1—0·3 g. of the hydrated sulphate were taken for estimation.

—G. F. M.

Precipitations with hydrogen sulphide; Hindrance of —— by neutral chlorides. L. Dede and P. Bonin. Ber., 1922, 55, 2327—2331.

THE precipitation of lead sulphide from 1/1000 molar solutions of lead chloride in water by hydrogen sulphide at 20° C. is completely inhibited by the presence of hydrochloric acid in a concention of 1·4N. In the presence of increasing concentrations of calcium, ammonium, or potassium chloride, decreasing concentrations of hydrochloric acid are sufficient to suppress precipitation entirely. Incomplete precipitation of lead sulphide is observed with considerably lower concentrations of hydrochloric acid. At higher temperatures, the effect of hydrochloric acid in the presence of neutral chlorides is still more marked. Similar results to those obtained with lead choride are also obtained with cadmium salts and apparently with tin salts. The precipitation of lead sulphide is hampered to a less degree by the presence of perchloric acid. In this case the addition of sodium perchlorate favours precipitation presumably by depressing the dissociation of the acid. The precipitation of lead chromate from acetic acid solution is incomplete in the presence of much chloride; in ammoniacal solution this is not the case.—H. W.

Iodometric method; New —— based on the formation and the estimation of cyanogen iodide. R. Lang. Z. anorg. Chem., 1922, 122, 332—348.

A volumetric method for the estimation of iodides is given based on the fact that an iodide will react with an oxidising agent ($\mathrm{KMnO_4}$) and hydrocyanic acid in the presence of hydrochloric and sulphuric acids to give cyanogen iodide, the end point being indicated by starch solution. This can be controlled by estimating the cyanogen iodide with thiosulphate

$$\mathrm{ICN}+\mathrm{S_2O_3}''+\mathrm{H}^{\cdot}\rightarrow\mathrm{I}'+\mathrm{S_4O_6}''.$$

The method is applicable in the presence of bromides and nitrates and can also be employed for the determination of the different stages of oxidation of iodine in mixtures. The reactions of hydrocyanic acid with iodine mono-chloride and hypoiodous acid have also been investigated.
—W. T.

See also pages (A) 885, *Relation of melting point to boiling point* (Lorenz and Herz). 891, *Fastness of dyestuffs* (Setlik). 893, *Sulphite liquors* (Sieber). 896, *Nitric oxide* (Klemenc and Bunzl). 897, *Separation of cerium* (Prandtl and Löschl). 902, *Liver oil* (Richmond and England). 907, *Tannin* (Atkinson and Hazleton); *Water-soluble matter in leather* (Hough). 908, *Nitrate fertilisers* (Mach and Sindlinger). 909, *Oxalic acid* (Müller). 911, *Malt analysis; Standard for estimation of colour in beers and worts* (Lampe); *Volatile acidity of wines containing sulphurous acid* (Marcille). 912, *Citric acid in wine and musts* (Von der Heide and Straube); *Rum* (Schäffer); *Butter* (Fascetti).

Patent.

Flash point of oils; Apparatus for determining ——. F. H. M. Klee. E.P. 185,814, 3.6.21.

The oil to be tested is contained in a vessel surrounded by an electrically heated water jacket. A stirrer is provided for the oil and the vapours above it. Ignition is effected by a spark or a coil heated to redness. The top of the vessel can be removed for open cup tests. A modification consists of an electrically heated vessel into which high-boiling oils of high flash-point may be dropped to determine their ignition temperature in the presence of heated air or oxygen.—T. A. S.

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given; they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Algem. Norit Maatsch. Compression, storage, and treatment of gases. 30,724. Nov. 10. (Holland, 14.11.21.)

Algem. Norit Maatsch. Drying gases. 30,725. Nov. 10. (Holland, 14.11.21.)

Algem. Norit Maatsch. Treating liquids. 30,726. Nov. 10. (Holland, 14.11.21.)

Arbuckle. Means for separating liquid and soli components of mixtures. 30,318. Nov. 6.

Baker. Regenerative furnaces. 29,409. Oct. 27.

Barnes and Fleming. Grinding mills. 28,846 Oct. 24.

Boberg, Söderlund, Testrup, and Techno Chemical Laboratories. Separating solids from liquids. 30,014 and 30,700. Nov. 2 and 9.

Bräuer. Cooling fluids. 30,233. Nov. 4.

Brinjes and Goodwin, and Seaman. Grinding mixing, etc. mills. 28,977. Oct. 24.

Broadbent and Sons, and Sturgeon. Centrifuga separators. 30,509. Nov. 8.

Chemical Engineering Co., and Spensley. Producing intimate mixtures of substances and obtaining chemical products. 29,728. Oct. 31.

Griffiths and Passburg. Obtaining large crystals from solutions. 29,064. Oct. 25.

Heenan. Drying air and gases. 29,767. Oct. 31.

Henshaw, Whittell, and Holmes and Co. Apparatus for bringing liquids and gases into intimate contact. 30,346. Nov. 7.

Kirke. 30,689. *See* XIX.

Lehane and Ruck. 30,764. *See* II.

Nitrogen Corp. Drying gases. 29,792. Oct. 31. (U.S., 9.11.21.)

Porteus. Mixing-machines for granular or pulverulent substances. 30,168. Nov. 4.

Raper. Drying-machines. 28,869. Oct. 24.

Sklenar. Reverberatory furnace. 30,649. Nov. 9.

Smidth and Co. (Smidth & Co.). Ball and tube mills. 30,538. Nov. 8.

Soc. des Condenseurs Delas. Evaporating, concentrating, distilling, etc. apparatus. 28,971. Oct. 24. (Fr., 21.7.21.)

Techno-Chemical Laboratories, and Testrup. Rotatable heat-transmitting appliances. 29,239. Oct. 26.

Tooth. Treatment of smoke and fumes. 28,842. Oct. 24.

Vallez. Coating filtering-frames. 29,168. Oct. 26.

Wade (Standard Development Co.). Manufacture of foam-forming liquids. 30,487. Nov. 7.

Weston. Gyratory crushers. 30,486. Nov. 7.

Complete Specifications Accepted.

11,972 (1921). Paterson. Filtering apparatus. (187,259.) Nov. 1.

12,048 (1921). Thompson (Sharples Specialty Co.). Centrifugal emulsifiers. (187,642.) Nov. 8.

13,206 (1921) and 6593 (1922). Rigby. Heatin or cooling liquids or admixed solids and liquids i evaporative or like treatment. (187,260.) Nov. 1

14,147 (1921). Weddingen. Removing incrustations from boilers and softening feed-water (187,647.) Nov. 8.

17,017 (1921) and 8186 (1922). Meek. Furnaces (187,657.) Nov. 8.

19,220 (1921) and 11,748 (1922). Marr, and Cok Oven Construction Co. Continuous drying pulverulent materials, applicable to the manufacture of neutral ammonium sulphate. (187,320 Nov. 1.

19,848 (1921). Paterson. Filtering apparatu (187,708.) Nov. 8.

20,147 (1921). Thatcher. Manufacture of sem permeable separators such as diaphragms, diffusio walls, etc. (187,728.) Nov. 8.

20,158 (1921). Kestner. Washing and displac ment of gases. (168,867.) Nov. 15.

20,414 (1921). Davis. Filters. (188,059.) Nov. 1

21,659 (1921). Roth. Separation of fine materi (187,381.) Nov. 1.

25,393 (1921). Chem. Fabr. Griesheim-Elektro and Sander. Apparatus for washing material whi has been separated by centrifugal action. (187,42 Nov. 1.

27,176 (1921). Pomeroy. Pulverising-apparat (188,173.) Nov. 15.

30,096 (1921). Silver Springs Bleaching and Dyeing Co., and Hall. Treating certain waste liquors. (188,208.) Nov. 15.

33,507 (1921). Bamburg. Grinding or crushing machines. (187,884.) Nov. 8.

33,810 (1921). Schnetzer. Preventing formation of scale in boilers, evaporators, etc. (174,905.) Nov. 1.

33,938 (1921). Harvey and Buckley. Centrifugal drying-machines. (188,243.) Nov. 15.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Beilby. Hydrogenation of hydrocarbon oils and residues. 30,655. Nov. 9.

Boocock, Laing, and Nielsen. Manufacture of fuel briquettes etc. 29,384. Oct. 27.

Butler. Manufacture of liquid fuel. 29,789. Oct. 31.

Capon (Wells). Gas-producers. 30,550 and 30,552. Nov. 8.

Capon (Wells). Apparatus for cooling and cleaning gas. 30,551. Nov. 8.

Coley. Gas manufacture. 30,773. Nov. 10.

Diehl. Recovery of coal from waste by flotation. 29,522. Oct. 28. (Ger., 3.11.21.)

Edison Swan Electric Co., and Percival. Manufacture of metallic filaments for incandescent electric lamps etc. 28,805. Oct. 23.

Ferguson. Feldspar tanks for coal-washing. 30,374. Nov. 7.

Gas Research Co. Gas generators. 30,678. Nov. 9. (U.S., 20.6.22.)

Hollinshead. Briquette fuel. 28,719. Oct. 23.

Kirke. Water-gas plants. 29,068. Oct. 25.

Lamplough. Treatment of hydrocarbon-bearing substances. 30,746. Nov. 10.

Lehane and Ruck. Manufacture of retorts etc. 30,764. Nov. 10.

Lewis. Burning blast-furnace gas in steam boilers. 29,464. Oct. 28.

Lockwood. Treating coal etc. 29,111. Oct. 25.

Loriette. Production of liquid-fuel mixtures with alcohol as basis. 30,106. Nov. 3. (Fr., 3.11.21.)

Mann. Suction-gas producers. 30,453. Nov. 7.

Merz. Fuels. 28,963. Oct. 24.

Monnot. Cracking oils. 29,383. Oct. 27.

Oddy. Distilling coal, peat, wood, etc. 29,469. Oct. 28.

Oddy. Purifying etc. hydrocarbons etc. 29,470 and 29,472. Oct. 28.

Oddy. Light hydrocarbons etc. for motors and lighting. 29,471. Oct. 28.

Peebles. Instrument for indicating heating quality of gas. 30,182. Nov. 4.

Rideal. Elimination of sulphur from oil. 30,837. Nov. 10.

Southgate. Apparatus for distilling and testing carbonaceous matter. 28,768. Oct. 23.

Sumner. Manufacture of gas. 29,368. Oct. 27.

Wellman Seaver Morgan Co. Gas-producers. 30,899. Nov. 11. (U.S., 12.11.21.)

White. Treatment of petroleum etc. 29,240. Oct. 26.

White. Low-temperature carbonisation of carbonaceous material etc. 29,241. Oct. 26. (India, 18.1.22.)

Wood. Gas retorts. 30,919. Oct. 11. (Australia, 30.11.21.)

Complete Specifications Accepted.

32,120 (1920). Parker and Bamber. Gas-scrubbers. (187,999.) Nov. 10.

11,419 (1921). Accioly. Manufacture of an alcoholic liquid for use as combustible. (187,640.) Nov. 8.

13,633 (1921). West, Madden, Boardman, and West's Gas Improvement Co. Destructive distillation of coal and like carbonaceous materials. (187,263.) Nov. 1.

16,554 (1921). Turner. Gas-generators. (187,277.) Nov. 1.

16,826 (1921). Marlow. Gas-producers. (187,282.) Nov. 1.

17,352 (1921). Meguin A.-G. Butzbach, and Müller. Apparatus for carbonising bituminous substances, such as coal or shale, at low temperature. (168,859.) Nov. 8.

17,587 (1921). Markham, and Staveley Coal and Iron Co. Distillation of solid carboniferous matter. (188,019.) Nov. 15.

17,873 and 20,740 (1921). Reid. Manufacture of gaseous fuel from lime-kiln gases. (188,022.) Nov. 15.

19,327 (1921). Giles (Field). Fuel for internal combustion engines. (187,326.) Nov. 1.

19,355 (1921). Illingworth. Production of smokeless fuel and coke. (187,328.) Nov. 1.

19,463 (1921). Blake. Alcohol fuels. (187,335.) Nov. 1.

19,525 (1921). Roberts. Carbonisation of coal. (187,336.) Nov. 1.

20,412 (1921). Tinker. Production of petrol. (188,058.) Nov. 15.

20,444 (1921). Franklin and Pettingall. Fuel. (187,351.) Nov. 1.

20,612 (1921). Young. Manufacture of gas. (188,073.) Nov. 15.

26,482 (1921). Koppers Co. Purification of gases. (170,572.) Nov. 8.

28,399 (1921). Dempster, Ltd., and Broadhead. Gas purifiers. (188,193.) Nov. 15.

33,441 (1921). Scheib and Koch. Manufacture of pure nitrogen-carbonic-acid mixtures from combustion gases. (172,958.) Nov. 1.

III.—TAR AND TAR PRODUCTS.

Applications.

Chem. Engineering and Wilton's Patent Furnace Co., and Shadbolt. Distillation of tar. 29,110. Oct. 25.

Humphrey and Humphrey. Boilers for pitch, tar, etc. 28,745. Oct. 23.

IV.—COLOURING MATTERS AND DYES.

Applications.

Burt, Boulton, and Haywood, and Miles. Manufacture of indophenolic bodies. 29,258. Oct. 26.

Imray (Soc. Chem. Industry in Basle). Manufacture of azo dyestuffs and chromium compounds thereof. 30,923. Nov. 11.

Plauson's (Parent Co.), Ltd. (Plauson). Dyes etc. 29,321. Oct. 27.

Complete Specification Accepted.

23,286 (1921). Ransford (Cassella u. Co.). Manufacture of salts of acridinium compounds. (188,127.) Nov. 15.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Brooke, Brooke, and Stapleton. Manufacture of paper etc. 29,481. Oct. 28.

Carbone, and Instituto Sierioterapico Milanese. Preparing cultures of *Bacillus felsineus.* 30,912. Nov. 11. (Ital., 12.11.21.)

Davies and Haig. 30,482. *See* VI.

Dreaper. Manufacture of viscose silk etc. 30,214. Nov. 4.

Fries. Manufacture of water-resisting paper. 29,491. Oct. 28. (Jugo-Slavia, 29.10.21.)

Hydroloid, Ltd. (Exportingenieure f. Papier u. Zellstofftechnik Ges). Washable printing papers. 29,054. Oct. 25.

Hydroloid, Ltd. (Exportingenieure f. Papier u. Zellstofftechnik Ges). Treatment of asbestos materials. 29,059. Oct. 25.

Hydroloid, Ltd. (Exportingenieure f. Papier u. Zellstofftechnik Ges). Water- and fire-proof paper. 29,060. Oct. 25.

Levy. Production of artificial filaments. 29,254. Oct. 26.

Levy. Manufacture of cellulose acetate. 30,136. Nov. 3.

Medhurst. Manufacture of paper. 29,245. Oct. 26.

Moriondi. Manufacture of viscose silk. 29,965. Nov. 2.

N. V. Nederlandsche Kunstzijde Maatsch. Purifying solutions of viscose etc. 30,577. Nov. 8. (Holland, 18.11.21.)

Nobel Industries, Ltd. 29,092. *See* XXII.

Ros, and Volos Manufacture, Ltd. Treating fibrous materials. 28,932. Oct. 24.

Schidrowitz. Manufacture of paper etc. 29,885. Nov. 1.

Schmitt. Cleaning cotton fibre etc. 29,460. Oct. 28.

COMPLETE SPECIFICATIONS ACCEPTED.

11,293 (1921). Dreyfus. Manufacture of cellulose derivatives. (187,639.) Nov. 8.

20,116 (1921). Ishizu. Treatment of ramie, china grass, etc. in the production of yarn or thread. (188,037.) Nov. 15.

20,195 (1921). McGill, and Volos Manufacture, Ltd. Treatment of fibrous materials. (187,346.) Nov. 1.

*22,609 (1921). Wade (Internat. Cotton Protecting Co.). Impregnated cotton bales. (187,394.) Nov. 1.

25,435 (1921). Kumagae and Chiba. Recovery of material for the manufacture of paper. (187,805.) Nov. 8.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Davies and Haig. Scouring, bleaching, dyeing, etc. wool etc. 30,482. Nov. 7.

Grant. Waterproofing textile fabrics. 30,460. Nov. 7.

Levy. Dyeing artificial filaments. 30,135. Nov. 3.

Marsden. Treatment of fabrics. 29,242. Oct. 26. (U.S., 27.2.22.)

Newell. Dyeing animal and vegetable fibre. 29,462. Oct. 28.

Plauson's (Parent Co.), Ltd. (Plauson). Dyeing. 28,881. Oct. 24.

Soc. Anon. dite Progil. Mordant for dyeing animal fibres. 30,027. Nov. 2. (Fr., 30.8.22.)

COMPLETE SPECIFICATIONS ACCEPTED.

18,817 (1921). Gott and Wallis. Apparatus for dyeing or bleaching textiles. (187,669.) Nov. 8.

29,044 (1921). Akt.-Ges. f. Anilinfabr. Dyeing animal or mixed fibres. (171,981.) Nov. 1.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Appareils et Evaporateurs Kestner. Extracting sodaic salts from bicarbonated mineral waters. 30,103. Nov. 3. (Belg., 5.11.21.)

Carmichael and Co., and Guillaume. Apparatus for manufacture of sulphuric acid. 30,632. Nov. 9.

Charity. Utilisation of waste lime from chemical works. 30,407. Nov. 7.

Chem. Fabr. Griesheim-Elektron. Production of stable compounds of calcium hypochlorite. 30,593. Nov. 8. (Ger., 8.11.21.)

Fowler and Subrahmaniam. Production of acetic acid from alcohol. 29,625. Oct. 30.

Freundler. Treatment of seaweed. 28,970. Oct. 24. (Fr., 25.10.21.)

Gerber. Dissociation of aluminiferous substances in combination with fixation of nitrogen. 30,133. Nov. 3.

Haynes and Williams. Fixation of nitrogen. 30,000. Nov. 2.

Jaques and West. Manufacture of ammonium compounds. 29,532. Oct. 28.

Kinzlberger u. Co. Production of iron-free chromium compounds. 30,132. Nov. 3. (Czecho-Slov., 4.11.21.)

Nitrogen Corp. Ammonia synthesis autoclave. 29,791. Oct. 31. (U.S., 9.11.21.)

Roberts. Manufacture of lime. 29,040. Oct. 25.

Sanders. 29,015. *See* X.

Staddon. Manufacture of products from magnesium-containing substances. 30,795. Nov. 10.

Thompson. 29,624. *See* X.

COMPLETE SPECIFICATIONS ACCEPTED.

6690 (1921). Potter and Robinson. Manufacture of chromium compounds. (187,636.) Nov. 8.

17,873 (1921). Reid. *See* II.

18,976 (1921). Deuts. Glühfadenfabr. Kurtz u. Schwarzkopf Ges. Apparatus for purifying hydrogen. (166,541.) Nov. 1.

19,220 (1921). Marr and others. *See* I.

20,583 (1921). Rheinisch-Nassauische Bergwerks- u. Hütten A.-G., and Schuphaus. Production of chemically pure hydrochloric acid. (167,752.) Nov. 8.

29,658 (1921). Manuf. de Prod. Chim. du Nord Etabl. Kuhlmann. Mechanically operated furnaces for roasting pyrites. (181,313.) Nov. 8.

33,441 (1921). Scheib and Koch. *See* II.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Allen. Method of glazing bricks. 29,562. Oct. 30.

Allport and Shenton. Kilns for firing pottery etc. 30,277. Nov. 6.

Bennett. Ovens or kilns for firing pottery etc. 29,826. Nov. 1.

Marks (Buffalo Refractory Corp.). Refractory compositions. 28,948. Oct. 24.

Niewenberg. Preparation of thermo-resistant glassware. 29,884. Nov. 1.

White (National Lead Co.). Abrasive sheet material. 29,898. Nov. 1.

COMPLETE SPECIFICATIONS ACCEPTED.

14,992 (1921). Testrup, and Techno-Chemical Laboratories. Manufacture of china clay. (188,010.) Nov. 15.

17,238 (1921). Lott. Production of charges of molten glass (187,661.) Nov. 8.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Arnot. Compositions for conditioning wood etc. 29,906. Nov. 1.

Avis and Jennings. Compound for weatherproofing pavements etc. 29,291. Oct. 27.

Avis and Jennings. Weatherproofing paving-blocks etc. 29,293. Oct. 27.

Forssman. Preservation of wood etc. 28,799. Oct. 23. (Ger., 22.10.21.)

Marshall. Structural material. 30,131. Nov. 3.

Pittman. 30,597. *See* XI.

Roberts. Portland cement. 29,041. Oct. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

20,979 (1921). Schloesser. Manufacture of material for making mortar from town refuse. (187,362.) Nov. 1.

20,944 (1921). Kambach. Heat-, cold-, and water-proof material. (167,757.) Nov. 8.

852 (1922). Douglas and Phibbs. Preservation of wood. (187,527.) Nov. 1.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Applications.

Barron, Halliwell, and Hindley. Hardening articles of iron or steel etc. 29,301. Oct. 27.

British Aluminium Co., and Gwyer. Aluminium alloys. 29,785. Oct. 31.

British Thomson-Houston Co. (General Electric Co.). Protecting metals from corrosion. 28,835. Oct. 23.

Coley. Reduction of ores, oxides, etc. 30,772 and 30,775. Nov. 10.

Continuous Reaction Co., and Skelley. Manufacture of ferrous alloys and weatherproof articles therefrom. 30,023. Nov. 2.

Demel and Leighton. Manufacture of gold leaf. 29,256-7. Oct. 25.

Duffield. Basic open-hearth furnaces etc. 30,925. Nov. 11.

Durant and Sulman. Treatment of ores containing oxide of copper or zinc. 29,516. Oct. 28.

Edison Swan Electric Co., and Percival. 28,805. *See* II.

Evans and Hamilton. Methods of reducing metals nd making alloys. 30,604. Nov. 9. (U.S., 23.5.22.)

Fink. High-temperature alloys. 29,616. Oct. 30.

Grönqvist. Cementation of steel and iron. 0,562. Nov. 8.

Harris. Electrode position of metal. 29,343. ct. 27.

Lijnden and Vermaes. Chloridising volatilisation f metals. 30,300. Nov. 6. (Holland, 12.11.21.)

Lijnden and Vermaes. Obtaining metals from heir chloride vapours. 30,301. Nov. 6. (Holland, 4.11.21.)

Moxham. Treatment of siliceous metal-bearing ninerals. 28,919. Oct. 24.

Otto. Liquid flux solder for aluminium. 30,580. Nov. 8.

Reis. Hardening and rustproofing metals. 29,272. Oct. 26.

Saltrick. Iron and steel alloys. 28,769. Oct. 23.

Saltrick. Nickel alloys. 28,770. Oct. 23.

Saltrick. Alloy steels. 28,771. Oct. 23.

Saltrick. Alloys. 29,193. Oct. 26.

Sanders. Treatment of galvanisers' waste flux etc. 29,015. Oct. 25.

Shepperd. Manufacture or treatment of iron and steel and their alloys. 30,892. Nov. 11.

Thompson. Treatment of flux skimmings from galvanising. 29,624. Oct. 30.

Torrance. Flux for soldering. 29,854. Nov. 1.

Tullis. Recovery of aluminium. 29,309. Oct. 27.

Complete Specifications Accepted.

19,052 (1921). Aitchison. Manufacture of unstainable steel and iron or alloys thereof. (187,310.) Nov. 1.

19,082 (1921). Elmore, and Chemical and Metallurgical Corp. Production of lead from lead sulphate. (187,313.) Nov. 1.

20,320 (1921). Greiner. Manufacture of iron alloys containing silicon. (188,049.) Nov. 15.

20,321 (1921). Greiner. Manufacture of alloys of iron. (187,729.) Nov. 8.

21,368 (1921). Soc. Chim. Usines du Rhône. Coating wires etc. (168,872.) Nov. 1.

21,568 (1921). Rushen (A.-G. Felder-Clement). Reduction of metal oxides by means of aluminium. (187,375.) Nov. 1.

25,751 (1921). Naito. Treatment of magnetic sand or finely-divided iron ore. (187,810.) Nov. 8.

28,776 (1921). Victoria Iron Rolling Co. Treatment of tin-plate scrap. (170,861.) Nov. 1.

XI.—ELECTRO-CHEMISTRY.

Applications.

British Thomson-Houston Co. (General Electric Co.). Insulating composition. 30,576. Nov. 8.

Godfrey. Leclanché cells. 28,904. Oct. 24.

Haddan (Graphitwerke A.-G.). Electrodes for electric furnaces. 29,378. Oct. 27.

Harris. 29,343. *See* X.

Long. Insulating material. 28,889—28,891. Oct. 24.

Pittman. Insulating and waterproofing materials. 30,597. Nov. 8.

Scott. Electrolytic apparatus. 28,947. Oct. 24.

Voigt. Electric accumulators. 29,295-6. Oct. 27.

Complete Specifications Accepted.

19,665 (1921). Pouchain. Electric accumulators. (188,027.) Nov. 15.

20,254 (1921). Thatcher. Electrolytically oxidising or reducing substances. (188,042.) Nov. 15.

20,395 (1921). Thatcher. Electrolytic cell. (188,056.) Nov. 15.

34,286 (1921). Fuller's United Electric Works, and Welch. Galvanic batteries. (187,892.) Nov. 8.

34,405 (1921). British Thomson-Houston Co. (General Electric Co.). Electric insulators. (187,893.) Nov. 8.

XII.—FATS; OILS; WAXES.

Applications.

Aische. Production of organic sulphonated oils of animal origin etc. 28,995. Oct. 25.

Bamburg. 30,556. *See* XX.

Boburg, Söderlund, Testrup, and Techno-Chemical Laboratories. Rendering oils etc. 30,917. Nov. 11.

Knapp and Levin. 29,972. *See* XVII.

Wilhelm and Wilhelm. Oil etc. extractors. 28,790. Oct. 23.

Complete Specifications Accepted.

17,137 (1921). Khorassany. Manufacture of soap. (187,660.) Nov. 8.

18,877 (1921). Schou. Oleaginous emulsifying materials, and the manufacture of edible substances. (187,298.) Nov. 1.

18,882 (1921). Schou. Manufacture of emulsions or emulsifying ingredients. (187,299.) Nov. 1.

23,003 and 23,284 (1921). Melamid. Manufacture of substances of the fatty acid type. (169,962 and 170,562.) Nov. 15.

430 (1922). Hull and Steer. Saponaceous cleaning composition. (187,526.) Nov. 1.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Assante. Submarine paint. 29,477. Oct. 28.

Pittman. 30,597. *See* XI.

Complete Specifications Accepted.

13,160 (1921). Lefebvre. Production of an oil having the properties of oil of turpentine. (188,008.) Nov. 15.

20,458 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Inks, water-colour paints, etc. (187,732.) Nov. 8.

4196 (1922). Smidt and Jaeger. Production of printer's ink. (187,537.) Nov. 1.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Davis and Hester. Treatment of rubber latex. 29,373. Oct. 27.

Gare. Utilisation of rubber latex. 30,874. Nov. 11.

Hydroloid, Ltd. (Exportingenieure f. Papier u. Zellstofftechnik Ges.). Imitation guttapercha and leather. 29,056. Oct. 25.

Plauson's (Parent Co.), Ltd. (Plauson). Colouring rubber etc. 29,202. Oct. 26.

XV.—LEATHER; BONE; HORN; GLUE.

Applications.

Hydroloid, Ltd. 29,056. *See* XIV.

Robinson. Process for plumping leather. 29,252. Oct. 26.

Complete Specification Accepted.

25,705 (1921). Renner and Moeller. Manufacture of bates and the operation of bating. (179,135.) Nov. 8.

XVI.—SOILS; FERTILISERS.

Application.

Jörgensen. Manufacture of a nitrogen-assimilating manure. 30,569. Nov. 8.

Complete Specifications Accepted.

11,039 (1921). Pease. Manufacture of fertilising-material. (187,251.) Nov. 1.

24,472 (1921). Sams. Fertiliser. (187,423.) Nov. 1.

1987 and 4966 (1922). Rhenania Verein Chem. Fabr., and Rusberg. Rendering soluble crude phosphates. (174,370 and 177,496.) Nov. 8.

XVII.—SUGARS; STARCHES; GUMS.

Applications.

Boberg, Spiers, and Techno-Chemical Laboratories. Treatment of starch-containing materials. 30,916. Nov. 11.

Knapp and Levin. Obtaining high-grade carbohydrates from waste fats etc. 29,972. Nov. 2.

Singer. Manufacture of starch. 30,337. Nov. 6. (Austria, 5.11.21.)

XVIII.—FERMENTATION INDUSTRIES.

Applications.

Distillers Co., and Meyer. Dehydrating alcohol. 30,143. Nov. 3.

Ledoga Soc. Anon. Manufacture of enzymatic preparations from pancreas gland. 30,481. Nov. 7. (Ital., 12.11.21.)

Meessen. Manufacture of malt wine. 29,223. Oct. 26.

Ward Baking Co. Manufacture of yeast. 30,815. Nov. 10. (U.S., 22.3.22.).

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Aluminium Plant and Vessel Co., and Tarbet. Sterilising and preserving liquids. 30,824. Nov. 10.

Birch, Simpson, and Simon, Ltd. Treatment of cereals. 29,901. Nov. 1.

Buffa. Preparation of chocolate. 29,222. Oct. 26. (Fr., 26.10.21.)

Clayton, and Comp. du Gaz Clayton. Disinfecting. 30,811. Nov. 10.

Kirke. Purification of boiler feed water. 30,689. Nov. 9.

Complete Specifications Accepted.

18,877 (1921). Schou. *See* XII.

19,140 (1921). Activated Sludge, Ltd., and Coombs. Treatment of sewage and other impure liquids. (187,315.) Nov. 1.

19,989 (1921). Dorr Co. Sewage treatment. (171,361.) Nov. 8.

20,276 (1921). Paterson. Apparatus for chlorinating water or other liquid. (188,045.) Nov. 15.

29,866 (1921). Boidin and Effront. Simultaneous production of demineralised amylaceous substances and lower nitrogenous matter for food purposes, by the use of tubers or cereals in whole or broken grains. (171,991.) Nov. 1.

30,096 (1921). Silver Springs Bleaching and Dyeing Co. Treatment of certain waste liquors. (188,208.) Nov. 15.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Bamburg. Hydrolysis. 30,556. Nov. 8.

Barrett Co. Manufacture of aromatic aldehydes. 28,836. Oct. 23. (U.S., [illegible]11.21.)

Fowler and Subrahmani[illegible]. 29,625. *See* VII.

Napp (Chem. Werke Altstetten A.-G.). Manufacture of 1-phenyl-2.3-dimethyl-4-dimethylamino-5-pyrazolone. 29,374. Oct. 27.

Ricard, Allenet, et Cie. Manufacture of butyl chlorides. 30,021. Nov. 2. (Fr., 28.12.21.)

Complete Specifications Accepted.

20,209 (1921). Wade (Lichtenthaeler). Apparatus for making ether. (187,347.) Nov. 1.

21,632 (1921). Badische Anilin u. Soda Fabrik. Manufacture of alcohols. (175,238.) Nov. 15.

29,034 (1921). Schatzkes. Purification of lactic acid. (173,479.) Nov. 15.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Applications.

Camiller and Hay. Manufacture of multicolour screens, plates, and films for colour kinematography. 29,629. Oct. 30.

Counsell Film Process and Chemical Co. Treatment of photographic films. 30,841. Nov. 10. (Australia, 22.11.21.)

Hydroloid, Ltd. (Exportingenieure f. Papier u. Zellstofftechnik Ges.). Sensitised papers. 29,053. Oct. 25.

Sokal (Kallo u. Co.). Light-sensitive film or layer. 30,451. Nov. 7.

Wadsworth Watch Case Co. Photographic mediums. 28,821. Oct. 23. (U.S., 31.8.22.)

Complete Specifications Accepted.

27,200 (1922). Marks (Daylight Film Corp.). Photographic developers. (187,932.) Nov. 8.

27,334 (1922). Marks (Daylight Film Corp.). Production of cinematograph films etc. (187,933.) Nov. 8.

XXII.—EXPLOSIVES; MATCHES.

Applications.

Barnes. Manufacture of fulminate of mercury. 28,788. Oct. 23.

Lisse. Explosives. 29,908. Nov. 1.

Nobel Industries, Ltd. (Du Pont de Nemours and Co.). Nitration of cellulose. 29,092. Oct. 25.

XXIII.—ANALYSIS.

Application.

Baker, and Tintometer, Ltd. Apparatus for testing colour of translucent liquids. 30,473. Nov. 7.

Complete Specification Accepted.

23,743 (1921). Schofield. Optical pyrometers. (188,132.) Nov. 15.

ABSTRACTS*

I.—GENERAL; PLANT; MACHINERY.

Humidity equilibria of various common substances. R. E. Wilson and T. Fuwa. J. Ind. Eng. Chem., 1922, 14, 913—918.

DATA, expressed in the form of curves, concerning the humidity equilibria of various common substances are discussed. In the determination of these data, each substance, in a finely divided state, was brought to equilibrium by successively exposing for 18 to 96 hrs. to a current of air of 15, 30, 50, 70, 90, and 100%, and then of 90, 70, 50, 30, and 15% relative humidity at 25° C. Equilibrium in each case was thus approached from both the saturated and unsaturated state of the substance. In most cases, the dry weight, found by passing air, previously dried by means of phosphorus pentoxide, over the substance heated to 50° C., agreed closely with the weight found after drying in an oven at 105°—110° C. All the curves have the same general shape, the water content of each substance rising rapidly in air having a high or low humidity, and slowly in air of 20 to 60% relative humidity. Wool, jute, and silk have a greater affinity for moisture than cotton and linen. Absorbent cotton has a very high affinity for moisture. Cellulose acetate silk retains less moisture than viscose, nitrocellulose, and natural silks, which have similar affinities for moisture. The moisture content of paper increases with an increase of lignin content. Foodstuffs have a high affinity for moisture, and tobacco and leather retain more moisture than any other substance examined. Carbon black and lampblack have similar affinities for moisture but are much inferior to activated charcoal and unheated gelatinous silica as absorbents for moisture. Finely divided inorganic substances such as kieselguhr, kaolin, asbestos, and glasswool, have characteristic low absorptive capacities for moisture. The increased drying effect of warm air is chiefly due to the resulting decrease of its relative humidity, and the moisture contents of substances, exposed over the ordinary range of indoor and outdoor temperatures, changes but slightly provided that the relative humidity of the surrounding air is constant.—A. J. H.

Materials of low thermal conductivity. E. Griffiths. Faraday Soc., 16.10.22. [Advance proof.]

THE ideal material for use as an insulator from a cold-storage engineer's point of view is stated to consist of a light substance, having an assemblage of minute cells enclosed in a framework which is impervious to moisture, since water has a very high thermal conductivity and is liable to set up decomposition in substances of organic origin. The paper gives the results of a series of investigations carried out on expanded rubber (a rubber converted into a highly cellular form and having an exceedingly low density), balsa wood (a very light wood obtained from Ecuador), the fibrous waste from a tree known as "*Kingia Australis*," mats made from cured eel grass sewn between sheets of strong paper, and compressed peat, with a view to ascertain if these materials would be suitable for cold-storage insulation. The values found for the thermal conductivity, expressed in B.Th.U. per sq. ft. per hr. for 1 in. thickness and 1° F. difference in temperature, were:—expanded rubber clippings, 0·342 and 0·308 for packing densities of 2·6 and 4·0 lb. respectively per cub. ft.; balsa wood, 0·329 and 0·377 for 2-in. boards weighing 5·75 and 8·6 lb. respectively per cub. ft.; *Kingia* wood waste, 0·339 for a packing density of 8·4 lb. per cub. ft.; eel grass mats, 0·316 and 0·341 for packing densities of 9·4 lb. and 13·4 lb. respectively per cub. ft.; compressed peat, 0·512 and 0·502 for specimens weighing 20 lb. and 29·5 lb. respectively per cub. ft. Before an opinion can be expressed on the merits of expanded rubber or eel grass mats the author considers that a long period test under service conditions will be required, and points out that the thermal conductivities of insulating materials in general are not invariable physical constants.

—S. G. U.

Pseudo-extraction; Winkelblech's phenomenon or ——. New methods of extracting solids. K. Charitschkov. J. Russ. Phys.-Chem. Soc., 1920, 52, 96—107.

WHEN certain pseudo-solutions, such as those of gelatin, agar-agar, and sodium oleate, are treated with various non-aqueous solvents insoluble in water, the solid disperse phase passes, partially or completely, into the liquid, non-aqueous phase in the form of a gel. It is suggested that this phenomenon, to which is given the name "pseudo-extraction," may find technical application in such operations as soap boiling and the extraction of gelatin and glue from jellies. (*Cf.* J.C.S., Dec.)

—T. H. P.

Liquid films formed on solid surfaces under dynamic conditions; Thickness of ——. Research Staff of General Electric Co., London (F. S. Goucher and H. Ward). Phil. Mag., 1922, 44, 1002—1014.

THE thickness of the film is dependent on the shape of the solid on which it is formed. For a flat slab of infinite thickness the relationship between the thickness (t), gravity (g), the viscosity (η), density (ρ), and velocity of drawing (v_e) is $t^2 = 2v_e\eta / \rho g$. If the solid is in the form of a fine wire of radius, r, the surface tension is dominant, and gravity negligible. In this case, $t/r = 4{\cdot}8\eta v_e/\gamma$, where γ is the surface tension. These equations apply to suspensions if the diameter of the particles does not exceed the thickness of the film. If the liquid wets the surface, the solid does not exert any specific action.—W. E. G.

Discharge of air through small orifices, and entrainment of air by the issuing jet. J. S. G. Thomas. Phil. Mag., 1922, 44, 969—988.

AN investigation into the effect of variation in the diameter of orifice and length of channel of downwardly directed jets, on the rate of flow and on the entrainment of air. The variation in the rate of discharge with the gas pressure can be represented by the equation $Q = A'e^{\alpha}$, where A′ and α are constants. In the case of thin discs, with orifices of diameter not less than three times the thickness of the plate, the discharge of air is given by the formula, $v_e{}^1 = {}^{509}d^{1\cdot892}\ e^{0\cdot483}$. With thick discs, as the diameter of the channel decreases, the value of α increases. For low pressures, the volume of air entrained increases linearly with the gas pressure, followed by a subsequent increase at a continuously decreasing rate. Anomalous behaviour is observed with thick discs. The jet becomes unstable over a certain range of pressures, the volume-pressure curve showing an inflexion. This instability is clearly demonstrated when the volume of air entrained per unit of air of the issuing jet is plotted against the pressure of the gas. A diminution in the size of the orifice is accompanied by a greater air entrainment up to a critical value of the diameter, at which point turbulence is impressed on the gas on entering the orifice. With decreasing diameter and constant length of channel the disturbance increases, but with

A

---

* The illustrations in the abstracts marked * are reproduced from the Illustrated Official Journal (Patents), by kind permission of the Controller of H.M. Stationery Office.

constant diameter and increasing length of channel the anomaly becomes less marked.
—W. E. G.

Evaporation of solvents. Wolff and Dorn. *See* XIII.

Measurement of low temperatures. Darling. *See* XXIII.

Thermometric lag. Griffiths and Awbery. *See* XXIII.

Patents.

Absorption and purification of gases and vapours. R. Adler. E.P. 165,451, 27.6.21. Conv., 28.6.20.

The gaseous substances on entering the absorption or purifying chamber, instead of coming in contact with atomised sprays of liquid, are made to flow between sheets of liquid arranged at convenient distances apart. These sheets are broken at suitable places to permit the gas to flow from the space below to the space above the sheet. With chambers of square or rectangular cross-section the liquid issues as thin continuous sheets from a set of horizontal parallel pipes fixed on or near the side walls of the chamber. The issuing pressure is such that each sheet can completely span the chamber. Passages for the gas across the sheets are made by suitably placed projections fixed a short distance from the opposite wall. Sometimes a second set of pipes is mounted on the opposite wall, in such a manner that sheets of liquid from them flow in the opposite direction to, and between the sheets issuing from, the first set. In this case each pipe is fitted with a guard placed between the pipe and the wall and so arranged that the sheet of liquid issuing from the opposite pipe immediately above meets the outer surface of this guard tangentially and then falls as a continuous sheet to the bottom of the chamber. The space between the guard and the pipe forms the passage through which the gas flows in passing from the lower to the upper gas space. In the cylindrical type of chamber the liquid is introduced through a central pipe which is fitted with a number of annular slotted nozzles which produce a series of parallel sheets of liquid. Adjustable pins can be fixed so that each sheet can be broken at a suitable point and communication thus provided between the spaces above and below the sheet.—S. G. U.

Corrosion in evaporating and distilling apparatus; Method of and means for preventing ——. Akt.-Ges. Kummler und Matter. E.P. 166,129, 4.7.21. Conv., 7.7.20.

The presence of minute traces of acids in the vapours from evaporators produces a large amount of corrosion, especially in pumps, compressors, etc., and it is proposed to make these vapours alkaline, not, as hitherto suggested, by neutralising the solutions to be concentrated, but by neutralising the vapours given off by the acid solutions. This is done by introducing the alkali in an atomised state either into the steam space of the evaporators, or at an intermediate point between the evaporator and the pump, or at the pump or compressor. For thorough mixing baffle plates are usually provided in the mixing chamber and provision is made for the return of the excess of alkali to the alkali feed tank. When it is known that a salt solution of a certain concentration produces vapours of an acid reaction and at another degree of concentration vapours of an alkaline nature, the invention provides for a thorough mixing of these vapours, without the further addition of alkaline substances.—S. G. U.

Lixiviation; Method of and apparatus for ——. **R. Adler. E.P. 166,525, 2.7.21. Conv., 13.7.20.***

The material to be lixiviated by solvents, with the addition of gases if desired, is fed into the charging hopper, a, from which it passes by a small **worm conveyor into the container, l,** which is **provided with an outlet, o, to permit of the** escape **of the displaced air or unabsorbed gases.** The **bottom of this container is connected to the** upper **end of the highest of three inclined tubes, b,** which are connected at their adjacent ends by trunks, c, and are provided with worm conveyors which can be adapted to permit of heating the material as it passes through the tubes if desired. The material after passing in turn through each of these three reaction tubes is discharged at the lowest point of the third tube into the lowest point of a fourth inclined tube, f, also fitted with a worm conveyor, which finally ejects the lixiviated material at g. The solvent is fed into the top of the tube, f, through h, and the gases are introduced into the lowest tube, b, by the pipe, k. The final separation of the gas from the solvent is effected in j. Any gas which is not absorbed by the solvent or is produced during lixiviation ultimately enters l and is carried off through o.—S. G. U.

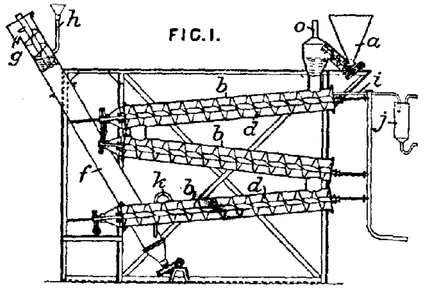


FIG. I.

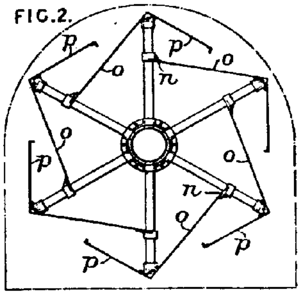
Drying systems. S. Buxton. E.P. 186,370, 2.5., 11.5. and 13.6.21.

Hot gases from boilers are delivered by a special flue into the first of a series of chambers in which the dryers are erected. Through these they may flow in turn either parallel to or across the axes of the drying tubes. With stationary dryers these chambers are usually provided with tubes to heat the air admitted to the dryers. With the rotary type the gases after leaving the chambers enter another chamber containing pipes through which the air is circulated, and then pass through another chamber containing an economiser before entering the chimney. When the material to be dried gives off obnoxious vapours, the air and vapours after leaving the dryers, pass to a condenser, and after the condensation of the moisture the air is discharged into the boiler furnace. If deodorisation is unnecessary the hot air and vapours can be discharged directly into the atmosphere. The drying chambers may be either stationary or rotary. In both cases each chamber consists of two coaxial shells forming a closed annular space which is itself totally surrounded by the chamber through which the flue gases pass. Boiler steam is admitted to this annular space, any condensed steam being removed by suitable devices at the lower end of the drying tubes. The stationary type of dryer is fitted with a worm conveyor, and the inner surface of the rotary tube type with a series of blades, to convey the material from the higher (the charging) to the lower (the discharging) end of the dryer. A centrally placed steam pipe provided with radial branches conveys steam to the annular space in the rotary type of dryer. The dryers are given a slight inclination and provided at each end with covers to which are attached the gears for admitting the wet and removing the dried material, and the pipes for admitting and withdrawing the air used. This hot air passes through the dryer in the opposite direction to the material. —S. G. U.

Drying apparatus. P. Scrive. E.P. 186,548, 28.12.21.*

A rotary drying apparatus is constructed of plates, o, p, which form the walls and buckets of a rotating prism, one form of which is shown in sectional view in the figure. The drying gases are withdrawn through the hollow shaft.—B. M. V.

FIG. 2.



Drying apparatus. J. E. Bolling, Assr. to Drying Systems, Inc. U.S.P (a) 1,431,145 and (b) 1,431,146, 10.10.22. Appl., 20.4.18 and 6.6.19.

(a) A fan is arranged to blow a current of air through a heater into the drying chamber, from which it enters a pipe communicating with the suction of the fan. This pipe is provided with an inlet and an outlet branch, each of these branches and the pipe itself being fitted with dampers, coupled together so that they can be operated simultaneously. The pipe damper is placed between the inlet and the outlet branches and operates in the opposite direction from the dampers in these branches. A thermostatic control placed between the drying chamber and the pipe damper adjusts the positions of the dampers in accordance with the fall in temperature in the drying chamber. (b) In a similar plant to that described above, the thermostatic motor is placed between the inlet pipe and the fan, and has connexions for adjusting the dampers according to the temperature changes in the conduit near the motor.—S. G. U.

Crushing or reducing minerals, ores, and other materials; Machines for ——. W. E. Bleloch and H. A. Stockman. E.P. 186,693, 1.7.21 and 7.2.22.

At each end of a strong rectangular frame are mounted two anvils capable of being adjusted by wedge bolts. The frame itself is supported near these ends, the bottom of the supports being designed as pivot points for four bars attached to the four pitmen operating on the anvils. Two cylinders having their axes parallel to the side of the frame are placed, one between each pair of pitmen, and are rigidly bolted to the frame. Each cylinder is provided with a hammer piston, suitably grooved to prevent leakage and retain lubricant. At either end of each cylinder is fitted an impact block, enlarged and rounded at its outer end where it strikes the pitman, but reduced at the inner end where it receives the blows of the hammer piston. A valve casing having suitably arranged ports and passages forms part of the cylinder casting. The valve controlling the admission and release of the driving fluid to the cylinders is fixed to a vertical spindle, and is given a rocking motion by an eccentric mounted on a belt-driven horizontal shaft carried on the frame of the machine. The upper ends of the pitmen at the ends of each cylinder are connected together by a rod provided with a resilient coupling, which absorbs shock or stress between the pitmen during the operation of the machine and also permits of adjustments.—S. G. U.

Pulverising apparatus. Pulverising material. R. E. H. Pomeroy. U.S.P. 1,431,251—2, 10.10.22. Appl., (a) 19.11.21, and (b) 16.1.22.

(a) A perforated rotating shell is partly filled with balls. An exhaust fan maintains a current of air through the shell, the air entering and leaving through the peripheral perforations. (b) Sets of the apparatus described in (a) are arranged in series, the air passing from one mill to the next.—T. A. S.

Fire-extinguishing liquid and method of using same. S. H. Hamilton. U.S.P. 1,431,789, 10.10.22. Appl., 1.9.21.

A liquid containing a soluble silicate and a frothing material is injected below the surface of the burning liquid. An inert gas under pressure causes the quenching liquid to rise to the surface of the burning liquid and there form an incombustible foam.—S. G. U.

Drying materials carrying a volatile inflammable solvent; Apparatus for —— and for recovering such solvent. Dunlop Rubber Co., Ltd. From W. K. Lewis and W. Green. E.P. 181,100, 4.3.21.

See U.S.P. 1,371,914 of 1921; J., 1921, 289 a.

Centrifugal separators. S. H. Hall. E.P. 183,133, 12.7.22. Conv., 15.7.21.

See U.S.P. 1,411,782 of 1922; J., 1922, 358 a.

Stills. N. Bologa. E.P. 187,007, 9.7.21.

See U.S.P. 1,377,520 of 1921; J., 1921, 535 a

Rotary dryers, kilns, furnaces, retorts, and the like; Discharging or charging devices for ——. F. D. Marshall. E.P. 186,974, 13.6.21.

Mixing and other purposes; Apparatus for regulating the feed of finely divided substances for ——. E. Whitehead. E.P. 187,029, 13.7.21.

Separating fine material; [Pneumatic] method of and apparatus for ——. G. Roth. E.P. 187,381, 15.8.21.

Fire - extinguishing materials. G.P. 358,572. *See* XII.

Optical pyrometer. G.P. 357,975. *See* XXIII.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Coal; Classification of ——. S. W. Parr. J. Ind Eng. Chem., 1922, 14, 919—923.

A useful summary of the properties of any coal is given by the calorific value and the ratio of volatile matter to fixed carbon, if these are calculated on the pure coal substance ("unit-coal") with ash, moisture, and pyrites deducted. The formula: Heat value for "unit-coal"=

$$\frac{\text{indicated B.Th.U.} - 5000\text{S}}{1{\cdot}00 - (1{\cdot}08\ \text{ash} + 22/40\text{S})}$$

("ash" is weight of ash from 1 gram of coal; S is per cent. of sulphur)

has been confirmed by comparison of results from coals of similar origin but of different ash and sulphur contents. In this the factor 1·08 is a correction for the volatile matter driven off from the ash on ignition. 5000 S is the heat derived from combustion of sulphur, and the quantity 22/40 S includes an arbitrary correction for non-pyritic sulphur. The quantities are determined on the dried coal. Similarly the "unit fixed carbon" is given by the formula,

$$\frac{\text{fixed carbon as determined}}{1\cdot00-(1\cdot08\ \text{ash}+22/40\ \text{S})}$$

the factors requiring correction affecting only the volatile matter. The classification of coals as regards these two quantities can be conveniently shown by points on a two-dimension diagram.
—C. I.

Coke; Shatter and tumbler tests for metallurgical ——. S. P. Kinney and G. St. J. Perrot. J. Ind. Eng. Chem., 1922, 14, 926—931.

The shatter test for blast-furnace coke in which 50 lb. of the material is dropped 6 ft. on to a steel plate, and the percentage remaining on a 2-in. screen ascertained, gives results concordant to 1—3%. The sample should be composed of pieces of a standard size, and large pieces about half the width of the oven are suggested. More reliable results are given by using four screens of dimensions 2 in. down to ½ in. The tumbler test, in which the sample is placed in a revolving drum and rotated a given number of times, was designed to measure the resistance of coke to abrasion in passing down the blast furnace. This it fails to do, as the proportion of the coke remaining on a ¼-in. screen is largely determined by the size of the pieces in the tumbler after a few rotations, *i.e.*, their resistance to impact. If small coke (pieces 0·25—0·75 in.) be used different cokes give very similar results, and this test appears to be of no value.—C. I.

Woods; Calorific values of American ——. S. W. Parr and C. N. Davidson. J. Ind. Eng. Chem., 1922, 14, 935—936.

Samples of wood can be dried in air at 105° C. without appreciable loss of constituents other than water, the weights being constant after 3 hrs. Samples of dried, well-seasoned woods contained 8·8—10·7% of moisture as determined by this method, and the calorific values of the dried samples ranged from 8448 B.Th.U. (hickory) to 8836 B.Th.U. (pine).—C. I.

Acetylene and ammonia; Formation of —— *during incomplete combustion.* K. A. Hofmann and E. Will. Ber., 1922, 55, 3228—3233.

The gaseous products of an inverted air flame burning in the vapours of various organic substances have been investigated by means of an apparatus in which the air supply is so adjusted that the flame just burns continuously. The following quantities of acetylene (in grams) are obtained by the decomposition of 100 g. of the organic compound: benzene, 5; phenol, 4·4; aniline, 2·5; diphenylamine, 2·7; carbazole, 2·4; pyridine, 1·7; anthracene, 1·6; anthracene residues, 0·24; coal tar, 4; middle oil from Rositz lignite tar, 1; benzoquinone, 1; hexane, 2. The formation of acetylene is partly due to thermal action, but oxidative degradation also plays a part, as is proved by the production of the gas from hexane. Hydrocyanic acid is also present in the gases (100 g. of aniline, carbazole, diphenylamine, and pyridine yield respectively up to 3, 1·5, 1·5 g., and a trace of hydrocyanic acid). Ammonia is formed to a slight extent during the combustion of air charged with a number of catalysts in hydrogen, coal gas, or benzene vapour. Hydrogen arsenide, chromyl chloride, and silicon tetrachloride impede its production, which is facilitated by osmium tetroxide and the osmium formed therefrom and, in particular, by nickel carbonyl. The action of the carbonyl (from which metallic nickel is produced) appears to indicate that the effect is due to catalytic hydrogenation of the nitrogen and not to an influence of the flame ions. The carbon liberated from benzene or coal gas favours the production of ammonia, possibly owing to the intermediate formation of hydrogen cyanide. The yields of ammonia are not improved noticeably by bringing volatile salts, such as sodium or lithium carbonates, into the flame, by spreading the flame over a porous clay surface impregnated with various salts, or by placing an inverted mantle over the orifice of the burner.—H. W.

Sulphur; Recovery of —— *from spent gas-purifying material by means of tetralin.* R. Kattwinkel. Brennstoff-Chem., 1922, 3, 310—311.

Many solvents which have been proposed from time to time for the recovery of sulphur from spent oxide either have been too dear or have given a dirty sulphur due to their solvent action on tarry substances. Tetralin (tetrahydronaphthalene), b.p. 203°—205° C., flash point 79° C., dissolves 3% of its weight of sulphur at normal temperatures and 40% at 100° C. On this account, by careful cooling, the sulphur can be produced in the form of fine crystals, all tarry matter being left in the mother liquor. The sulphur recovered is clear yellow and crystalline, burning without residue, and melting in an open tube at 119° C. After extraction, the mass is treated with hot air in order to vaporise any tetralin, and is then ready for further use.—A. G.

Petroleum oils; Sulphur compounds and oxidation of ——. C. E. Waters. J. Ind. Eng. Chem., 1922, 14, 725—727.

In a carbonisation test oils were heated to 250° C. in contact with air for 2½ hrs., diluted with petroleum ether, and the precipitate filtered off and weighed. Oils of low sulphur content had usually low carbonisation values and *vice versâ*. Sulphur compounds are contributory to rapid oxidation. A considerable part of the sulphur is found in the asphaltic matter precipitated by the addition of petroleum ether to the oxidised oil. A steam turbine sludge was found to contain 0·33% of sulphur, or 0·65% on an oil-free basis. The oil-free deposit from a transformer contained 0·57% of sulphur. Oil-free samples of carbon from an internal-combustion engine contained 0·52% to 3·08% of sulphur. The carbon residue from a coke test contained a higher percentage of sulphur than the unheated oil. Precipitates from oils exposed for 100 hrs. to sunlight and air contained considerable percentages of sulphur, roughly proportional to the sulphur content of the original oil.—H. M.

Petroleum [and other] oils; Determination of absolute viscosity of ——. W. H. Fulweiler and C. W. Jordan. J. Ind. Eng. Chem., 1922, 14, 723—724.

Petroleum, animal and vegetable oils show changes in viscosity after standing in glass viscosimeters for 24 hrs., but further standing for several weeks does not effect any considerable further change. Experiments were made on viscosimeters of the Bingham and Green type, in one of which the capillary was 24 cm. long and 0·416 mm. in diam., and in another 10 cm. long and 0·918 mm. in diam. Temperatures constant within 0·005° were obtained. A highly refined white oil showed a decrease in viscosity of 0·54% after standing for 24 hrs., and after two months, a decrease of 0·43%. A reddish filtered petroleum oil showed an increase of 0·42% in 24 hrs., and the same increase after standing for 5 weeks. A sample of an unfiltered oil exposed to light showed an increase of 1% over a similar sample kept in the dark. Castor oil showed an increase of 0·33% after standing for 24 hrs., lard oil a decrease of 0·3%.—H. M.

Viscosity of oils; Change in —— with the temperature. W. H. Herschel. J. Ind. Eng. Chem., 1922, 14, 715—723.

For petroleum products with a viscosity less than that of water, fluidity $=1/\mu=A+Bt$ (*cf.* Dean and Lane, J., 1921, 726 A). This equation indicates a straight line relation. The fluidity-temperature graphs for some of the aliphatic hydrocarbons and other very fluid liquids have a curvature which decreases as the viscosity decreases. The straight line graph are more convenient for extrapolation. Fluidity-temperature equations are applicable to definite chemical compounds of low viscosity. There is considerable doubt as to what form of equation best applies to oils of high viscosity. Slotte's formula (Beibl. Ann. Physik., 1892, 16, 182), if it be assumed that the temperature coefficient is small, may be simplified to $\mu=A/(1+at+bt^2)$. The logarithmic viscosity-temperature diagram, using Fahrenheit degrees, gives practically straight-line curves for oils of medium viscosity, and these curves meet approximately at a point. In such a diagram for naphthene base oils most of the graphs are fairly straight, with the exception of those for fuel oils from Mexico and Persia, the former showing marked viscosity hysteresis, a phenomenon characteristic of colloids, the presence of which is probably the cause of the curvature of graphs for fuel oils. Most mineral oils, especially refined lubricating oils, show approximately straight line graphs. Narrowness of cut does not influence the slope of the graphs. Graphs of fatty oils are generally more curved but less steep than those of mineral oils. The viscosities of different samples of castor oil and rape-seed oil vary considerably.—H. M.

Lubrication; Mechanism of ——. Methods of measuring the property of oiliness. R. E. Wilson and D. P. Barnard. J. Ind. Eng. Chem., 1922, 14, 682—695.

The coefficient of friction, f, of a journal bearing is a function of at least nine variables, and can only be a function of the combination of these variables in such forms that all dimensions are cancelled out. Therefore the following formula may be used: $f=\phi\ (zn/p\times c/d\times l/d\times S\times M\times O)$, where z is the viscosity of the lubricant, n the revolutions per minute, p the pressure on bearing, c diametrical clearance on bearing, d diameter of journal, l length of bearing, S surface condition of bearing, M method of oiling, and O the "oiliness" factor of the lubricant. The first factor, zn/p, includes the only three important variables involved in making tests on a given bearing under varying conditions. In curves obtained by plotting observed values of f against zn/p for two different bearings there can be distinguished a region of perfect fluid film lubrication, in which the friction coefficient is roughly proportional to zn/p; a critical point of minimum friction where the speed or viscosity becomes so low, or the pressure so high, that the fluid film begins to rupture; and a region of partial lubrication in which there is increasing friction as zn/p decreases below its critical value. The safe average operating value of zn/p should be obtained by multiplying its value at the critical point by a factor of safety of about 5. In the region of fluid film lubrication f is a function of zn/p; the oiliness of the lubricant and the nature of the bearing metal have no effect, nor has the method of oiling, so long as the bearing is filled. In the region of partial lubrication the oiliness of the lubricant is more important than its viscosity, the nature of the metal plays an important part, and f is not necessarily a function of zn/p. The "oiliness" of a lubricant is the property which causes one fluid to give lower coefficients of friction (generally at slow speeds or high loads) than another fluid of the same viscosity. The property of oiliness plays no part in perfect fluid film lubrication, but becomes important in the cases of starting and stopping, imperfect supply of oil, reciprocating motion, and some irregular conditions. The condition of oiliness lowers the critical value and enables a lower factor of safety to be employed. A friction machine of the Deeley type was used to investigate the coefficient of friction. Using surfaces of glass it was found that oils containing 5% of neutral lard oil and 1% of stearic acid gave much lower values for the coefficient than did straight mineral oil. Using cast iron and steel surfaces, the presence of 0·5% of stearic acid lowered the coefficient to less than one half. Attempts were made to determine the static coefficient between perfectly smooth, flat surfaces. Experiments were made on the interfacial tension of liquids and metal surfaces. The lowering of interfacial energy is a measure of the tendency of some constituent to concentrate at the metal surface; a lowering of the friction coefficient depends on the nature and structure of the adsorbed film. Measurements of the electrical resistance of adsorbed films were made, and a study was made of the clogging of capillaries, of the adsorption of stearic acid by iron reduced in hydrogen, and of cutting lubricants.—H. M.

Lubricating oils; Bearing friction and friction experiments with ——. Duffing. Z. angew. Chem., 1922, 35, 605—607.

A certain force, K, is required to produce deformation of the ultimate particles of a lubricant in flowing motion, and $K=\mu dV/d_u$, where K is the force per unit of surface in dynes/cm.^{2}, V is the velocity in cm./sec., d_n the distance between the nearest layers, and μ units of absolute viscosity. In cases of laminar flow the following formulæ accord with the results of practice: $\delta p/\delta x=\mu\Delta u$; $\delta p/\delta y=\mu\Delta v$; $\delta u/\delta x \mp \delta v/\delta y=0$. In these formulæ $\Delta=\delta^2/\delta x^2+\delta^2/\delta y^2$ is equivalent to Laplace's operator. These formulæ may be made easier to deal with by the introduction of the function of flow, Ψ, but are still subject to difficulties caused by the edge conditions. It has been supposed that the lubricant is between two flat surfaces, under constant pressure, and that the surfaces move with a constant velocity. The conditions are much more complicated in the case of a bearing, in which the viscosity, μ, can be calculated from the moment of friction by the formula $Mr=4\pi\mu\omega R_1^2R_2^2/(R_1^2-R_2^2)$. The case is, however, quite different if the journal lies eccentric to the bearing. This produces a great increase in pressure, which may reach 60—70 atm. A machine has been constructed for the measurement of friction under such conditions; the bearing is suspended in a stirrup, and any desired pressure may be put upon it. The velocity may be varied from 3000 to 16,000 revs. per min. and the pressure may be raised to 8000 kg.—H. M.

See also pages (A) 932, *Products of coal carbonisation* (Bradley and Parr). 952, *Alcohol* (Mariller and van Ruymbeke). 957, *Absorption of ethylene by sulphuric acid* (Damiens). 963, *Analysis of gases* (Strache and Kling). 964, *Gas analysis* (Schaller and Berndt); *Bingham viscosimeter* (Herschel).

Patents.

Peat; Apparatus for dewatering and compressing ——. C. W. G. Clewlow. E.P. 186,690, 1.7.21.

The apparatus deals with peat which has received preliminary treatment, *e.g.*, by heat and pressure, in order to render the moisture mechanically separable. A conical feed hopper is connected at its base to a chamber containing a perforated cage, so that an annular space is left for drainage. The cage is removable and is in the form of an inverted truncated cone. From this basket the material falls to a compacting, compressing and delivering device consisting of a screw conveyor working in a perforated liner, leaving an annular drainage space in the conveyor chamber, and a ram extrusion press fed by the screw conveyor. The shaft of the conveyor is hollow and a steam injector supplies petroleum or hot tar through the hollow shaft and discharges the hot oil through a hole in the side of the shaft into the peat passing through the conveyor chamber.—A. G.

Coal; Process of recovering —— held in suspension from coal-bearing water and streams. C. E. Holland. U.S.P. 1,397,735, 22.11.21. Appl., 13.11.20.

In a process for the treatment of water from streams draining coal-mining districts, the coal and organic matter in the liquid are coagulated and precipitated by passing an electric current through the liquid as it flows continuously through a tank, and the coagulum and precipitate separated from the liquid by sedimentation and filter-pressing. —H. Hg.

Coking of coal. S. R. Illingworth. E.P. 186,384, 26.5.21. Addn. to 164,104.

The coking process described in the earlier patent (J., 1921, 501 A) may be carried out under reduced pressure, this being particularly advantageous when the higher temperatures are employed. The vacuum used would depend upon circumstances, but at temperatures above 450° C. a vacuum of at least 20 inches of mercury would be necessary, and above 600° C. endeavours would be made to attain 28 inches.—W. P.

Coke oven. A. Roberts, Assr. to Chicago Trust Co. U.S.P. 1,430,588, 3.10.22. Appl., 8.3.20.

The heating wall has a number of vertical flame flues communicating with a transfer flue, the latter being reinforced by tie blocks which allow of free passage of the gas.—W. P.

Retorts [; Rotary ——] for treatment of carbonaceous or other material. F. D. Marshall. E.P. 186,375, 24.5.21.*

In rotary retorts which are heated by the passage of hot gases through their interior, baffles or internal shelves, G (see fig.), are provided, having one end attached to the inner face of the retort chamber, the other end projecting towards the interior. The shelves are bent or corrugated so as to form pockets for collecting the material from the bottom of the retort as the latter revolves, and showering it upon the surface of the shelf immediately in advance. To stiffen the shelves the inner ends may be connected together or fixed to a circular plate. The shelves may also be perforated or constructed as grids, and instead of being arranged in lines parallel to the sides of the retort, they may follow the curvature of the sides, so as to form portions of a spiral, thus imparting a swirling motion to the gases. Propellers or the like, H, I, may also be arranged between the sets of shelves and at the inlet end of the retort to break up and to impart a whirling motion to the heating gases, as shown by the arrows.—A. R. M.

FIG.1.

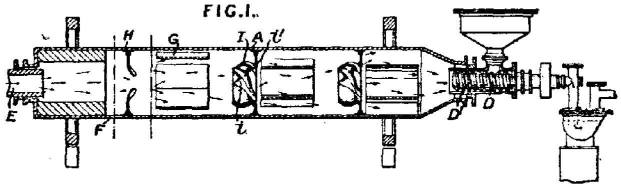
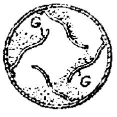


FIG.3.



Coal or the like; Manufacture of liquid or soluble organic compounds from ——. F. Bergius. G.P. (A) 303,272, 25.12.14, (B) 307,671, 18.7.15.

About 88% of the constituents of coal are converted into liquid or soluble products by heating the coal with hydrogen under pressure in the presence of (A) a liquid dispersoid which is capable of restricting the reaction, *e.g.*, high-boiling mineral oil or tar, or their high-boiling distillates or distillation residues, or (B) a liquid product which has been obtained by hydrogenating coal, and is capable of further hydrogenation at the temperature of the reaction. —L. A. C.

Burning hydrocarbon oils; Method and apparatus for ——. C. E. Chapman and J. Goodfellow. E.P. 186,446, 6.7.21.*

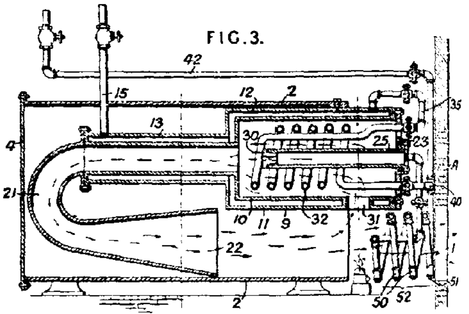


FIG.3.

Complete combustion of heavy hydrocarbon oil is attained by atomising it with superheated steam into a retort-like device, 10, provided with a cooling jacket, 12. The retort is fitted with a discharge horn, 21, having a bell mouth from which the flame enters the furnace, first impinging on the superheater, 52, supplying steam to the atomiser, 30. Part of the products of combustion is drawn in through the opening, 31, and circulated through the retort along with the incoming atomised oil. The retort and horn are lined with refractory material. —T. A. S.

Gas scrubber with rotating drum. Berlin-Anhaltische Maschinenbau A.-G. G.P. 356,434, 23.5.20.

A rotating drum containing liquor for scrubbing the gas is provided with an annular partition constructed of two perforated cylinders, containing filling material, and with one or more baffles, parallel to the ends of the drum, with openings alternately in the middle and at the circumference for the passage of the gas.—L. A. C.

Tar and the like; Process for increasing the yield of —— in purifying hot producer gas. Façoneisen-Walzwerk L. Mannstaedt und Co. A.-G., and H. Bansen. G.P. 358,592, 12.5.18.

Tar or an emulsion of tar-oil and water produced by injecting water into hot producer gas, or by partially cooling producer gas having a high water content, is again brought in contact with the hot gas,

whereby water is evaporated from the tar or emulsion, and condensed on further cooling the gas.
—L. A. C.

Desulphurising petroleum and similar oil. W. R. Walkey and A. F. Bargate. E.P. 186,738, 18.7.21.

The oil to be desulphurised is vaporised in the presence of steam and a gaseous dissociating agent, *e.g.*, chlorine or sulphur dioxide, to decompose the hydrogen sulphide formed. The reaction is rendered more effective by passing the gaseous products through a chamber, packed with porous material and surrounded with an electric coil to produce a magnetic field. A convenient chamber can be made out of 5 feet of 6" pipe round which is coiled 3¼ miles of copper wire of $\frac{1}{32}$" diameter, carrying a current of 20 ampères.—T. A. S.

Hydrocarbons; Process and apparatus for treating ——. W. Münder, Assr. to The Chemical Foundation, Inc. U.S.P. 1,431,246, 10.10.22. Appl., 31.12.15.

Light hydrocarbons free from asphalt and sulphur are produced by subjecting heavy hydrocarbons to distillation under ordinary pressure. The distillate is then heated under pressure, with continuous distillation, in an autoclave.—T. A. S.

Hydrocarbons; Process and apparatus for treating —— to produce those of lower boiling point. J. C. Black. U.S.P. 1,431,772, 10.10.22. Appl., 15.8.21.

Oil is cracked by passing it through a coil, heated to cracking temperature, and maintaining it at this temperature for some time in a "digester" of arger cross-sectional area than the cracking coil. The oil is then passed through chambers where the pressure is successively diminished to cause the vaporisation of the various fractions.—T. A. S.

Petroleum refining; Recovery of by-products of ——. C. I. Robinson, Assr. to Standard Oil Co. U.S.P. 1,431,259, 10.10.22. Appl., 3.10.19.

The unsaturated portions of light hydrocarbons produced in the heat treatment of petroleum are recovered by treating the oils with 90% sulphuric acid at 55°—75° F. (13°—24° C.). The resulting sludge is separated and diluted, whereby the oily constituents are separated. The aqueous acid is distilled, the distillate consisting of an oily layer and aqueous alcohols.—T. A. S.

Hydrocarbon oils; Treating [refining] ——. Deutsche Erdöl A.-G., Assees. of F. Schick. G.P. 357,768, 19.3.21.

Hydrocarbon oils are treated with alcohols to which an appropriate small amount of water, acids, or alkalis is added, so as to cause the separation of a layer containing the colouring, odorous, resinous, and asphaltic matter from the hydrocarbon oils, which are subsequently treated with alcoholic solutions of acids and alkalis. A solution of hydrochloric acid in ethyl alcohol, or sulphuric acid in amyl alcohol, alcoholates, or an alcoholic solution of pyridine may be so employed.—J. S. G. T.

Coal; Process for reclaiming and recovery of —— from water or other liquids. C. E. Holland. E.P. 171,670, 7.9.21. Conv., 13.11.20.

See U.S.P. 1,397,735 of 1921; preceding.

Fuel feeding and drying apparatus. W. R. Wood. U.S.P. 1,432,509, 17.10.22. Appl., 16.12.19.

See E.P. 124,314 of 1918; J., 1919, 312 A.

Carbonaceous material; Apparatus and process for treating —— for the recovery of the volatile hydrocarbon constituents thereof. C. C. Bussey, Assr. to S. E. Darby. U.S.P. 1,432,275–6, 17.10.22. Appl., 10.4.18.

See E.P. 154,658 of 1919; J., 1921, 39 A.

Combustion process. R. J. Anderson, Assr. to International Fuel Conservation Co. U.S.P. 1,433,059, 24.10.22. Appl., 6.3.19.

See E.P. 150,761 of 1919; J., 1920, 714 A.

Incandescent coke; Apparatus for conveying and discharging —— into cooling chambers. Sulzer Frères Soc. Anon. E.P. 173,761, 3.1.22. Conv., 3.1.21.

Liquid fuel burner. W. B. Wattson. E.P. 187,324, 18.7.21.

Paraffin wax. G.P. 357,303. *See* III.

Gas and calcium carbide. E.P. 185,135. *See* VII.

Fatty acids from montan wax. G.P. 358,402. *See* XII.

Gas analysing apparatus. E.P. 162,249. *See* XXIII.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Discharge of air through small orifices. Thomas. *See* I.

Wood of eucalyptus and western white pine. Mahood and Cable. *See* V.

Patents.

Lamp wicks; Process for treating ——. J. Feeney. E.P. 173,208, 6.8.21. Conv., 18.12.20.

Lamp wicks are immersed in milk of lime of sp. gr. 1·100, and the solution boiled until its sp. gr. becomes 1·150. The wicks are then removed and dried. Wicks so prepared burn without smoking and are more durable.—J. S. G. T.

Incandescence mantles and process of manufacture. Aktiebolaget Keros. G.P. 358,514, 18.12.21. Conv., 15.1.21.

Fibres impregnated with solutions of salts of the rare earths are assembled parallel to one another and after the addition of an agglutinant are subjected to pressure. The resulting fibres, either prior to or subsequent to ignition, are woven into the form of mantles, so that their longer axes are essentially normal to the contour of the luminous surface of the mantle. Mantles so prepared possess increased rigidity and elasticity, and a considerably higher lighting efficiency.—J. S. G. T.

III.—TAR AND TAR PRODUCTS.

Phenols of coke-oven tar and low-temperature tar; Conversion of —— into benzene in an experimental installation. F. Fischer, H. Schrader, and K. Zerbe. Brennstoff-Chem., 1922, 3, 305—307.

The semi-industrial plant previously described (J., 1922, 891 A) was used in order to investigate whether results obtained on such a scale were comparable with those obtained in a laboratory apparatus, in which a 90% yield of benzene was obtained by reduction of phenols with hydrogen in a tinned iron tube. The quantity of phenol put through the plant varied from 220 to 12,300 g. per hr., and the velocity of the hydrogen varied from 8 to 99 l. per hr. correspondingly. The crude benzol obtained, of b.p. 80°—100° C., varied from 50·9% of the theoretical yield, using 815 g. of cresol mixture per hr., to 81·7% with 3100 g. per hr. Coal gas was used in one experiment in place of hydrogen, the yield obtained being 73·0% of the theoretical, but there was a slight separation of carbon.—A. G.

Benzene from lignite. F. Fischer and H. Schrader. Brennstoff-Chem., 1922, 3, 307—310.

The authors, continuing the work described in the preceding abstract, find that almost 50% of the weight of phenols from lignite tars can be reduced to benzol by means of hydrogen. The benzol is mixed with other substances boiling at temperatures up to 180° C. The calorific value of benzene is about 10,000 cals./g., whilst that of phenol is only 7800 cals./g., so that for equivalent calorific values 78 g. of benzol corresponds to 100 g. of phenol. The phenols are derived from the humus portion of the coal, and whilst in gasworks benzene is formed direct in the retorts, in low-temperature operations it must be produced by reduction of the phenols occurring in the tar.—A. G.

Creosote oils; Coke residue test for ——. C. S. Reeve and F. W. Yeager. J. Ind. Eng. Chem., 1922, 14, 966—967.

Wide variations in results are obtained when the coke residue of creosote oil is determined by coking in a glass bulb. This is due to the tendency of the glass to fuse at the full temperature required for coking. Very concordant results, slightly lower than the average results with glass bulbs, are obtained by distilling to 355° C. in a retort and coking the residue in a platinum crucible.—C. I.

Products of coal carbonisation [xylol]; Decomposition processes applicable to certain ——. M. J. Bradley and S. W. Parr. Chem. and Met. Eng., 1922, 27, 737—744.

Tar oils consisting mainly of xylol could be obtained in large quantities by the low-temperature carbonisation of coal if the demand for them justified it. In order to find further uses a research was carried out on the decomposition products of xylol in an electric furnace at temperatures between 250° and 900° C. and in presence of different gases and contact surfaces. Amongst the results were the following. In an atmosphere of hydrogen and methane the decomposition products are benzene and methane in theoretical proportions. In presence of ethylene the main products are high-boiling compounds, chiefly solid. Iron or metallic oxide surfaces cause a complete decomposition into carbon and gaseous products. Surfaces of carbon, pumice, etc. favour the production of unsaturated high-boiling compounds. Carbon dioxide and steam render liquid hydrocarbons more stable. The effect of increased pressure depends entirely on the gas present. Amongst the products identified were *n*-hexane, cyclohexane, diphenyl, ditolyl, stilbene, phenanthrene, naphthalene, anthracene, methyl derivatives of the two last, pyrene, and chrysene.
—C. I.

Pernitric acid as an analytical reagent. [*Detection of aniline, benzene, hydrogen peroxide, and nitrites.*] I. Trifonow. Z. anorg. Chem., 1922, 124, 136—139.

Pernitric acid reacts with aniline, yielding an intensely yellow product. The per-acid is formed by the action of hydrogen peroxide on an acidified solution of a nitrite (*cf.* page 936 A). The above reaction with aniline can therefore be employed for the detection of hydrogen peroxide or nitrite. Benzene gives with pernitric acid a yellow colour which changes into dark red on the addition of alkali. Toluene and xylene gave a fainter yellow colour, which, however, does not change on the addition of alkali. Thus benzene can be detected in the presence of toluene, xylene, and the aliphatic hydrocarbons; the aliphatic members are not coloured. Similarly benzene can be detected in methylated spirits.—W. T.

Anthraquinone; Quantitative determination of ——. O. A. Nelson and C. E. Senseman. J. Ind. Eng. Chem., 1922, 14, 956—957.

The method for estimating anthraquinone described by Lewis (J., 1918, 459 A) has been modified so that a determination can be completed in about ½ hour. To about 0·5 g. of the sample of anthraquinone thoroughly ground with 3—4 g. of zinc dust, is added 100 c.c. of a boiling 5% solution of caustic soda. After standing for 5 mins., the red product is filtered into a suction flask, through a layer of asbestos fitted within a filter consisting of a glass tube, 24 cm. long and 3·5 cm. diam. and suitably tapered at one end. This filtering tube contains a mechanical stirrer and is heated electrically to 90°—95° C. The residue is washed with hot caustic soda solution until it contains no anthraquinone. The red solution of oxanthranol is titrated in the suction flask with a standardised solution of potassium permanganate (3·8 g. per l.) until it is colourless. Beyond this end point, the addition of permanganate produces a dark green colour, or bluish-green when phenanthraquinone is also present. The potassium permanganate solution is standardised by means of pure anthraquinone under the same conditions, and provided that oxidation by air is prevented, the method gives accurate results even in instances where the anthraquinone contains phenanthraquinone, anthracene, phenanthrene, phthalic anhydride, phthalic acid, or other oxidation products of anthracene and phenanthrene.
—A. J. H.

β-Naphthylamine; Analysis of ——. H. R. Lee and D. O. Jones. J. Ind. Eng. Chem., 1922, 14, 961—963.

Methods for the estimation of β-naphthylamine in the presence of β-naphthol, ββ-dinaphthylamine, and α-naphthylamine have been tested by means of specially purified samples of these substances. In the usual direct nitrite titration method, high results are obtained when β-naphthol is present, since this is converted into nitroso-β-naphthol. Direct titration with $N/10$ sodium nitrite at 20° C. gives results higher than theory even when β-naphthol is absent, and it is better to use $N/2$ nitrite at 0°—5° C. β-Naphthol-1-sulphonic acid is not affected by nitrous acid and on this fact is based the following accurate method: 0·65 g. of the sample of β-naphthylamine is sulphonated, initially at 0°—5° C. and finally at 15° C. when necessary, with 20 c.c. of 25% oleum. The product is diluted with ice and boiled to remove sulphur dioxide, then diluted to 200 c.c., cooled to 20° C., and, after the addition of 15 c.c. of concentrated hydrochloric acid, is titrated with $N/10$ sodium nitrite, the end point being reached when a distinct blue colour develops with starch-iodide 5 mins. after the last addition of nitrite. If 3·5 g. of the sample is used, titration is carried out with $N/2$ nitrite at 0°—5° C. If in this method an amine content of 96% and a m.p. of 109° C. or higher is obtained, the absence of any appreciable amount of impurities is assured. The following method is suitable for the accurate determination of both β-naphthylamine and β-naphthol. Dry hydrogen chloride is passed through a solution of 3·5 g. of the sample in 300 c.c. of dry benzene for 1—2 hrs., the precipitated β-naphthylamine hydrochloride is filtered off, washed with dry benzene saturated with hydrogen chloride, and dried at 60° C. *in vacuo*. It is then dissolved in not more than 200 c.c. of water, and after the addition of 25 c.c. of 20% hydrochloric acid, the β-naphthylamine is determined by titrating with *N*/2 sodium nitrite at 0°—5° C. The benzene filtrate is evaporated to dryness (loss of β-naphthol by sublimation must be avoided), the residue dissolved in 200 c.c. of 1% caustic soda, and β-naphthol determined, after acidifying with hydrochloric acid and adding an excess of sodium bicarbonate, by titrating with *N*/2 diazotised *p*-nitraniline solution. A modified Kjeldahl-Gunning method is also described. Acid-insoluble impurities are estimated by dissolving 5 g. of the sample in 150 c.c. of boiling 1·5% hydrochloric acid, filtering the solution through a Gooch crucible, washing the residue with hot water, and drying to constant weight at 100° C. At least 10% of the β-naphthol present passes into the filtrate, whereas only 0·1—0·2% of ββ-dinaphthylamine is soluble. Hence the latter can be isolated from the residue by solvent extraction and then weighed or analysed for nitrogen. Melting point curves for the binary systems, β-naphthylamine+β-naphthol, β-naphthylamine+ββ-dinaphthylamine, and β-naphthylamine+α-naphthylamine are given, and by means of the last-named the amount of α-naphthylamine in β-naphthylamine not containing large amounts of β-naphthol and ββ-dinaphthylamine may be estimated. The following specifications are suggested for technical β-naphthylamine: m.p. not below 109·0° C. (corr.); content of β-naphthylamine not less than 96·0%, β-naphthol, insoluble matter, and moisture not more than 3·0%, 0·5%, and 0·5% respectively. (*Cf.* J.C.S., Dec.)—A. J. H.

Formation of acetylene and ammonia during incomplete combustion. Hofmann and Will. *See* IIa.

Patents.

Aromatic hydrocarbons; Process of producing ——. A. S. Ramage, Assr. to Bostaph Engineering Corp. U.S.P. 1,430,585, 3.10.22. Appl., 24.6.18. Renewed 23.2.22.

Phenols are converted into aromatic hydrocarbons by treating with hydrogen at about 700° C. in the presence of a catalyst consisting of a lower oxide of iron.—W. P.

Paraffin-wax; Production of —— [*from lignite tars, producer gas tars, etc.*]. T. Helvey. G.P. 357,303, 2.7.21.

Paraffins of various degrees of purity, *e.g.*, ceresin, stearin, montan wax, or oils containing paraffin wax, are added to the tar heated to about 80° C., and the whole stirred. The mixture is then treated with water, salt solutions, lyes, or acids, the layer richer in paraffin separated, and the paraffin-wax recovered therefrom.—J. S. G. T.

1.4-*Naphtholsulphonic acid*; *Manufacture of* ——. British Dyestuffs Corp., Ltd., J. Baddiley, J. B. Payman, and E. G. Bainbridge. E.P. 186,515, 10.9.21.

1.4-Naphtholsulphonic acid is obtained in good yield and quality by the action of chlorosulphonic acid on α-naphthol in presence of a suitable solvent, preferably tetrachloroethane. *Example.* 144 pts. of α-naphthol is suspended in 600 pts. of tetrachloroethane, and 127 pts. of distilled chlorosulphonic acid is added, the temperature being maintained below 80° C. The mixture is then heated at 50° C. for 24 hrs. After dilution with water, and separation of the tetrachloroethane, the liquor is neutralised with either lime or sodium carbonate. The isomeric acids present should not amount to more than 1—2%, and if desired they can be removed by adding barium chloride solution until a precipitate ceases to form.—G. F. M.

Dec.)—A. J. H.

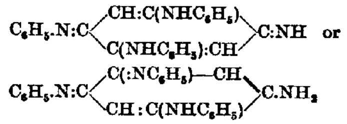
Pitch; Treating ——. F. J. Commin. U.S.P. 1,432,742, 24.10.22. Appl., 27.12.20.

See E.P. 162,727 of 1920; J., 1921, 462 A.

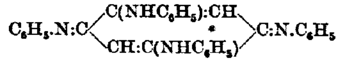
IV.—COLOURING MATTERS AND DYES.

Aniline; Oxidation of ——. *Amine oxidation. VII.* S. Goldschmidt and B. Wurzschmitt. Ber., 1922, 55, 3220—3227.

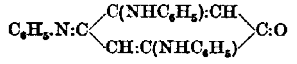
Benzoquinonephenyldi-imine, $N(C_6H_5){:}C_6H_4{:}NH$ is polymerised by glacial acetic acid or a small quantity of hydrochloric acid in the presence of ether almost quantitatively to the trimeride, $N(C_6H_5){:}C_6H_2(NH.C_6H_4.NH.C_6H_5)_2{:}NH$ (*cf.* Willstätter and Kubli, J., 1909, 1244). It depends essentially on the nature and quantity of the added acid (and therefore on the hydrogen ion concentration) whether the di-imine is polymerised to Emeraldine or to Willstätter's compound. The substance,



which has been isolated by oxidising aniline salts with lead peroxide by Börnstein (*cf.* Majima and Aoki, J., 1911, 1369) is obtained under comparable conditions when benzoquinonephenyldi-imine is condensed with aniline. Azophenine,



obtained according to Börnstein (J., 1901, 701) by the further oxidation of aniline, is produced when aniline is mixed with dianilinobenzoquinonephenyldi-imine in ethereal solution in the presence of a little glacial acetic acid. Dianilinobenzoquinoneanil,



formed by the oxidation of aniline in acid solution by hydrogen peroxide, owes its production to the hydrolysis of benzoquinonephenyldi-imine to ammonia and benzoquinonephenylimine,

$$C_6H_5.N{:}C_6H_4{:}O$$

and condensation of the latter with aniline. The complex products of the oxidation of aniline appear therefore to be largely due to the intermediate formation of benzoquinonephenyldi-imine and its subsequent decomposition in various directions. (*Cf.* J.C.S., Dec.)—H. W.

H-acid and its intermediates obtained from naphthalene-2.7-disulphonic acid; Method for identifying ——. D. F. J. Lynch. J. Ind. Eng. Chem., 1922, 14, 964—965.

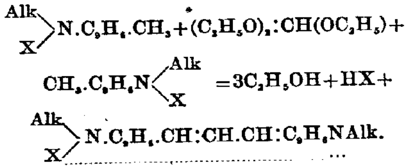
A method for identifying 1.8-dinitro-3.6-naphthalenedisulphonic, 1.8-diamino-3.6-naphthalenedisulphonic, 1.8-aminonaphthol-3.6-disulphonic (H-acid), and 1.8-dihydroxynaphthalene-3.6-disulphonic (chromotropic) acids in the presence of each other by means of their reactions with solutions containing benzidine hydrochloride, 2-cymidine sulphate, α-naphthylamine-hydrochloric acid, pseudocumidine-hydrochloric acid, tolidine-hydrochloric acid, *p*-nitrotoluidine-hydrochloric acid, cobalt chloride, and zinc sulphate is developed. Except those in which cobalt chloride and zinc sulphate are used (neutral solution is then necessary), the tests are carried out with 3—5 c.c. of 5—10% hydrochloric acid containing not more than 0·1 mol. of the sulphonic acid per l. The physical properties of several organic salts of these four sulphonic acids are described. (*Cf.* J.C.S., Dec.)—A. J. H.

1-*Hydroxylaminoanthraquinone and some of its derivatives.* W. H. Beisler and L. W. Jones. J. Amer. Chem. Soc., 1922, 44, 2296—2306.

1-Nitroanthraquinone is best prepared by warming anthraquinone with fuming nitric acid (sp. gr. 1·60), and crystallising the crude product successively from glacial acetic acid, toluene, and acetone. It has m.p. 232·5°—233·5° C. and the amino compound obtained by reduction with potassium sulphide has m.p. 252°—253° C. When the nitro compound is reduced in pyridine solution with hydrogen sulphide it yields 1-hydroxylaminoanthraquinone, the sulphonic acid derivative of which dyes wool and silk reddish-brown without a mordant. When air is bubbled through the aqueous solution of the hydroxylamino compound 1-nitrosoanthraquinone is obtained. —W. G.

Pinacyanols; Constitution of the ——, a contribution to the chemistry of the quinocyanines. W. König. Ber., 1922, 55, 3293—3313.

The structure assigned to Pinacyanol by Mills and Hamer (J., 1921, 41 A) has been confirmed by a comparison of the absorption spectra of Pinacyanol and ψ-isocyanine and estimation of the persistence and maxima, and by the synthesis of Pinacyanols by the condensation of quinaldinium salts with ethyl orthoformate in the presence of suitable agents such as acetic anhydride or zinc chloride:



$$\overset{Alk}{\underset{X}{>}}N.C_9H_6.CH_3+(C_2H_5O)_2:CH(OC_2H_5)+CH_3.C_9H_6N\overset{Alk}{\underset{X}{<}}=3C_2H_5OH+HX+\overset{Alk}{\underset{X}{>}}N.C_9H_6.CH:CH.CH:C_9H_6NAlk.$$

Since the constitution of the cyanines has been largely elucidated, it appears desirable to delete the common names of the substances (*e.g.*, cyanines, isocyanines, ψ-isocyanines, etc.) from the scientific literature and to replace them by the general term quinocyanines, by which is understood the salts of quinolyldihydroquinolylenemethanes which are not methylated at the nitrogen atom. The three classes, 2.2′, 2.4′ and 4.4′-quinocyanine salts, are thus suitably distinguished. The further derivatives are termed benzothioazolocyanines (thiocyanines) and indoleninocyanines (indocyanines). Further types are produced by the streptostatic introduction of vinylene groups between the quinoline residues and are designated mono- (di-, tri- etc.) vinylene-2.2′ or 2.4′ or 4.4′-quinocyanine salts. As examples may be quoted: dimethyl-ψ-isocyanine iodide = 1.1′-dimethyl-2.2′-quinocyanine iodide; Pinaverdol=1.6.1′-trimethyl-2.4′-quinocyanine iodide; ψ-dicyanine bromide=1.1′-diethyl-4.6.4′.6′-tetramethylstreptomonovinylene-2.2′-quinocyanine bromide; dicyanine=1.1′-diethyl-4.6.2′.6′-tetramethylstreptomonovinylene-2.4′-quinocyanine iodide. (*Cf.* J.C.S., Dec.)—H. W.

Patents.

Basic dyestuffs [triarylmethane derivatives containing a thiazole ring]; Manufacture of new —— possessing affinity for unmordanted vegetable fibre. British Dyestuffs Corp., Ltd., J. Baddiley, E. H. Rodd, and H. H. Stocks. E.P. 186,517, 14.9.21.

A new series of basic dyestuffs are obtained by condensing Michler's hydrol or its homologues with a suitable arylbenzthiazole by means of sulphuric acid and oxidising the resulting leuco compound. As instances of the benzthiazoles which can be used 1-phenyl-5-methylbenzthiazole, prepared by treating benzyl-*p*-toluidine with sulphur, and 4′-amino-1-phenyl-5-methylbenzthiazole (dehydrothiotoluidine) are mentioned. The new dyestuffs are green, and dye wool and tannin-mordanted cotton in bright shades of a fastness exceeding that of known basic greens. They have in addition the property of dyeing unmordanted cotton, giving shades of a brightness hitherto unapproached by a substantive cotton green. They are also useful in dyeing paper, yielding a clean "back-water." *Example.* 27 pts. of Michler's hydrol (tetramethyldiaminobenzhydrol) and 22·5 pts. of 1-phenyl-5-methylbenzthiazole are mixed together, charged into 250 pts. of sulphuric acid monohydrate, and heated on a water bath for 5 hrs. The mixture is then diluted, and the leuco base precipitated by neutralising with sodium hydroxide. It is collected, dissolved in hydrochloric acid, and oxidised with lead peroxide. The lead is finally removed as sulphate, and the dye precipitated by the addition of common salt.—G. F. M.

Azo-dyestuffs; Manufacture of chromium compound of ——. Soc. of Chem. Ind. in Basle, and F. Straub. E.P. 186,635, 18.3.21. Addn. to 104,04 (*cf.* U.S.P. 1,221,849; J., 1917, 542).

Azo dyestuffs capable of being chromed are treated in alkaline solution with the complex chromium compounds formed by the action of alkaline suspensions of chromium hydroxide on organic compound containing more than one hydroxyl group, *e.g.* polyhydric alcohols and phenols, tanning agent sugars, and organic by-products from the manufacture of sulphite-cellulose. For example, 20·8 pts. glycerin is added to a solution of 46·8 pts. of potassium hydroxide in an aqueous paste of chromiu hydroxide containing 14 pts. of chromic oxide, an the mixture is boiled until the chromium hydroxid has dissolved. The solution is made up to 200 pt 71·2 pts. of the dyestuff from diazotised 1-amino-hydroxynaphthalene-4-sulphonic acid and α-naphthol is added, the solution is boiled for 10 hrs. und a reflux condenser, diluted with 600 pts. of co water, and, after neutralisation of the alkali wi mineral acid, the dyestuff is salted out, filtered, a dried. The product dyes wool in an acid bath de blue shades fast to light and fulling.—L. A. C.

Safranines; Preparation of anthraquinonyl deri tives of ——. Akt.-Ges. für Anilin-Fabr., Asse of W. Herzberg and W. Bruck. G.P. 357,2 31.3.20. Addn. to 355,491 (J., 1922, 853 A).

In the process described in the chief patent, anth quinone derivatives are employed in which t primary amino group is attached to the anth quinone nucleus by means of an intermediate gro For example, 1-*p*-aminophenylaminoanthraquin is treated with dimethylisorosinduline chlor (Neutral Blue) and sodium hydroxide in the p sence of nitrobenzene at 50° C. until a test port gives a grass-green solution in concentrated s phuric acid. The crystalline product on treatm with 25% oleum yields a water-soluble sulphonic a which dyes wool indigo-blue shades from a vat. —L. A. C

Colour lakes. G.P. 358,047. *See* XIII.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Wood of eucalyptus (Eucalyptus globulus) western white pine (Pinus monticola); Anal of ——. S. A. Mahood and D. E. Cable. J. Eng. Chem., 1922, 14, 933—934.

A continuation of work previously described Schorger, J., 1917, 867 A). The solubility of n various solvents is considerably influenced by ts state of division; in these investigations all amples were reduced to sawdust which passed hrough an 80-mesh and was retained by a 100-mesh ieve. The composition of western white pine is imilar to that of longleaf pine, although the latter ields more soluble matter to cold and hot water nd alkali. Although, on destructive distillation, ucalyptus yields nearly as much acetic acid as a ardwood, the yield of acetic acid on hydrolysis is nuch less than that similarly obtained from hardwoods previously analysed (*loc. cit*). Eucalyptus esembles conifers in its low ash content. The ellulose isolated from western white pine and ucalyptus contains approximately the same mount of α-cellulose, but the remaining cellulose is lmost entirely γ-cellulose in the case of eucalyptus nd an equal mixture of β- and γ-cellulose in he case of western white pine. The lignin con-ent was determined by extracting 2 g. of the ir-dried material for 4 hrs. with a mixture of lcohol and benzene of minimum b.p., afterwards isintegrating it by treatment for 16 hrs. at room emperature with ten times its weight of 72% ulphuric acid, then boiling the product, after ilution, till its acid content was 3%, for 2 hrs. nder a reflux condenser, and filtering through a ared alundum crucible. The residue was washed ree from acid with hot water, dried at 105° C., and eighed as lignin.—A. J. H.

ood; Removal of resin from —— prior to the manufacture of cellulose. H. Wenzl. Zellstoff u. Papier, 1922, 2, 228—232.

ETHODS depending on the use of petroleum hydro-rbons in which 90% of the total resin is extracted ve been worked out, some of them depending on e use of high pressures and moderate tempera-res. Chlorinated hydrocarbons are hardly itable, but "tetralin" (tetrahydronaphthalene) pears particularly promising. The process of nson and Bennett with the use of 70% alcohol ., 1922, 380 A), is of interest as a subsidiary of e sulphite spirit scheme, since much of the quisite plant is common to both. When the e of the wood particles is reduced to 25×45 mm. e extraction of 71% of the resin content has en effected. Methods depending on the use of ulsified organic solvents have not been very ccessful in spite of the low cost, owing to the fective penetrating power of such emulsions. In e process molten resin or pitch has been employed 200° C. for the treatment of very resinous wood ste, but the residual wood is rendered useless r cellulose manufacture. A process of extraction ith dilute ammonia solution at 70° C. has given gh yields of resin, but it is necessary to extract e resin from the ammoniacal solution by means gasoline, and the double process is not onomical. Many processes are based on the use caustic soda and sodium carbonate for the traction of resin as a preliminary stage in the gestion of the wood for the manufacture of kraft llulose. By these methods, however, the chemical operties of the resin are profoundly modified. metimes very high pressures and moderate mperatures are recommended on this account; e use of reducing agents such as hydrosulphite, d of an indifferent atmosphere such as hydrogen s, have also been proposed.—J. F. B.

ugar formation in a sulphite digester. E. C. Sherrard and C. F. Suhm. J. Ind. Eng. Chem., 1922, 14, 931—932.

experimental digestions of white spruce by the itscherlich process, the total, free, and combined lphur dioxide in the liquor being 3·80%, 2·39%, d 1·41% respectively, little sugar was formed temperatures below 100° C. Sugar was most rapidly formed during the stage at which the wood chips suffered disintegration, and the total amount of sugar produced in the production of a good quality pulp was 11% on the weight of the dry wood used. During the early part of the digestion, the rate of formation of sugar closely followed the rate of removal of lignin. In a digestion in which the values for total, free, and combined sulphur dioxide were 5·60%, 4·46%, and 1·14% respectively, there was formed 16% of sugar, but the loss of cellulose was 2% greater.—A. J. H.

Cellulose [α-cellulose]; Determination of alkali-resistant ——. P. Waentig. Zellstoff u. Papier, 1922, 2, 225—228. (*Cf.* J., 1922, 408 A).

IN the standard method for the determination of resistant or α-cellulose in wood pulp the principal source of discrepancies is the re-precipitation of colloidal cellulose when the paste is diluted with water before filtration. A modified procedure is recommended as follows: 3·5 g. of the pulp is dried at 105° C., weighed, and steeped in a porcelain mortar with 50 c.c. of 17·5% sodium hydroxide solution for 45 mins. at the ordinary temperature, the mass being worked up with a pestle to a uniform paste. 50 c.c. of water is then stirred in and the paste is transferred to a Buchner funnel, 8—10 cm. in diam., covered with a fine cotton cloth filter. It is washed on the filter with 200 c.c. of 8% sodium hydroxide solution and sucked as dry as possible. The cake of cellulose is treated with 50 c.c. of 5% acetic acid, sucked dry again, transferred back to the mortar, broken up, and stirred again with a further 50 c.c. of 5% acetic acid. The cellulose is collected on the filter, washed until neutral to litmus paper, and dried at first on a clock glass, and then at 105° C. in a stoppered weighing bottle until the weight is constant. The results are expressed in terms of dry substance. This method generally yields values 2—3% lower than the older method, presumably because of the longer contact with alkali and the more complete washing out of the colloidal cellulose with the 8% caustic soda, but it is contended that the results are more uniform and are obtained under conditions corresponding more closely with those of practical mercerisation in the viscose industry.—J. F. B.

Paper; Application of direct dyes in colouring ——. W. C. Holmes. J. Ind. Eng. Chem., 1922, 14, 958—960.

EXCEPT for the production of light shades, direct dyes are particularly suitable for dyeing paper in the hollander. A direct dyestuff, absorbed as such by paper, produces deeper and brighter shades than when absorbed as a metallic lake. The formation of aluminium lakes in the hollander should especially be avoided, since for most colours, these are inferior in strength and brilliance to the corresponding calcium, barium, and even iron lakes. Where lake formation cannot be avoided, the calcium lakes should be produced by addition of calcium chloride. High temperatures are not desirable, but it is advantageous to add salt, since brighter effects are thereby obtained with a saving of dyestuff. In colouring ground wood furnishes, lake formation is desirable, since in this case a dyestuff, absorbed as such, produces shades of inferior depth and brightness than when absorbed as a metallic lake. When Pontamine Sky Blue 5BX is dyed upon bleached sulphite and ground wood furnishes, the depth of shade developed on the former is several times greater than that on the latter, although there is no material difference in the amounts of dye actually absorbed. Hence, in colouring ground wood furnishes calcium chloride should be added to the hollander before the introduction of the dyestuff. The fastness of shade, in the case of some direct dyestuffs, is improved by the addition of copper sulphate to the hollander, and this addition should be made after the colour has been allowed "to run" for a short period.—A. J. H.

Piezo-micrometer and its applications [to testing paper etc.]. J. Strachan. Proc. Tech. Sect. Papermakers' Assoc., 1922, 3, 20—32.

The author describes a device for determining the thickness of a sheet of paper submitted to a definite known pressure. The paper is placed between pressure plates between which a known pressure is produced by a lever system. A micrometer is adjusted so that a platinum needle carried on the end of the micrometer screw makes contact, without sensible mechanical pressure, with the upper of the two pressure plates. The contact is determined electrically by the closing of an electric circuit and is accurate to within 1/20,000 inch. The thickness of the sheet of paper is obtained from the micrometer reading in the usual manner. Graphs are given of the relation of the volume, V, of samples of various materials—untanned kid skin, rubber, varieties of paper—to the pressure, P. There is a time lag between the application of the pressure and the attainment of the maximum appropriate compression. Between the limits of compression, P and V are related by the equation $PV^n=constant$. Air space in paper comprises interstitial air-space and porosity air-space, the former consisting of space between the fibrous and mineral constituents of the paper, the latter consisting of the capillary pores in the material, and the author contends that the calculation of air-space by the method adopted in the "C.B.S. Units" is liable to error.—J. S. G. T.

Humidity equilibria. Wilson and Fuwa. *See* I.

Patents.

Fibrous or artificial filamentary materials; Apparatus for treating with liquids ——. F. Linnemann. E.P. 169,695, 15.9.21. Conv., 1.10.20.

Hanks of fibrous material or, *e.g.*, artificial silk, are supported on hank rods attached to a vertically reciprocating frame extending over a series of tanks containing liquor for treating the material. The movement of the frame alternately submerges the hanks and raises them out of the liquor, and, while the hanks are hanging out of the liquor, moves them along the series. The liquid may flow continuously through the tanks in the opposite direction to that of the hanks, or means may be provided for admitting a fresh supply of liquid to the tanks each time the hanks are raised.—L. A. C.

Textile fabric; Artificial —— and process for its manufacture. J. E. Brandenberger. U.S.P. 1,394,270, 18.10.21. Appl., 18.5.20.

A viscous solution such as is used for the manufacture of artificial silk is emulsified with air or other inert gas, the emulsion is allowed to stand for a time to allow large bubbles to rise and break, and is then spun into threads in the usual way. The threads thus obtained contain numerous minute bubbles and are therefore very light, opaque, and warm to the touch. By suitable regulation of the quantity of bubbles thus introduced, a material having the appearance and feel of wool can be obtained.

Vulcanised fibre; Separating chlorine compounds from ——. Elektro-Osmose A.-G. (Graf Schwerin Ges.). G.P. 357,057, 23.3.20.

Vulcanised fibre disposed between diaphragms constructed of fibrous vegetable material so arranged that the cations migrate more rapidly than the anions, is subjected to the electro-osmotic action of a continuous electric current, and is thereby dechlorinated and improved in durability and insulating properties.—L. A. C.

Cellulosic material; Manufacture of sheets of —— with a compact surface. M. Mangold. G.P. 357,098, 12.12.18. Conv., 23.10.18.

Cellulosic material which has been compressed and subsequently loosened on the surface to hinder impregnation with liquid beyond a desired depth, is converted superficially into sodium-cellulose by treatment with sodium hydroxide, and subsequently into viscose. The surface is hardened by drying, yielding material possessing properties similar to those of viscose. In the case of material prepared from wood-pulp, substances such as carbohydrates, lignin, resins, and albumins, which hinder the formation of sodium-cellulose are removed by previous treatment under pressure with sodium hydroxide in excess.—L. A. C.

Cellulosic material; Rendering —— resistant to water. F. Beck. G.P. 357,972, 14.12.19.

Cellulose precipitated by diluting solutions of it in concentrated solutions of salts, such as calcium thiocyanate, is moulded into shape, washed with water, dried, and steeped in a concentrated solution of an alkali or alkaline-earth salt, *e.g.*, calcium thiocyanate, and again washed and dried. The treatment improves the tensile strength of the material, and renders it resistant to water.—L. A. C.

Cellulose butyrate; Process of preparing ——. G. J. Esselen, jun., and H. S. Mork, Assrs. to A. D. Little, Inc. U.S.P. 1,425,581, 15.8.22. Appl., 26.7.20.

See E.P. 167,143 of 1921; J., 1922, 748 A.

Waste liquors from pulp mills and similar liquors; Apparatus for evaporation and dry distillation of ——. Aktiebolaget Cellulosa. E.P. 165,72 14.6.21. Conv., 29.6.20.

See G.P. 349,438 of 1921; J., 1922, 450 A.

Turpentine oil obtained in manufacture of sulphate cellulose. G.P. 358,050. *See* XIII.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Patents.

Textile fibres in the loose state; Process and apparatus for dyeing and other treatment of ——. J. T., and J. Brandwood. U.S.P. 1,432,318-9, 17.10.22. Appl., 14.5.21.

See E.P. 182,575 of 1921; J., 1922, 666 A.

Bleaching agent. G.P. 357,956–7. *See* XII.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Pernitric acid; Properties and structure of ——. I. Trifonow. Z. anorg. Chem., 1922, 124, 123-135.

Pernitric acid is formed by the action of hydrogen peroxide on an acidified nitrite solution; low temperature and low concentration are not essential for its formation. Above 70° C. it decomposes rapidly. The per-acid can be estimated by the addition of potassium bromide in dilute solution, and the determination of the liberated bromine by means of potassium iodide solution. The reaction of formation is represented by the equation

$$2HNO_2+3H_2O_2+(n-1)H_2O=N_2O_6,nH_2O+3H_2O$$

and not as given by Raschig (J., 1904, 934; 1905

276) or Schmidlin and Massini (J., 1910, 693). Pernitric acid thus receives the formula

$NO_2.O.O.NO_2,nH_2O$.

The reactions of pernitric acid with some organic compounds are given (*cf.* p. 932 A).—W. T.

Phosphoric acid, sodium phosphate, and pyrophosphates; Volumetric determination of ——. F. X. Moerk. Amer. J. Pharm., 1922, 94, 641—650.

PHOSPHORIC acid and disodium phosphate can be determined volumetrically by titration with sodium hydroxide and hydrochloric acid respectively, using a mixture of methyl orange and indigo-carmine as indicator. To obtain results by this method in consistent agreement with the silver phosphate precipitation method followed by titration the liberated acid with alkali hydroxide up the permanent formation of brown silver xide, the dilution of the reacting solutions must be specified and a definite quantity of odium chloride, depending on the dilution, must e added; the silver phosphate method is not pparently affected by these factors. For the eutralisation method using the indicator the rocedure is as follows. To 100 c.c. of water r salt solution, 0·2 c.c. each of 0·1% methyl range solution and 0·3% indigo-carmine solution are added, followed by dilute hydrochloric cid until the green colour changes without producing a violet colour. The indicator solution thus repared is divided into two equal parts, one being eserved, and the other added to the phosphoric acid olution to be estimated, and the mixture titrated with *N*/2 sodium hydroxide or hydrochloric acid, as the case may be, to match the tint of the eserved solution. The end point corresponds in each case to the formation of NaH_2PO_4. Under these conditions results in agreement with the silver phosphate method were obtained by titrating in presence of 7·5% sodium chloride for phosphoric cid and 2·5% for the phosphate. Under similar conditions sodium pyrophosphate can be titrated with acid as a di-acid base.—G. F. M.

Phosphoric acid and sodium phosphate; Methyl red in the assay of ——. F. X. Moerk and E. J. Hughes. Amer. J. Pharm., 1922, 94, 650—655.

HE U.S.P. (IX) method for the volumetric etermination of phosphoric acid and phosphates lways gives lower results than either of the wo methods described in the preceding abstract. he mixed indicator method is the most rapid, ut is influenced by the weight of substance aken, by the amount of sodium chloride present, nd by the strength of the volumetric solutions. The est results when working with unknown quantities re obtained by the silver phosphate method, trating back the liberated acid with alkali hydroxide, using methyl red as indicator. The procedure is as follows: To 50 c.c. of standard lver nitrate solution one drop of methyl red and trace of alkali to produce a yellow colour are dded, followed by 10 c.c. of the solution to be sayed. The liberated nitric acid (3 mols. per mol. H_3PO_4, or 1 mol. per mol. of Na_2HPO_4) is titrated th alkali hydroxide until the supernatant liquid again yellow. During the titration the pink lour may fade, in which case one or two drops more methyl red must be added.—G. F. M.

lcium carbide. E. Botolfsen. Ann. Chim., 1922, 18, 5—48.

RBIDE was prepared by direct combination of mmercial calcium, from which the coating of ide had been removed, and lampblack, previously rified by heating to redness in a current of lorine. An excess of calcium was used and conct between the elements was effected by piercing les in the metal and placing the carbon therein. The mixture was then heated *in vacuo*, but no appreciable reaction took place at temperatures below the melting-point of the metal, even when heating to 700° C. was continued for 50 hrs. Carbide was formed when the metal fused, but distillation of the metal proceeded faster than the reaction, so that carbon containing only traces of carbide remained. On heating in an atmosphere of argon at normal pressure for 6 hrs. at 800°—850° C., no volatilisation of calcium occurred, but no increase in the formation of calcium carbide was observed. Further attempts made with calcium vapour were successful, and on heating 5 g. of calcium and 2 g. of carbon at 850°—875° C. for 17 hrs. only 7% of the carbon remained uncombined, whilst in the case of 11 g. of calcium heated with 5 g. of carbon at 1025°—1050° C. for 10 hrs., only 1·5% of free carbon remained. Finally when 14 g. of calcium was heated with 4 g. of carbon at 925°—975° C. for 45 hrs., all the carbon was converted into carbide. The excess of calcium was found as a metallic deposit in the upper part of the tube. Pure carbide, as described by the author, is white, but the substance prepared by the above method is black. It rapidly decomposes in air, yielding acetylene; the resulting lime is whiter than that obtained from industrial carbide, so that the colour is not due to the presence of free carbon; moreover industrial carbide containing up to 6% of carbon is grey. Experiment showed that the colour was due to iron from the containing vessel, but further specimens made in an alundum tube were also black. In the latter case, analysis showed the presence of metallic aluminium formed by the action of calcium on alumina. The dissociation of commercial carbide was effected by heating 3 g. to 1050° C. for 18 hrs., when a deposit of several centigrams of metallic calcium was obtained in a finely divided condition. When an iron vessel is used for the purpose, the carbon liberated attacks the vessel with the formation of Fe_3C. No trace of a sub-carbide of calcium was found. The presence of certain substances, *e.g.*, iron and iron oxide, affects the progress of the dissociation.

—H. J. E.

Magnesium sulphate; The octahydrate of ——. S. Takegami. Mem. Coll. Sci. Kyoto, 1921, 5, 191—199.

WHEN magnesium sulphate crystallises from aqueous solutions containing sodium sulphate at 25° C. it separates as the octahydrate, which has not previously been recognised. If the proportion of sodium sulphate is increased, astrakanite $MgSO_4,Na_2SO_4,4H_2O$, is eventually formed. At 30° C., however, when the proportion of sodium sulphate is increased to about 32 mols %, the octahydrate is transformed into heptahydrate. The octahydrate changes into heptahydrate when air-dried. In a magnesium sulphate—sodium sulphate—water system containing 7—9% of sodium sulphate in solution, the octahydrate of magnesium sulphate is stable below 45·5° C. and the heptahydrate from this temperature to at least 77·2° C. The number of solid phases to be taken into account in the equilibrium of the reciprocal salt pair

$$MgSO_4+2NaCl \rightleftharpoons MgCl_2+Na_2SO_4$$

thus becomes, with the addition of $MgSO_4,8H_2O$, ten.—E. H. R.

Calcium carbonate; Solubility of —— *in water in equilibrium with a gaseous phase containing carbon dioxide.* Y. Osaka. Mem. Coll. Sci. Kyoto, 1921, 5, 131—141.

A THEORETICAL paper, in which, assuming for the first and second apparent dissociation constants of carbonic acid the values $3·5\times10^{-7}$ and $4·91\times10^{-11}$, but allowing for the fact that carbon dioxide dissolved in water is combined only to a small extent and that carbonic acid is in reality a much stronger acid than acetic acid, the solubility product of calcium carbonate (calcite form) at 25° C. is calculated to be $7{\cdot}24\times10^{-9}$. A formula is given from which the solubility of calcium carbonate at any partial pressure of carbon dioxide can be calculated, assuming the degree of dissociation of calcium bicarbonate to be the same as that of calcium acetate at the same concentration.—E. H. R.

Rare earths; A new mineral which contains the —— as its main component. F. Henrich and G. Hiller. Ber., 1922, 55, 3013—3021.

A HYDRATED phosphate of yttrium and erbium, PO_4(ErY etc.), $2H_2O$, termed weinschenkite, occurs in very small quantity in the Bavarian Oberpfalz in white, matted, globular deposits and in radiating needles on brown hæmatite from which it is readily detached. An accurate quantitative analysis of the mineral has not yet been possible owing to the small quantity available. (*Cf.* J.C.S., Dec.)—H. W.

Radium solutions; Durability of ——. A. Becker. Z. anorg. Chem., 1922, 124, 143—152.

THE permanency of the solution is defined as its constancy of emitting emanation. The author found that solutions containing 0·02 to 0·0000005 mg. of radium per grm. of solvent did not show any decay in eight years. The possible experimental error was 1%.—W. T.

Gels of inorganic salts; General method for obtaining ——, and its relation to theories of the colloidal state. K. Charitschkov. J. Russ. Phys.-Chem. Soc., 1920, 52, 91—96.

THE action of hydrogen chloride or carbon dioxide on a solution of sodium (potassium etc.) naphthenate in a hydrocarbon containing excess of naphthenic acid yields colloidal sodium chloride or carbonate; oleic acid may be used in place of naphthenic acid. The products thus obtained, including colloidal cupric and mercuric chlorides, etc., exhibit Brownian movement and the corresponding ultramicroscopic appearance. When ferric naphthenate is treated with hydrogen chloride, the latter exerts a reducing action, the product being ferrous chloride. (*Cf.* J.C.S., Dec.)—T. H. P.

Salts; Adsorption of —— on metal surfaces. H. von Euler and G. Zimmerlund. Arch. Kem. Min. Geol., 1922, 8, [14], 1—23.

MEASUREMENTS have been made of the silver nitrate and potassium chloride adsorbed from aqueous solution by finely divided gold particles and by gold-leaf. The amount adsorbed increases with the amount of salt in solution, at first linearly and then tending to a maximum. At the maximum there is more adsorbed than would correspond to a unimolecular layer on the gold. Experiments are also described with mercury dropping through a calomel solution, in which the amount of mercury in solution was determined by measuring its effect as an enzyme poison.—W. O. K.

Phosphorus. W. Marckwald and K. Helmholz. Z. anorg. Chem., 1922, 124, 81—104.

THE authors found the melting point of scarlet phosphorus to be 592·5°±0·5° C., and the critical temperature of the yellow modification 720·6° C. By rapid cooling of phosphorus vapour a mixture of the yellow and scarlet modifications is deposited, whilst slow cooling gives the pure yellow form. A hypothesis is advanced to explain this and also the phenomenon observed on cooling liquid scarlet phosphorus (*cf.* J.C.S., Dec.). The authors show that the crystals isolated from the melt of the scarlet variety are identical with Hittorf's phosphorus. Black phosphorus changes into the scarlet form on being heated to 575° C.—W. T.

Naturally occurring gases; Examination of —— II. F. Henrich and G. Prell. Ber., 1922, 55, 3021—3025.

THE method for the collection and examination of naturally occurring gases (*cf.* J., 1920, 748 A) has been simplified and extended. The gases from three springs near Leopoldsdorf, Bavaria, contained respectively oxygen 13%, with nitrogen and rare gases, oxygen 18·8%, with nitrogen and rare gases, and oxygen 18·2%, nitrogen 81·8%, argon and neon 1·1%. Since the ratio, nitrogen : rare gases in the gases is approximately the same as in air, it appears that air has in some manner been enclosed below the water in the spring. The low oxygen content of the gases in comparison with that of air is explained by the greater solubility of oxygen than of nitrogen in water. (*Cf.* J.C.S., Dec.)—H. W.

Naturally occurring gases; Examination of —— III. F. Henrich and G. Prell. Ber., 1922, 55, 3026—3030.

THE gases from a number of pools on the Luisenbur near Wunsiedel and Alexanderstad (Fichtelgebirge consisted mainly of nitrogen (and rare gases) and methane, with small quantities of oxygen and carbon dioxide and traces of hydrogen sulphide. The methane, carbon dioxide and hydrogen sulphide appear to owe their origin to a bacterium which is similar to but not identical with *B. methanigenes*. Nitrogen and the rare gases must be derived initially from the air. The ratio of rare gas to nitrogen is, however, in two instances rather more than 50% greater than in air. It is suggested that the air was imprisoned beneath the water and a portion of its nitrogen was assimilated by bacteria.—H. W.

See also pages (A) 928, *Sulphur from spent gas purifying material* (Kattwinkel). 932, *Hydrogen peroxide and nitrites* (Trifonow). 942, *Formation of nitrides* (Tammann). 963, *Sulphuric acid* (Balarew); *Phosphoric acid* (Feigl); *Boric acid* (Kolthoff); *Nitrous and arsenious acids* (Klemen and Pollak).

PATENTS.

Gas and carbonaceous materials [calcium carbide]; Production of ——. J. H. Reid. E.P. 185,135, 22.2.21.

COAL ground to pass through an 8-mesh sieve and calcium carbonate ground to pass a 40-mesh sieve are intimately mixed and carbonised in a retort at 2600°—2800° F. (1400°—1550° C.). The tarry distillate produced at lower temperatures is not formed, the sole products from 4000 lb. of limestone and 4000 lb. of coal being 27,000 cub. ft. of gas of high calorific value and 6520 lb. of coked residue. The latter is passed at a high temperature to an electric furnace, where it yields 3000 lb. of calcium carbide and 90,000 cub. ft. of carbon monoxide. An improved current efficiency in the carbide furnace is obtained due to the uniformity of the charge. If desired the molten carbide may be run into water and the resulting acetylene and hydrogen led back through the furnace chamber, wherein the mixture is converted into hydrocarbons such as methane, ethylacetylene, and methylallene.—C. I.

Alkali from felspar and other minerals; Process for the extraction of ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 186,199, 15.7.21.

TEN pts. of finely ground felspar is allowed to stand for some time with 10 pts. of a 10% solution of hydrochloric acid. The mixture is then diluted with 40 pts. of water and submitted to a treatment in a colloid mill. The colloidal dispersion so obtained is heated to about 225° C. at 25 atm. pressure in an autoclave, whereupon a large proportion of the potash in the felspar goes into true solution. The solution is filtered and concentrated by evaporation

A more refractory mineral requires treatment at high pressure with superheated steam at 125°—350° C. Extraction of the potash is facilitated if the felspar is heated in a "revolver" furnace with carbonaceous material or heated with reducing gases before being subjected to the process.—H. R. D.

Hydrogen peroxide; Production of ——. Woodlands, Ltd. From J. Pátek. E.P. 186,840, 12.10.21.

Solutions of hydrogen peroxide, or solutions (persulphates) which yield it on heating, are sprayed or atomised on to a surface of sulphuric acid or fused sodium bisulphate heated to a temperature above the boiling point of the solution. The hydrogen peroxide evaporates immediately and escapes with the steam to a condenser, in which it is rapidly condensed.—H. R. D.

Ferrous sulphate; Method of oxidising ——. C. J. Herrly, Assr. to Union Carbide Co. U.S.P. 1,430,551, 3.10.22. Appl., 13.7.20.

Ferrous sulphate is subjected to the action of oxygen with an oxide of nitrogen as catalyst, in presence of water and sufficient sulphuric acid.
—C. I.

Dicalcium phosphate; Manufacture of ——. M. Helbig. G.P. 357,763, 3.7.20.

Raw materials containing tricalcium phosphate are dissolved in mineral acid and the solution is heated in the presence of a quantity of magnesium chloride sufficient to provide chlorine ions equivalent to at least half of the calcium present.—L. A. C.

Aluminium compounds; Preparation of —— nearly free from iron from solutions of ferruginous alumina. Chem. Fabr. Griesheim-Elektron. G.P. 357,900, 1.8.19.

Ferric salts present in aluminium solutions are reduced to ferrous salts and the aluminium salts in solution are converted into insoluble compounds by evaporation and thermal decomposition in the absence of air.—L. A. C.

Copper sulphate; Production of —— from waste material containing copper or its alloys. S. Hiller. G.P. 358,611, 2.9.20. Conv., 24.8.20.

An intimate mixture of waste material containing copper or its alloys and not more than 10% of its weight of sodium chloride is roasted as in the chloridising roasting of copper sulphide ores, and is subsequently treated with sulphuric acid. If the material contains tin, a small proportion of calcium oxide, silica, or alumina is added before roasting.
—L. A. C.

Graphite; Purification of —— by means of an electric current. Graphitwerk Kropfmühl A.-G. G.P. 358,520, 13.3.19.

A mixture of graphite and coal is heated above 2200° C., whereby impurities combined with the graphite are sublimed. By allowing the sublimed vapour to condense at different temperatures, the various impurities may be recovered separately.
—L. A. C.

VIII.—GLASS; CERAMICS.

Quartz; Elasticity and symmetry of —— at high temperatures. A. Perrier and B. de Mandrot. Comptes rend., 1922, 175, 622—624.

A study of the variation in the elasticity of quartz with change of temperature showed that decreasing values are obtained up to 575° C., whilst beyond that point the values increase at first very greatly for small increments of temperature, then to a gradually diminishing extent. At the inversion point (transition from α- to β-quartz) the crystal passes from the rhombohedral to the hexagonal system.—H. J. E.

Patents.

Glass furnaces; Feed troughs for ——. W. G. Clark. E.P. 163,995, 27.5.21. Conv., 27.5.20.

The feed trough of a glass furnace is provided internally with an electric heating element which enables chilled glass in the trough to be melted whilst the batch in the furnace is being heated. As soon as the glass is melted the current may be directed through the molten glass.—C. A. K.

Clay; Treatment of ——. W. Feldenheimer and W. W. Plowman. E.P. 186,855, 21.11.21. Addn. to 184,271 (J., 1922, 756 a).

The clay is deflocculated in a dilute aqueous solution of sodium or potassium pyrophosphate.
—H. R. D.

Artificial meerschaum; Method of producing ——. P. Deussing. E.P. 172,004, 18.11.21. Conv., 23.11.20. Addn. to 164,319.

See G.P. 340,533 of 1920; J., 1921, 892 a.

Refractory material. E. D. Frohman. E.P. 186,968, 10.6.21.

See U.S.P. 1,372,016 of 1921; J., 1921, 348 a.

Clays; Treatment of —— and manufacture of articles and materials therefrom. W. Smith. U.S.P. 1,432,629, 17.10.20. Appl., 1.9.21.

See E.P. 149,440 of 1919; J., 1920, 658 a.

Glass; Apparatus for feeding ——. W. J. Miller. E.P. 172,634, 6.12.21. Conv., 6.12.20.

IX.—BUILDING MATERIALS.

Patents.

Wood; Method of treating ——. F. B. Dehn. From The Studebaker Corp. E.P. 187,018, 12.7.21.

Wood is treated with a liquid mixture such as that made by mixing 30 lb. of Manila gum, 3 galls. of Baltic linseed oil, and 7 galls. of turpentine and adding zinc oxide ground in varnish in the proportion of 8 lb. per gallon of the first mixture. The treated wood is gradually heated for 3 hrs. to a temperature above its critical point or for 4 hrs. to 200° F. (93° C.). After this treatment the strength of the wood is greatly increased and its critical temperature raised.—A. R. P.

Slag; Method for obtaining highly porous ——. C. H. Schol. E.P. 145,032, 14.6.20. Conv., 29.8.14.

See U.S.P. 1,163,605 of 1915; J., 1916, 118.

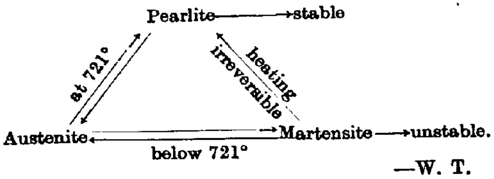
X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Iron-boron-carbon; The ternary system ——. R. Vogel and G. Tammann. Z. anorg. Chem., 1922, 123, 225—275.

The authors discuss the results of Hannesen (J., 1915, 84) and Tschischewsky and Herdt (J., 1917, 650) who investigated the system iron-boron. The disagreement of their results is found to be due to differences in the rate of cooling. Rapid cooling results in the separation of supersaturated mixed crystals. Hannesen worked with small quantities and the cooling was much more rapid than in the work of Tschischewsky and Herdt. The authors have carried out a systematic study of the ternary system iron-boron-carbon and their results are given in detail. Equilibrium sets in so slowly in the system that the structure and properties of the ternary alloys depend to a large extent on the preliminary heating. The limiting proportion of boron having an influence on the structure was found to be 0·02%.—W. T.

Steels; Honda's conception of the A1 transformation and the quenching of ——. M. Chikashige. Z. anorg. Chem., 1922, **124**, 59—60.

A THEORETICAL paper in which the author criticises the views of Honda (J., 1919, 821 A), and claims that a better interpretation is given by the following scheme:—



—W. T.

Steels; Influence of velocity of cooling on the position of the critical points and the structure of ——. W. Schneider. Stahl u. Eisen, 1922, **42**, 1577—1584.

THREE carbon steels, A, B, and C, containing 0·30, 0·89, and 1·25% carbon and 0·14% manganese, were used. Ball specimens 10 mm. diameter were prepared from rods of these steels, and the Portevin water resistance was used to regulate the cooling velocities. The Ac1 and Ar1 points of the steels were 726°, 725°, 725° C. and 715°, 716°, 716° C. respectively. The effect of increasing the cooling velocity on the Ar1 points is to produce a distinct lowering, whilst increasing heating velocity produces a not inconsiderable raising of the Ac1 points. The pearlite point is lowered by increasing the initial temperatures. It is suggested that this change is due to "crystal nuclei" which remain in the solid solution. The higher the temperature as primary cause and the longer the time of cooling as secondary cause, the smaller the number of "crystal nuclei" which remain to initiate decomposition of the solid solution on cooling. Microscopical examination shows that the grain size decreases with increasing cooling velocities. Quenching tests with water at different temperatures showed that steel A is troostitic even with the quenching bath as low as 20° C., the cooling curve showing the upper critical point. In steel B the change point is lowered and martensite appears after quenching in water at 50° C. Steel C shows the evolution of heat in the low temperature regions with quenching in water at 50° C. For the retention of martensite in hypoeutectoid steels, the lower the carbon, the lower must be the temperature of the quenching bath, but with steels containing 0·9% carbon and over, such differences no longer exist. It is indicated by all the tests that martensite is formed with evolution of heat, and it is accepted that in the formation of troostite and martensite, of the whole of the heat absorbed at the Ac1 point, does not become free on cooling, the remainder being retained latent by the structural constituents.

—J. W. D.

Titanium; Estimation of —— in ferrous products. L. Losana and E. Carozzi. Giorn. Chim. Ind. Appl., 1922, **4**, 394—396.

THE method is based on the oxidation of titanous to titanic compounds by methylene blue (*cf.* Ferrari, J., 1920, 837 A), which is found to be without action on other usual constituents of irons and steels. Solutions of 3·9 and 1·95 g. per l. respectively of methylene blue, corresponding with about 0·001 g. and 0·0005 g. of titanium per c.c., are convenient, the exact titres being determined experimentally. (1) *Steels and cast irons*: Of these, which seldom contain as much as 1% of titanium, 2—5 g. of the sample is evaporated gently to dryness with hydrochloric acid diluted with its own volume of water, the dry residue being heated on a water-bath for 15 mins. with concentrated hydrochloric acid to dissolve the whole of the titanium. The liquid is diluted to 200—300 c.c. and treated for 30 mins. at 60° C. with 25 c.c. of concentrated hydrochloric acid and a few grams of zinc dust. As the titanium reacts only after the iron, the liquid is tested to ensure the complete reduction of the iron, and is then filtered rapidly, through a glass wool plug on which is placed a little granulated zinc, into a flask filled with carbon dioxide, the filtrate being titrated immediately with the methylene blue solution until a distinct coloration appears. (2) *Ferro-titaniums*: Since these are insoluble in acids, 0·5 g. of the finely-divided metal is fused with potassium bisulphate, the mass being then digested with 50% hydrochloric acid on a water-bath for 20 mins. and the liquid made up to a definite volume. The reduction and titration, as described above, are then carried out with an aliquot part. The method yields satisfactory results provided that the reduction, filtration, and titration are effected rapidly.—T. H. P.

Ferrosilicon; Toxic properties of commercial ——. N. Kurnakow and G. Urasow. Z. anorg. Chem., 1922, **123**, 89—131.

COMMERCIAL ferrosilicon has been found to evolve poisonous and explosive gases. The alloy containing about 50% Si is sensitive to water and is very dangerous. The authors found that in iron-silicon alloys with 33·4 to 100% by weight of silicon, a solid phase of variable composition (55·18—61·5% Si) was formed, which solidified at 1245° C. This phase (lebeauite) can form ternary and quaternary solid solutions with phosphorus and aluminium. The ternary solid solutions (Fe-Si-P and Fe-Si-Al) of lebeauite are stable towards water. The quaternary solution of lebeauite (Fe-Si-P-Al) is attacked by water, phosphine being evolved. Ferrosilicon with less than 33·4% Si and containing γ-iron will dissolve phosphorus and aluminium to the extent of 1·7% and 3% respectively. These ternary and quaternary solutions resist the action of water. Calcium phosphide will dissolve neither in solid nor in liquid ferrosilicon.—W. T.

Non-ferrous alloys; Use of —— under superheat. H. C. Dews. Engineering, 1922, **114**, 541—542.

THE behaviour of copper and its principal commercial alloys at high temperatures is discussed with especial reference to their tensile strength and ductility, and a number of curves showing the alteration of these properties with the temperature are given. The tensile strength of copper falls rapidly with increasing temperature up to 700° C., then much more slowly, while its ductility decreases slowly to the same temperature, then very rapidly increases. Similar curves are obtained for 70:30 brass with the bend in the tensile strength curve at 550° C. and the minimum ductility at 400° C., while in 60:40 brasses the tensile strength curve bends much more sharply at 475° C. Probably the most suitable alloys for engineering materials at high temperatures are those of copper and nickel, some of which, *e.g.*, the 80% Cu, 20% Ni alloy, have a tensile strength and ductility at 500° C. equal to that of gun metal at ordinary temperatures.

—A. R. P.

Binary alloys; Relation between the equilibrium diagram and hardness in ——. T. Isihara. Sci. Rep. Tôhoku Imp. Univ., 1922, 11, 207—222.

THE maximum hardness of copper-nickel alloys occurs when the alloy consists of atomic proportions of nickel and copper and is not affected by annealing or ageing. This agrees with Tammann's theory of the hardness of binary alloys orming continuous solid solutions. Quenching of ron-copper alloys containing less than 20% Cu ncreases the hardness to a degree depending on the emperature at which quenching takes place, and he curve showing the relation between quenching emperature and hardness shows breaks at the Ar 2 and Ar 3 points, the Ar 3 point being very marked. On ageing, the hardness first increases slightly, then decreases. In the aluminium-zinc series the hardness-quenching temperature curve shows a break at 262° C. in alloys containing 5—68% Al, corresponding to the transformation of the β phase into $\alpha+\gamma$. Quenching of these alloys from above the eutectoid point results in a considerable increase in hardness, while ageing increases the hardness only of alloys in the $\beta+\gamma$ region. The hardness of the copper-tin alloys substantiates Heycock and Neville's diagram of their constitution (Phil. Trans., 1904, **A 202**); ageing has little effect on the hardness. In the copper-aluminium series quenching from a temperature above the eutectoid point considerably decreases the hardness instead of, as in the case of steels, increasing it, thus showing the incorrectness of the interference theory of hardness (Jeffries and Archer, J., 1921, 515 A). It is shown that Hayward's theory (Chem. Met. Eng., 1921, **65**, 695) that the central portion of an annealed steel bar is harder than the outer portion owing to variation of thermal stress from the centre towards the periphery, is improbable and that the results observed are due to the edge effect, the portion of metal near the edge having a smaller resistance to deformation than the central part of the bar.—A. R. P.

Metal; Effect of temperature, pressure, and structure on the mechanical properties of ——. Z. Jeffries and R. S. Archer. Chem. and Met. Eng., 1922, **27**, 747—751.

THE temperature scale of a solid metal can be divided roughly into a region, below atmospheric temperature, in which the metal is brittle, an intermediate region extending up to the temperature of recrystallisation, and a zone of hot working lying above the temperature of recrystallisation. Pressure applied uniformly on a metal does not effect any permanent change in structure or properties, as metals are perfectly elastic. Hardness increases with the pressure especially for soft materials. It is difficult to describe the structure of a metal with reference to the orientation of its grains. Ordinarily the grains possess varied orientations, but a certain uniformity of orientation occurs in cold-worked metals which persists to some extent after annealing. Fine grain is held generally to promote toughness, strength, and ductility, but at high temperatures it leads to flow at the grain boundaries especially under prolonged application of a load. Cold deformation produces refinement of grain in the sense that one original grain exhibits a mixture of orientations after severe cold work, but the directional properties of the metals are never obliterated. Failure of crystals under load always takes place on crystallographic planes and the only "strength property" of a single crystal is its elastic limit in shear, which has a different value in different crystallographic directions. The properties of crystals depend on the characteristics of the constituent atoms and on the type of space lattice arrangement. All metals crystallising with the face-centred cubic arrangement are ductile throughout a wide range of temperature. Ductile metals possess the property of limiting the extent of slip on any one plane and transferring the successive movement to another slip plane without actual rupture of the first.—C. A. K.

Metals; Mechanical properties of —— as affected by grain size. Z. Jeffries and R. S. Archer. Chem. and Met. Eng., 1922, 27, 789—792.

BELOW the recrystallisation temperature grain boundaries of metal crystals retard plane slip due to variation of orientation of the adjacent crystals and the presence of amorphous metal. Decrease in size of grain would therefore tend to increase the strength and hardness of a metal. The quantitative relation of strength to grain size is dependent on the number of grains on the cross-section, though when this number becomes relatively large (1000 or more) the absolute grain size is more important. Fracture takes place normally through the grains when a ductile metal is broken "cold," but at temperatures just below the melting point grain boundaries are sources of weakness and the fracture is intergranular. The grain size conducive to maximum elongation is neither very fine nor extremely coarse, this property being influenced by the size and shape of the test-piece, temperature conditions, and rate of loading. Lower values for elongation are observed generally in test-pieces of small section. Brittleness may be due to the hardness of amorphous metal at the grain boundaries, although the individual crystals are plastic, *e.g.*, in tungsten, or may be due primarily to the brittle character of the crystal itself, *e.g.*, in zinc. Under tensile strain for reduction of area metals at high temperatures somewhat resemble soft glass, since the hardening effect of the deformation is removed by spontaneous annealing. The reduction of area of single crystals is very high, and extremely small grain size, such as probably occurs in hardened steel, is unfavourable to plasticity of any kind; ordinarily the reduction in area is greater the smaller the grain size.—C. A. K.

Metals; Behaviour of two —— towards one another when dissolved in mercury. G. Tammann and W. Jander. Z. anorg. Chem., 1922, **124**, 105—122.

THE authors investigated the affinity of one metal for another when dissolved in mercury by measuring the freezing point depression of the compound crystals and comparing this with that of the components, and by measuring the influence of the one metal on the e.m.f.-concentration curve of the other dissolved in a third, more noble liquid metal. Thus the addition of small amounts of a more noble to a less noble metal has but a very small effect on the e.m.f. if the compound of the two metals is very highly dissociated, whereas if a stable compound is formed, then a sudden change in the e.m.f. is caused when the concentrations of the metals correspond to the composition of this compound. The following intermetallic compounds were found to be very stable: $AuZn$, Mg_2Sn, $CeSn_2$ and Ce_4Bi_3. Others were very highly dissociated in solution in mercury, for example, compounds of gold with cadmium and lead, of silver with zinc and cadmium, of copper with zinc and cadmium.—W. T.

Metals; Velocity of the action of oxygen, hydrogen sulphide, and the halogens on ——. G. Tammann and W. Köster. Z. anorg. Chem., 1922, **123**, 196—224.

WHEN iodine, chlorine, or air acts on a metal, various surface colours are formed and these colours can be employed as a means of determining the rate of thickening of the film of compound formed (*cf.* J., 1920, 519 A). The rate of chemical action is assumed to be high, but diffusion through the film of compound formed is slow. The rate in the case of iodine is inversely proportional to the thickness of the film and is independent of the temperature. Silver iodide exists in two forms; at the transition point, 145° C., there is a change in the rate of reaction. In the case of the action of moist air containing chlorine and bromine on copper, silver, and lead, there is a parabolic relationship between time of action and thickness of the film. Colours due to the formation of films of oxides are formed by heating several metals in the air, the rate of formation being independent of the rate of flow of gas. The rate of increase of thickness of film with time follows an exponential law. At higher temperatures oxidisable metals are immediately covered with a thin film of oxide which protects the metal from further action. The oxidation is much more rapid in moist air. Hydrogen sulphide reacts rapidly with copper and manganese, more slowly with silver, and still more slowly with lead. Iron, cobalt, nickel, chromium, antimony, bismuth, tin, aluminium, zinc, and cadmium show no change after contact with the gas for several days. The action of air on copper-zinc alloys was also investigated.—W. T.

Nitrides [of metals]; Rate of formation of some ——. G. Tammann. Z. anorg. Chem., 1922, 124, 25—35.

The rate of increase in thickness of the film of nitride formed on heating metals in nitrogen was measured by the change in colour of the films. In the case of cerium, lanthanum, and a mixture of the two the rate of increase of the film thickness plotted against the logarithm of the time gave two straight lines cutting in each case at a definite temperature (*cf.* Tammann and Köster, *supra*). The same applies to metals in oxygen. The presence of moisture in the gases greatly accelerates their action. The film of nitride on iron protects the metal. Cobalt, nickel, molybdenum, tungsten, tantalum, and silicon do not change in an atmosphere of nitrogen at 700° C. Magnesium and calcium are converted into their grey nitrides. —W. T.

Metallurgical coke. Kinney and Perrott. *See* IIa.

Adsorption on metal surfaces. Von Euler and Zimmerlund. *See* VII.

Copper. Hahn and Leimbach. *See* XXIII.

Bismuth. Kurtenacker and Werner. *See* XXIII.

Patents.

[*Chromium-*] *iron alloys* [*; Production of* —— *of low carbon content*]. J. C. Gillott. E.P. 186,982, 6.7.21.

Chromium-iron alloys of low carbon content, in which the chromium is the minor constituent, are prepared by melting separately ferrochromium of high chromium content and pig-iron or steel scrap or a mixture of these, and tapping each batch of molten metal into a converter where, if not already present, an alloy of silicon and manganese is added so that at least 2% Si is present in the charge. The mixture is blown until the carbon and silicon contents have been sufficiently reduced to allow of the resulting metal being worked, and towards the end of the operation a certain amount of manganese is added.—A. R. P.

Ores [*especially oxidised copper ores*]*; Treatment and concentration of* —— [*by the flotation process*]. H. H. Smith. E.P. 166,888, 11.7.21. Conv., 26.7.20.

A mixture of steam and air is blown through a mixture of carbon and a sulphur-bearing material, *e.g.*, iron pyrites, contained, under a layer of lime, in a retort heated to about 700° C. The evolved gases, consisting chiefly of hydrogen sulphide and carbon dioxide, together with smaller amounts of hydrogen and carbon monoxide, are passed through a thick pulp of ground ore and water until the liquid just shows a sulphide reaction. The pulp is diluted, a frothing and stabilising agent added, and the mixture subjected to a flotation process.—A. R. P.

Flotation processes for concentrating ores and the like. A. C. Vivian. E.P. 186,760, 5.8.21.

In the separation of the more valuable constituents of ores, concentrates, metal products, and like heterogeneous materials, organic substances are added which act chemically upon the metal or metal compound to be separated, forming tarry or resinous complexes or decomposition products which facilitate separation of the metal or metal compounds by flotation. Suitable substances are oximes (phenylglyoxime), isonitroso-compounds (cupferron or nitrosophenylhydroxylamine-ammonium, dinitrosoresorcinol), and amino-acids (taurocholic acid), and they may be used alone or in conjunction with known oiling or frothing agents.—J. W. D.

Furnace for roasting pyrites and like ores; Mechanically operated ——. Manuf. de Prod. Chim. du Nord Etabl. Kuhlmann. E.P. 167,464, 27.6.21. Conv., 5.8.20.

In a roasting furnace of the shelf type the rabble arms are fitted with a series of teeth arranged parallel to one another and obliquely to the axis of the rake, so that the end of one tooth touches the same circle of travel as the adjoining tooth. The individual teeth have the shape of the mould-board of a plough and meet the material substantially in a vertical direction, the off-take angle of the teeth being approximately 45°, the natural piling angle of the material treated. In order to compensate for the increase in resistance against the rakes when they act centrifugally, the teeth are given a slight curvature.—C. A. K.

Bearing metal alloy. T. Goldschmidt A.-G. E.P. 169,703, 27.9.21. Conv., 1.10.20.

An alloy containing 70—75% Pb, 15—25% Sb, 3—6% Sn, 1—3% Ni, and 0·6—1·5% Cu, the copper being introduced in the form of 0·8—2·2% of copper phosphide.—J. W. D.

Rare metals [*e.g., zirconium*]*; Process for the preparation of* ——. Westinghouse Lamp Co., Assees. of J. W. Marden. E.P. 173,236, 21.12.21. Conv., 21.12.20.

A salt of the rare metal which does not volatilise at the temperature of the reaction, or a double salt with another metal, is reduced by heating with aluminium, iron, or other suitable metal in quantity slightly less than the stoichiometric amount, and the heating is continued *in vacuo*, after the reaction has taken place, until all the salts present are volatilised, leaving a residue of the pure rare metal. For example, potassium zirconofluoride is mixed with a little less than the theoretical quantity of aluminium and the mixture is heated in an evacuated vessel in an induction furnace. After the vigorous reaction has taken place the temperature is raised until the aluminium, potassium, and excess zirconium fluorides have volatilised, leaving a greyish spongy mass of pure zirconium. —A. R. P.

Nickel alloys. W. Jones, and Sylvette, Ltd. E.P 186,381, 26.5.21.

A nickel silver alloy containing Al 1—3%, F 2—4%, and to which a small quantity of a deoxidi ing agent, *e.g.*, manganese or magnesium, has bee added, may be cast into the form of such article as forks, spoons, etc. The complete compositio of such an alloy may be Cu 55%, Zn 17%, Ni 22% Al 2·25%, Fe 3%, and Mn 0·75%.—C. A. K.

Nickel; Production of —— from nickel carbonyl. H. E. Fierz and H. A. Prager. E.P. (A) 186,457 and (B) 186,458, 14.7.21.

(A) An apparatus for the decomposition of nickel carbonyl consists of a double-walled rectangular chamber, the sides of which are heated to about 300° C. by the passage of hot gases through the space between the walls. The top and bottom of the chamber are cooled by water and the interior is cooled by a cooling liquid flowing through a series of pipes. Nickel carbonyl is passed through the chamber and is in contact with cooling surfaces except at the side walls where decomposition is effected. By this means a pure compact deposit of nickel forms on the side walls of the reaction chamber which can be detached readily for removal of the nickel. (B) The reaction chamber contains a series of parallel hollow iron plates, spaced apart (¾"), which may be heated internally by the passage of hot gases. Practically all the nickel separates on these plates as a compact coherent deposit. —C. A. K.

Nickel; Manufacture of pure ——. H. Sefton-Jones. From Soc. Anon. "Le Nickel." E.P. 187,111, 16.9.21.

The process is the same as that described in G.P. 355,887 (J., 1922, 765 A) except that the use of hydrochloric acid instead of, or as well as, hydrofluoric acid for washing the metal after the first reduction is claimed. The final reduction process may be carried out with the addition of magnesia or of alkali or alkaline-earth carbonates instead of with lime, the object of these additions being to assist in the removal of sulphur compounds.—A. R. P.

Aluminium alloys. The British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 187,089, 29.8.21.

Alloys of aluminium, copper, and silicon containing at least 50% Al, 25% Si, and 15% Cu are claimed, especially those containing 70% Al, 27·5—15% Cu, and 2·5—15% Si. Within these limits alloys having a scleroscope hardness of 45 and a tensile strength of 21,000—24,000 lb. per sq. in. may be produced, which are suitable for die casting and for the preparation of moulds and cores for the manufacture of rubber goods.—A. R. P.

(A) *[Smelting] furnace.* (B, D, E) *Ore-smelting furnace.* (C) *Smelting of ores.* H. L. Charles. U.S.P. 1,394,470–4, 18.10.21. Appl., 23.1.20.

(A) In an ore-smelting furnace a monolithic arch of highly refractory material, *e.g.*, silica, lime, fireclay, magnesite, chromite, is moulded above the usual firebrick arch, allowed to set, and then baked by means of the furnace gases. (B) An abutment is built up between the side walls of adjacent reverberatory smelting furnaces and is cut away adjacent to the ends of the arch roofs of the furnaces. In the spaces thus formed are abutment plates fitted with screws and bolts, so that the width of the spaces may be varied as desired according to the expansion or contraction of the arch roofs of the furnaces. (C) The hearth of a reverberatory furnace is provided with a dam of refractory material over which the slag flows into a chamber forming an extension of the hearth. In this chamber the slag comes in contact and reacts with lime rock, whereby its specific gravity is reduced and separation of metal from the slag is facilitated. (D) The ore inlet of a reverberatory furnace is surrounded by a water-box closed by a water-jacketed sliding cover. The ore-inlet nozzle is water-jacketed and is mounted so that it can be moved through an arc in order to regulate the distribution of ore in the furnace. (E) Means are provided for water-cooling the refractory material of the furnace flue and of the throttle-ledge over which the hot gases pass from the furnace to the flue.

Thermit mixture. G. W. Merrefield. U.S.P. 1,430,667, 3.10.22. Appl., 25.10.21.

A mixture of 11—13% of aluminium, 70—72% of iron oxide, 10—12% of low carbon steel, and 6—9% of ferromanganese is used as a thermit mixture for manganese-steel.—C. A. K.

White metal. C. E. Hansen. U.S.P. 1,431,113, 3.10.22. Appl., 5.4.22.

A white metal alloy containing copper, nickel, zinc, tin, and cobalt.—C. A. K.

Bearing metals and the like containing embedded material which does not form an alloy with the metal; Manufacture of ——. G. Ising and H. Borofski. G.P. 357,447, 7.12.20.

A mass of large diameter of a metal containing embedded non-metallic material is reduced by drawing or pressing to a small diameter, and is then cast at a relatively low temperature into the desired shape.—L. A. C.

Titanium alloy. A. W. Clement, Assr. to The Cleveland Brass Mfg. Co. U.S.P. 1,431,725, 10.10.22. Appl., 18.12.17.

An alloy containing 5—25% of titanium and an appreciable quantity, but not more than 30%, of chromium, together with iron and an appreciable quantity of molybdenum.—C. A. K.

Acid-proof casting. H. Terrisse and M. Lévy. U.S.P. 1,432,923, 24.10.22. Appl., 8.7.20.

See E.P. 151,974 of 1920; J., 1921, 895 A.

Furnace for hardening or tempering steel tools or for heating or annealing metals, glass, pottery, or the like. J. R. C. August. U.S.P. 1,432,946, 24.10.22. Appl., 2.6.20.

See E.P. 139,276 of 1919; J., 1920, 302 A.

Copper sulphate. G.P. 358,611. *See* VII.

Aluminium coils. U.S.P. 1,431,237. *See* XI.

XI.—ELECTRO-CHEMISTRY.

Patents.

Electric battery [electrode]. R. C. Benner and H. F. French, Assrs. to National Carbon Co. U.S.P. 1,393,739, 18.10.21. Appl., 16.1.19.

In order to increase the useful life of the cells and to decrease corrosion of the zinc electrode in electric cells, especially dry cells, the zinc is plated with bismuth, or a bismuth compound is mixed with the usual paste placed in contact with the zinc, or, in non-paste cells, bismuth chloride is applied to the surface of the lining of bibulous material in contact with the zinc.

Lead accumulators; Viscid electrolyte for ——. P. Weber. G.P. 358,409, 21.4.21.

A viscid mixture of sulphuric acid with a non-setting mass of plaster of Paris and fine charcoal, kieselguhr or other inert substance is employed as electrolyte in lead accumulators.—J. S. G. T.

Aluminium; Manufacturing electric coils of ——. E. W. Küttner, Assr. to The Chemical Foundation, Inc. U.S.P. 1,431,237, 10.10.22. Appl., 5.9.18.

In the manufacture of electric coils from wires or bands of aluminium or aluminium alloys, the metal is treated with an oxidising agent both prior and subsequent to winding into coil form.—T. A. S.

Purifying liquids; Method of and apparatus for [electrically] ——. F. W. Mitchell and J. E. Pfeffer. U.S.P. 1,431,245, 10.10.22. Appl., 2.8.18.

Liquid is forced by means of compressed air through a cylindrical vessel fitted with spaced perforated electrodes.—T. A. S.

Electric furnace with suction device for gases. A. Helfenstein. G.P. (A) 356,424, 17.3.17, (B) 356,425, 12.4.17, and (C) 356,426, 13.6.17.

(A) The furnace shaft is provided with gas outlets to which are attached gas-discharge tubes, the latter being so arranged that they serve as the fire-tubes of a boiler for generating steam. The infiltration of air and the consequent splintering of parts of the furnace and the formation of explosive mixtures are thus prevented. (B) The gas conduits and the steam boiler are disposed approximately vertically. In like manner the socket for connecting the gas conduit is arranged vertically within the furnace shaft and the boiler connected thereto axially. Dust reaching the gas conduit is in this manner prevented from remaining there, and heat interchange is not reduced owing to this cause. (C) The gas conduits are built into the masonry of the furnace, and the steam boilers are built into the gas conduits near the walls of the furnace shaft and of the shaft for charging the furnace. Gas conduits provided on both sides of the furnace are joined together at the end of the furnace, and vertical fire-tube boilers are arranged at the junction so as more efficiently to utilise the heat of the furnace gases prior to their discharge. Cylindrical boilers may be employed.
—J. S. G. T.

Insulating material for luting electrical conductors and cables. Felten u. Guilleaume Carlswerk A.-G. G.P. 357,665, 8.5.19.

Partially polymerised synthetic rubbers, or natural rubbers, gutta percha, balata or mixtures of these, depolymerised in each case so as to afford a thick viscid mass, are employed.—J. S. G. T.

Ozone generating apparatus. H. B. Hartman. E.P. 187,558, 23.5.22.

See U.S.P. 1,423,658 of 1922; J., 1922, 718 A.

Storage-battery plates; Paste for ——. A. Willard, Assr. to Willard Storage Battery Co. U.S.P. 1,432,508, 17.10.22. Appl., 2.6.17.

See E.P. 155,944 of 1919; J., 1921, 121 A.

Recovering coal suspended in water. U.S.P. 1,397,735. *See* IIA.

Vulcanised fibre. G.P. 357,057. *See* V.

Preserving vegetable material. G.P. 357,409. *See* XIXA.

XII.—FATS; OILS; WAXES.

Fat constants; Relationships between ——. J. Lund. Z. Unters. Nahr. Genussm., 1922, **44**, 113—187.

The temperature coefficients of the sp. gr. and refractive indices of a number of representative oils and fats and of their insoluble fatty acids were found to average 0·00066, 0·00036, and 0·00068, 0·00037 per 1° C. respectively. The presence of free fatty acids increases the saponif. and iodine values of fats and decreases the sp. gr. and refractive indices. Non-fatty matter and higher alcohols decrease the saponif. and iodine values and increase the sp. gr. and refractive indices. The difference between the constants of fats and those of their insoluble fatty acids is accurately expressed by the following formulæ in which S=saponif. value, N= neutralisation value, I_g, I_f, D_g, D_f, R_g, R_f, repr sent the iodine values, sp. gr.×1000 and refractiv indices×1000 of the glycerides and free fatty acid respectively, while K_s, K_d, and K_r are constant usually 0·000236, 0·112, and 0·051 respectively $N—S=K_sS^2$, $I_f—I_g=K_sI_gS$; $D_g—D_f=K_dS$; R_g— $R_f=K_rS$. The equations for the chemical con stants apply to fats and oils of mean molecula weight (saponif. value 181—198) without referenc to their constitution. The equations for th physical constants apply to ordinary aliphatic fat and oils of average molecular weight, but are no entirely independent of their constitution. Th differences remain almost unaffected by hydrogenating the oils or fats. If the constants of a fat ar known, those of its fatty acids can be accuratel calculated by means of these formulæ except i certain cases in which soluble, cyclic or oxyacids ar present. The formulæ apply to polymerised oil and fats, but these show certain irregularities. I the case of waxes the relationships are different, particularly in the case of the sp. gr., a fact which can be made use of in analysis. The constants of the aliphatic glycerides and fatty acids are related by the following equations:

$$D_g = 847{\cdot}5 + 0{\cdot}3S + b\,I_g$$
$$R_g = 1468{\cdot}5 — 0{\cdot}08S + c\,I_g$$

where b=0·14 to 0·16 and c=0·10 to 0·11.

$$D_f = 847{\cdot}5 + 0{\cdot}18N + b_1I_f$$
$$R_f = 1468{\cdot}8 — 0{\cdot}125N + c_1I_f$$

where b_1=0·135 to 0·155 and c_1=0·095 to 0·105

Tables are given showing the exact values of these factors for the whole range of saponif. and iodine values. The constants of fats containing glycerides of oxyacids, and those of their free fatty acids, are connected by the equations:

$$D_{15} = 847{\cdot}5 + 0{\cdot}3S + 0{\cdot}14I + e\ \text{Ac.}$$
$$R_{40} = 1468{\cdot}8 — 0{\cdot}08S + 0{\cdot}11I + f\ \text{Ac.}$$

where e=about 0·32 and f=about 0·06, and Ac=acetyl value.

Those for fats containing glycerides of cyclic acids by

$$D_{15} = 847{\cdot}5 + 0{\cdot}3S + 0{\cdot}14I + g[\alpha]_D$$
$$R_{40} = 1468{\cdot}8 — 0{\cdot}08S + 0{\cdot}10I + h[\alpha]_D$$

where g=about 0·50 and h=about 0·16.

Constants for polymerised oils are related by t equations

$$D_{15} = 847{\cdot}5 + 0{\cdot}3S + 0{\cdot}14I_g + 0{\cdot}44\,(I_g—I_p)$$
$$R_{40} = 1468{\cdot}8 — 0{\cdot}08S + 0{\cdot}105I_g + 0{\cdot}11\,(I_g—I_p)$$

where I_p is the iodine value after polymerisatio By using these equations, if any two of the four co stants are determined experimentally the other t can be accurately calculated. Ordinary glycerid can be distinguished from those oxy-fatty acid cyclic fatty acids or from polymerised oils, but t use of the equations throws no light on cases adulteration. The melting points of fats and the free fatty acids cannot be co-ordinated with t above-mentioned constants owing to the complic tions caused by the presence of mixed glycerides.
—H. C. R.

Solid and liquid fatty acids; Separation of — W. Meigen and A. Neuberger. Chem. Umscha 1922, **29**, 337—342.

Various published methods were tested on know mixtures of solid and liquid fatty acids, but none was a true quantitative separation obtaine By the methods of Bull and Fjellanger (Apoth Zeit., 1916, **31**, 55), Fachini and Dorta (J., 191 397), and David (J., 1910, 1395) only about one-ha of the liquid acids was recovered in a nearly pu state. By precipitating the aqueous solution of th potassium salts with excess of thallous sulphat however, an almost quantitative separation o stearic, palmitic, and elaïdic acids from oleic acid was attained, and no recrystallisation was necessary. A mixture of 0·502 g. of oleic acid with 0·505 g. of stearic acid gave 0·509 g. of solid acids of iodine value 0·3 and m.p. 68° C., while a mixture of 0·200 g. of oleic acid and 0·502 g. of stearic acid gave 0·529 g. of solid acids of iodine value 0·9 and m.p. 67·5° C.—H. C. R.

Rancidity [*in oils and fats*]; *Influence of air, light, and metals on the development of* ——. J. A. Emery and R. R. Henley. J. Ind. Eng. Chem., 1922, **14**, 937—940.

Metals accelerate the production of rancidity in ard, corn (maize) oil, and cottonseed oil in the presence of air or oxygen, but the action of the metal is independent of the corrosive action of the at upon it. Light is necessary for the development of rancidity in fats exposed to air and not in contact with metals, but not when the fat is in contact with metals. When air is excluded, *e.g.*, by filling the containing vessel completely with the oil or fat, there is no development of rancidity, even when fats are in contact with metals, but rancidity develops n an atmosphere of carbon dioxide. One experiment indicated that moisture has little influence. Fats stored, with and without contact with metals, n an atmosphere of oxygen developed rancidity earlier, and the development of rancidity progressed more rapidly than when stored in air. The catalytic action of metals can be prevented by coating them with bakelite, and a copper strip so treated remained unattacked at the end of several weeks when immersed in lard exposed to the air at 0° C.—A. J. H.

See also pages (A) 925, *Pseudo-extraction* Charitschkov). 928, *Absolute viscosity of oils* Fulweiler and Jordan). 929, *Change in viscosity of ils with temperature* (Herschel). 955, *Phytosterols f ragweed pollen* (Heyl). 964, *Bingham viscosimeter* (Herschel).

Patents.

Fats; Manufacture of nutritious ——. G. Schicht A.-G., and A. Grün. E.P. 160,840, 31.3.21. Conv., 1.4.20.

Neutral fats, alone or mixed with free fatty acids, re converted into mono- and di-glycerides by heating with glycerol and are then converted into mixed glycerides by esterification with free fatty acids. They are finally refined in the manner ustomary for edible fats. The process may be xpedited by using catalysts such as metallic tin r zinc. Mixed glycerides containing butyric and proic acids, such as occur in butter, can be manufactured in this way and cholesterol, lecithin, atural colouring matters, and vitamins may be dded.—H. C. R.

Fat resembling butter; Manufacture of ——. Oelwerke Germania G.m.b.H. G.P. 357,877, 27.4.20.

mixture of fatty acids of similar constitution to ose present in butter is treated with glycerin, and e mixture of glycerides obtained is purified. For ample, a stream of a non-reacting gas is passed for veral hours through a mixture of 193 pts. of fatty ids from tallow, 7 pts. of crude butyric acid, 4 pts. of glycerin, and a catalyst, agitated on a ater-bath.—L. A. C.

ls and fats; Process for the purification of ——. N. Goslings. E.P. 172,923, 23.6.21. Conv., 14.12.20. Addn. to 167,462–3 (J., 1922, 769 A).

me or other insoluble soaps of solid fatty acids, as ll as soluble salts, and bases, such as alkaline-rth or other metal oxides or hydroxides, which m insoluble soaps with fatty acids, are added to s and fats in the process described in the chief tent. For example, 85 kg. of a suspension of lime in water, containing 70% of calcium oxide, and 25 kg. of sodium chloride are added gradually, at the ordinary temperature, to 10,000 kg. of raw rapeseed oil containing 5% of free fatty acids. The mixture is agitated until the free fatty acids are neutralised, and then heated, under reduced pressure if desired, to expel the water. The temperature is then raised slowly to 90° C., 500 kg. of powdered lime-coconut oil soap is added, and solid material is separated by filtration or centrifuging.—L. A. C.

Extraction of oils, fats, waxes, and the like; Method of and plant for ——. J. A. Reavell, and Kestner Evaporator and Engineering Co., Ltd. E.P. 186,642, 1.4.21.

The solvent is heated, passed to the extractor, and then circulated through the heater and extractor until the whole mass reaches the desired temperature. The effluent (oil, moisture, and solvent) is then passed through a vaporiser and the vapours and oil particles from this are passed through a separator, the effluent being afterwards passed through a distiller and through another separator where the final separation of the oil takes place. The vapours from the latter separator are passed through a condenser and the condensed liquid, after passing through a separator to remove the water, is passed back to the solvent storage tank. The Kestner horizontal tubular evaporator (E.P. 122,500; J., 1919, 163 A) can function as heater, circulator, vaporiser, and distiller.—H. C. R.

Extraction of oil from oil-containing material; Apparatus for ——. Schlotterhose und Co. G.P. 357,693, 18.7.20. Addn. to 347,394 (J., 1922, 261 A).

In the apparatus described in the chief patent, a larger filtering surface is provided, and stoppage of the process owing to defects in the filtering surface is avoided by separating the suction and filtering apparatus into a number of separate chambers, which can be operated together or independently of one another.—L. A. C.

Triglycerides; Process for hydrolysing —— *into fatty acids and glycerin.* R. Tern. G.P. 357,695, 8.2.21.

Triglycerides are hydrolysed by subjecting them, in the presence of water, to the action of ultra-violet rays at the ordinary temperature and pressure.
—L. A. C.

Fatty acids; Process of manufacturing —— [*from montan wax*]. W. Mathesius. G.P. 358,402, 31.1.18. Addn. to 350,621 (J., 1922, 728 A).

Montan wax is substituted for the hydrocarbons specified in the previous patent. The resulting fatty acids may be employed in soap manufacture.
—J. S. G. T.

Wax and resin colloids; Preparation of neutral, solid ——. Chem. Werkstätten G.m.b.H. G.P. 357,378, 8.2.21.

Heated wax or resin is agitated, with or without application of pressure, with concentrated solutions of, *e.g.*, alkali lactates, until a homogeneous mixture is obtained. The product is stirred or kneaded while hot with oils and fats, such as marine animal oil or rape-seed oil, and other organic solvents, while other organic material, such as pitch, anthracene residues, or paraffins, is subsequently added to the mixture. The products are suitable for use as lubricants, pastes, and ointments.—L. A. C.

Detergent and bleaching agent; Manufacture of a ——. Deutsche Gold- und Silber-Scheideanstalt vorm. Roessler. G.P. (A) 357,956, 13.3.19, (B) 357,957, 17.6.19.

(A) A detergent and bleaching agent is prepared by mixing sodium peroxide and a little more than the equivalent weight of sodium bicarbonate with waterglass of, *e.g.*, 30° B. (sp. gr. 1·263), with or without the addition of protective agents, such as magnesium or calcium silicate. After setting, the mixture is ground and dried. (B) The oxygen content of the above product is increased by the addition of hydrogen peroxide during any stage of the process of manufacture.—L. A. C.

Fire-extinguishing and washing materials; Process for manufacturing ——. Plauson's Forschungsinstitut G.m.b.H. G.P. 358,572, 27.10.21.

Chlorinated hydrocarbons are dispersed in water in a Plauson colloid mill or other high-speed impact mill, with the addition, if desired, of a small amount of protein, glue, gum, soap, or other protective colloid, and organic substances affecting the mutual solubility of the chlorinated hydrocarbon and water. Thus, a colloidal suspension of 1 pt. of chlorinated hydrocarbon in 3 pts. of water is equally effective as a detergent as the pure chlorinated substance, and is moreover less volatile. —J. S. G. T.

Viscous oily compositions; Manufacture of —— and treatment of waxes for use therein. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 186,950, 13.4.21.

See G.P. 347,084 of 1920; J., 1922, 300 A.

Lime sludge; Process of separating saponaceous matter from ——. P. Krebitz. E.P. 186,960, 3.6.21.

See G.P. 355,492 of 1920; J., 1922, 770 A.

Pea-nuts, ground nuts, etc.; Preservation [by compression in bulk] and/or transportation of ——. A. W. MacIlwaine. E.P. 187,257, 22.4.21.

XIII.—PAINTS; PIGMENTS; VARNISHES RESINS.

Lithopone; Present knowledge on ——. E. Maass and R. Kempf. Z. angew. Chem., 1922, 35, 609—611.

The faults to which lithopone are subject when used as a pigment in exterior coatings are examined and the various hypotheses usually advanced in explanation criticised. All of the hypotheses purporting to account for the inferior behaviour of this pigment on weathering appear to be open to criticism. In certain patented processes designed to render lithopone fast to light, the photosensitiveness is attributed to the presence of chlorides from the materials employed in its manufacture. —A. de W.

Scheele's green; Composition of ——. G. Bornemann. Z. anorg. Chem., 1922, 124, 36—38.

The author finds that Scheele's green is not acid copper ortho-arsenite, $CuHAsO_3$, but a neutral arsenite, $3CuAs_2O_4,xH_2O$. The composition was found to vary with the method of preparation, the product being richer in copper oxide the larger the excess of alkali employed.—W. T.

Fineness and bulk of pigments. H. A. Gardner, H. Parks, and N. Pihlblad. Circ. 143, Paint Manufacturers' Assoc. U.S., April, 1922. 72 pp.

A standardised procedure for the determination of the proportion of particles of a pigment or paint retained on a standard screen of 325 meshes to the inch has been worked out. The wire screen, which is conveniently of 3 in. diam., is tared to the nearest mg., wetted on both sides with a liquid which "wets" the pigment under examination, and a weighed quantity of the sample (2—10 g.) transferred to the screen. If the pigment is wetted with difficulty by water, it may be previously wetted with a liquid with which water is miscible, *e.g.*, alcohol or alternatively other washing liquids, *e.g.*, turpentine etc., may be used. The screen containing the pigment is then held under a tap delivering 300—500 c.c. of liquid per min., a soft camel-hair brush being used to assist the operation of screening. After the majority of the finely-divided portion of the pigment has passed through the screen, the latter is immersed to a depth of 0·5-in. in an 8-in. porcelain dish containing 250 c.c. of the washing liquid, the pigment remaining on the screen being then brushed with a soft 1-in. camel-hair brush at the rate of two strokes per sec. during two periods of 10 secs. each. The screen is then raised from the dish after each 10-sec. period to let the liquid run through, and the liquid in the dish changed after every two brushing periods. This is continued until typewritten letters can be read through an 8 cm. layer of the wash liquid. Finally the pigment adhering to the brush is transferred to the screen, and the latter and its contents washed with, *e.g.*, alcohol and ether, dried, and weighed. Notes are appended as to methods of guarding against possible sources of error, *e.g.*, distinguishing between secondary aggregates and coarse primary particles. Photomicrographs of screened coarse particles from typical pigments mounted on a talking machine disc (J., 1920, 342 A) are given. The method previously published (J., 1920, 356 A) is elaborated in extenso, and sketches are given of the apparatus recommended for the determination of specific gravities of pigments under diminished pressure. The paper includes tables giving relationships between sp. gr., weights per solid gallon, and gallons (U.S. standard gallon=0·833 Imp. gallon) per unit lb. of various paint media, solvents, and dry pigments, and a chart correlating these figures with specific gravities from 0·7 to 9·7. These data, together with the proportion of residue left on a 325-mesh screen, using a specific washing liquid, are given for a very large number of pigments and fillers of U.S. proprietary manufacture, together with such information regarding the sample as was voluntarily submitted by the maker.—A. de W.

Paints; Miscellaneous exposure tests on ——. H. A. Gardner. Circ. 153, Paint Manufacturers' Assoc. U.S., June, 1922. 32 pp.

Examination of both sprayed and hand-brushed paint work on the walls and roof of a building after exposure for 32 months pointed to slightly more uniformity of application in the case of the hand-brushed work in places where the surface was rough or sunken. Examination of various wood and metal test panels after exposure for 3 years on Young's Pier at Atlantic City showed the remarkable protective qualities of paints made on a basis of American vermilion (basic lead chromate), no fading, chalking, or carbonation being apparent. As a medium for metallic aluminium and metallic zinc paints boiled linseed oil is to be preferred to spar varnish, which in turn is superior to collodion solutions. In paints containing red lead, a protective covering coat or addition of a pigment fast to light, *e.g.*, iron oxide, is advisable on account of the bleaching which red lead suffers on exposure. An inspection, after exposure for 11 months, of white paints having a basis of antimony oxide, alone and mixed with white lead, zinc oxide, or barium sulphate, together with titanium oxide mixed with zinc oxide, and also other mixed pigments, showed the superiority of zinc oxide over white lead as an ingredient of both antimony oxide and titanium oxide paints. Titanium oxide, when present in proportions of 10% and 15% in a pigment consisting otherwise of inert fillers, showed poor results after weathering for 20 months, but when present in proportions of 6% and 9%, together with 40% of zinc oxide, withstood exposure well under the same conditions; the addition of whiting as a constituent of the inert fillers was, however, inadvisable. In a series of tests in which white pine panels covered with three coats of paints consisting of antimony oxide alone and with various other pigments were exposed for 16 months, an optimum result was secured when the antimony oxide was present in about equal amount to both barytes and zinc oxide, the chalking tendency and slow drying of the antimony oxide being partly counterbalanced by the zinc oxide. The same mixture also showed the best behaviour on storage, antimony oxide alone having a tendency to become stringy. Discoloration of antimony oxide paints to a salmon-pink cast occurs when they are exposed to hydrogen sulphide. A preliminary exposure test in a sulphur-producing region in Texas of three paints in two of which the pigment consisted of leaded zinc oxide and lithopone and in the third "titanox" (titanium oxide and barium sulphate) and zinc oxide, showed the great superiority of the last-named paint in maintaining its purity of colour.—A. de W.

Vanadium as a drier for linseed oil; Experiments with ——. H. A. Gardner. Circ. 149, Paint Manufacturers' Assoc., U.S., April, 1922. 7 pp.

Confirming the results obtained by Rhodes and Chen (J., 1922, 334 A), the author finds that linseed oil siccatised with vanadium becomes dark brown in colour. Whilst the cost of vanadium drier is greater han that of cobalt drier, the latter is more efficacious and gives products paler in colour. Although vanadium rosinate cannot be prepared by heating ammonium metavanadate with rosin, the fused inoleate can be obtained by heating ammonium natavanadate to 300° C. with raw linseed oil to which has been added 10% of linseed oil fatty acids. The time of drying of linseed oil siccatised with vanadium is not markedly different from that of oil siccatised with other known driers.—A. de W.

Fossil resins; Esterification of —— and production of neutral varnishes therefrom. H. A. Gardner and P. C. Holdt. Circ. 151, Paint Manufacturers' Assoc. U.S., May, 1922. 10 pp.

Experiments carried out on a laboratory scale to determine the conditions for esterification of the highly acid gum-resins, Congo, Pontianak, and Manila to substantially neutral esters, showed that care should be taken completely to "crack" or "run" the resin before addition of glycerin for esterification, or polymerisation of the product to an infusible mass results. Copper and aluminium act as catalysts in the polymerisation, which, however, is entirely inhibited when "running" has been thorough. The authors have determined the times and temperatures necessary to accomplish complete "running" on 100-g. batches of the three gum-resins named and recommend the use of 6—8% of glycerin on the weight of the "run" gum-resin, a temperature of 292°—295° C. being maintained for such time as may be necessary to secure the desired degree of neutralisation compatible with maintenance of colour. Addition of about 0·3% of zinc dust either before or after "running" reduces the time necessary for subsequent esterification. Comparative trials of varnishes made with normally "run" gum-resin and with an esterified gum-resin showed the absence of any tendency of the latter to cause "livering" with zinc oxide over a period of 8 months in storage, whilst tests of the esterified product against caustic soda solutions indicated a great degree of resistance to alkali.—A. de W.

Resin acids of the coniferæ. V. Nitrosochloride, nitrosite and nitrosate of pinabietic acid and abietic acid (Levy). Constitution of abietic acid and abietene. O. Aschan. Ber., 1922, 55, 2944—2959.

Pinabietic acid obtained from pine oil bears a very close resemblance to Levy's abietic acid obtained from American colophony. The nitrosochlorides, nitrosites, and nitrosates of the two compounds appear to be identical, so that they are to be regarded as structurally identical but possibly stereoisomeric with one another, since certain (unpublished) differences are exhibited in their optical behaviour. The tetrahydroxy acid described by Levy (J., 1906, 1057; 1907, 1151; 1910, 33) and characteristised by its well defined individuality and high melting point, appears to be derived from associated silvinic acid since the authors have not obtained it from either abietic or pinabietic acids. Levy's abietene and Virtanen's pinabietene (*cf.* J., 1921, 594 A) must be regarded as structurally identical 7.13-dimethyl-2-isopropyl-5.6.7.8.9.10.13.14-octahydrophenanthrenes. (*Cf.* J.C.S., Dec.)
—H. W.

Solvents; Evaporation of ——. H. Wolff and C. Dorn. Farben-Zeit., 1922, 28, 31—33.

The losses in weight sustained by weighed quantities of various solvents contained in Petri dishes or spotted on filter papers, when exposed to the air at ordinary temperatures, showed that no connexion exists between the rate of evaporation and the boiling-point. Petroleum hydrocarbons appear in general to volatilise more rapidly than benzene hydrocarbons of the same boiling-points. The presence of dissolved oil or resin in a solvent retards the volatilisation of the latter; two bends indicating retardation appear in the curve showing loss in weight with time, one at the commencement of the process and one towards the end. For one and the same solvent, the rate of evaporation varies with the different resins present as solutes.
—A. de W.

Humidity equilibria. Wilson and Fuwa. *See* I.

Abietic acid. Madinaveitia. *See* XX.

Patents.

Pigment and method of producing same. P. Fireman, Assr. to Magnetic Pigment Co. U.S.P. 1,392,925–7, 11.10.21. Appl., 22.6.20.

The pigments are prepared by oxidation of freshly precipitated ferrous hydroxide under varying conditions. *Examples:* (A) A solution of ferrous chloride of sp. gr. 1·06—1·09 is treated with a quantity of calcium hydroxide sufficient to precipitate 75—85% of the iron, and the mixture is treated with air and steam at a temperature not above 100° F. (38° C.) until the ratio of ferrous to ferric iron is about 1:0·5. The mixture is then heated to boiling by increasing the amount of steam, and oxidation continued until a lemon-yellow product is obtained. (B) Ferrous chloride solution of sp. gr. 1·07—1·105 is rendered alkaline with sodium carbonate and treated with air and steam at a temperature not exceeding 110° F. (43° C.) at first, but gradually rising to the boiling point. The product, on drying, is a bright brown pigment. (C) Ferrous chloride solution of sp. gr. 1·05 is treated with insufficient calcium hydroxide to precipitate the whole of the iron, and air and steam are introduced, oxidation being effected at a temperature rising gradually from 105° F. (40·5° C.) to 130° F. (54° C.). Pigments of varying shades of tan are obtained by varying the temperature between the limits specified.

Colour lakes; Preparation of ——. P. Kraïs and H. Wislicenus. G.P. 358,047, 8.8.20.

"Sprouted" alumina, prepared by exposing aluminium which has been treated with mercury salts to the action of moist air, is employed for the preparation of colour lakes, the alumina, *e.g.*, being agitated with solutions of dyestuffs.—L. A. C.

Chambers for collecting lampblack; Process for transferring heat for preventing deposition of oil and water in ——. F. und K. Meiser. G.P. 358,048, 2.7.21.

A limited circulation of gas is maintained by means of fans or natural draught through a series of chambers for the deposition of lampblack, the hot gases from the first chamber being led into the last chamber to expel water and oil deposited therein. The gases leaving the last chamber pass into a cooler in which oil and water vapour are condensed. —L. A. C.

Condensation products of cresols and xylenols; Manufacture of resinous ——. Chem. Werke Grenzach A.-G. G.P. 357,756, 8.2.20.

Compounds such as *o*-cresol, crude cresol containing phenol, or *m*-xylenol, are treated with air or oxygen in the presence or absence of catalysts, *e.g.*, with moist air at 150°—170° C. for 10—12 hrs. in the presence of manganese dioxide or ferric chloride. Unchanged phenols are separated by distillation in a current of steam. The products are either soft, or hard and brittle, and of a dark brown or black colour, according to the time and temperature of treatment, and soft products can be hardened and rendered brittle by further heating.—L. A. C.

Condensation products of phenolcarboxylic acids or their derivatives and aldehydes; Manufacture of ——. Farbw. vorm. Meister, Lucius, und Brüning. G.P. 357,757, 24.1.20, 357,758 and 358,401, 5.3.20. Addns. to 339,495 (J., 1922, 639 A).

Aromatic hydroxycarboxylic acids in alkaline solution, or aromatic alkoxycarboxylic acids, are treated with formaldehyde, or substances capable of yielding it, at atmospheric or moderately high temperatures, or are treated with aldehydes at high temperatures under pressure. Examples are given of the preparation of resinous products by the action of formaldehyde on a mixture of *o*- and *p*-hydroxybenzoic acids in alkaline solution at the usual temperature, on *m*-cresotinic acid in alkaline solution at 30° C., on *o*-methoxybenzoic acid in the presence of concentrated sulphuric acid at 100 ° C., on *o*-ethoxybenzoic acid at 140°—150° C. under pressure, and on salicylic acid at 130° C. under pressure; by the action of paraformaldehyde on 2-ethoxynaphthalene-3-carboxylic acid at 100° C. in the presence of acetic acid and concentrated hydrochloric acid; by the action of ethylal on a mixture of *o*-, *m*-, and *p*-cresotinic acids at 130° C. under pressure; and by the action of benzaldehyde on 2-hydroxynaphthalene-3-carboxylic acid at 130°—140° C. under pressure in the presence of zinc chloride.—L. A. C.

Condensation products of phenols and aldehydes; Manufacture of ——. Felten und Guilleaume Carlswerk A.-G. G.P. 358,195, 3.8.19.

Insoluble and infusible condensation products, especially suitable for the manufacture of electrical insulators, are prepared by the action of aldehydes, *e.g.*, formaldehyde or its polymerisation products, or furfural, on phenols in the presence of phenols which contain one or more basic groups in addition to the hydroxyl group or groups, *e.g.*, aminophenols, methylamino or ethylamino derivatives of phenol, cresol, or naphthol, hydroxyquinoline, or hydroxydiphenylamine.—L. A. C.

Condensation products of phenol alkyl ethers and formaldehyde; Manufacture of resinous ——. Akt.-Ges. für Anilin-Fabr., Assees. of (A) C. Marx, O. Siebert, and H. Wesche, (B) C. Marx and H. Wesche. G.P. (A) 358,399, 25.11.20, (B) 358,400, 8.12.20.

Resinous products suitable, *e.g.*, for the manufacture of varnishes, are prepared by treating (A) phenol alkyl ethers substituted in the meta position to the alkoxy group by an alkyl or alkoxy group, *e.g.*, *m*-cresol methyl ether or resorcinol diethyl ether, or (B) *ar*-tetrahydronaphthol alkyl ethers, with formaldehyde, or compounds capable of yielding the same, in the presence of acids. *ar*-Tetrahydronaphthol alkyl ethers are prepared by sulphonating tetrahydronaphthalene, fusing the product with alkalis, and treating the product with alkylating agents.—L. A. C.

Oil of turpentine; Improving the odour of — obtained, e.g., in the manufacture of sulphate-cellulose. A. W. Arldt. G.P. 358,050, 7.3.17.

Mercaptans are removed from crude oil of turpentine, obtained, *e.g.*, in the manufacture of sulphate-cellulose, by treating the oil with hydrogen at 100°—120° C., under normal or increased pressure, in the presence of alkaline solutions of lead oxide, zinc oxide, or other metal oxides, or iron or other metals. —L. A. C.

Pencil drawings on paper; Fixing and blackening ——. A. Grünert. G.P. 358,584, 13.10.21. Addn. to 317,444 (J., 1920, 377 A).

In the process described in the chief patent, the upper roller or plate is removed slightly from the surface of the paper, the intermediate space being filled with the electrolyte.—L. A. C.

Dispersoids, colloid powder and [plastic] masses therefrom; Manufacture of ——. H. Plauson, Assr. to D. R. Rotman. U.S.P. 1,392,849, 4.10. Appl., 8.2.21.

See E.P. 156,142 of 1920; J., 1922, 381 A.

Resin colloids. G.P. 357,378. *See* XII.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Latex of Hevea Brasiliensis; Function of calciu chloride in coagulation of ——. G. Verne Comptes rend., 1922, 175, 719—721.

The addition of calcium chloride solution to lat of *H. Brasiliensis* accelerates the coagulation a increases the yield of rubber, the latter dependi to some extent on the amount of added chlorid The rubber thus obtained contains calcium, pho phate, and chloride in percentages which vary the amount of solution added. The author conclud that the calcium reacts with the soluble phosphat of the latex forming calcium phosphate which incorporated in the rubber and the resulting chlorid causes protein coagulation; further, the normal c agulation is more complete. The increase in weigh of product is due to all three factors.—H. J. E.

Stearic acid in latex from Ficus fuvla, Reinw. A. J Ultée. Bull. Jardin Botan. Buitenzorg, 1922, 105—106. Chem. Zentr., 1922, 93, III., 1055.

Of the coagulated latex only 7·7% was insoluble i alcohol, and extraction of this residue with benzen yielded 1·1% of rubber (calculated on the origin weight). The alcoholic extract from 12 g. whe cooled deposited 8·35 g. of wax, m.p. 52°—58° C. which on saponification gave potassium stearate an a phytosterol. The wax is not identical with th from *Ficus elastica*.—D. F. T.

Rubber vulcanisation; Studies in ——. Relation between chemical and physical state of cure of rubber vulcanised in the presence of certain organic accelerators. N. A. Shepard and S. Krall. J. Ind. Eng. Chem., 1922, **14**, 951—956.

As was already realised by Weber in 1902, products obtained by the vulcanisation of one and the same batch of crude rubber to the same coefficient may possess different physical constants. The physical state of the vulcanised rubber is now recognised as of main significance from the point of view of performance in service, whereas the chemical degree of vulcanisation has the more important bearing on the stability of the physical condition. When organic accelerators are used the relationship between the physical properties and the vulcanisation coefficient becomes strikingly irregular (*cf.* Cranor, J., 1920, 73 A). Mixtures containing rubber (48 pts.), zinc oxide (48), and sulphur (3) with hexamethylenetetramine (0·5 pt.), aldehyde-ammonia (0·75), thiocarbanilide (1·5), and *p*-nitrosodimethylaniline (0·25) respectively as accelerator, when vulcanised for 60 mins. at 141·7° C. (287° F.) gave almost identical stress-strain curves (elongation about 400% at 1070 lb. per sq. inch). In determining the corresponding coefficients of vulcanisation, disturbing factors were eliminated as far as possible (*cf.* Kelly, J., 1922, 301 A); the resulting values were 0·87, 0·98, 1·38, 1·03 respectively.—D. F. T.

Patents.

Vulcanisable compositions. W. Frost, and H. Frost and Co. E.P. 186,709, 5.7.21.

An adhesive and plastic rubber mixture for repair purposes consists of an ordinary vulcanisable mixture softened by the addition of about 30—40% of carbon tetrachloride or other suitable solvent. —D. F. T.

Rubber; Conversion of natural or artificial —— into other varieties of rubber or into material resembling gutta-percha. Siemens und Halske A.-G. G.P. 354,344, 23.1.20.

Dispersions of hydrohalides or halogen derivatives of rubber in chloroform or ethylene chloride are reduced by treatment with zinc or other metals, and the product is washed with water or dilute acid. The product is more or less viscous according to the method of treatment, and resembles gutta-percha if ethylene chloride is used as dispersion agent. —L. A. C.

Insulating material. G.P. 357,665. *See* XI.

XV.—LEATHER; BONE; HORN; GLUE.

Humidity equilibria. Wilson and Fuwa. *See* I.

Pseudo-extraction. Charitschkov. *See* I.

Patents.

Tannery waste liquor containing sulphides; Purification of ——. Adler und Oppenheimer, Lederfabr., A.-G. G.P. 358,105, 3.2.14.

Hydrogen sulphide liberated by treating tannery waste liquors with acids is burnt and the sulphur dioxide liberated thereby is led into the liquor to decompose residual hydrogen sulphide with precipitation of sulphur. Dissolved or emulsified material derived from the hides is precipitated simultaneously, and a clear liquor free from objectionable odour is obtained.—L. A. C.

Products insoluble in water; Manufacture of —— from glycerin and albumins. G. Diesser. G.P. 358,540, 1.8.15.

Egg- or blood-albumin is ground with glycerin, yielding liquid products which rapidly harden either alone or on treatment with formaldehyde or potassium bichromate. The products are suitable for making moulded articles, for use as an adhesive for cellulose, waste leather, or cork, or for adding to rubber.—L. A. C.

XVI.—SOILS; FERTILISERS.

Soils; Field moisture capacity and wilting point of ——. W. L. Powers. Soil Sci., 1922, **14**, 159—165.

The wilting point of different crops varies more than is usually suspected. The variation among different crops is greater on a heavy than on a light soil. From irrigation studies it is shown that a heavy soil may retain as much as two inches of utilisable water per acre-foot depth, peat can retain 3—4 in., and a coarse sand only ½ in. The bearing of these points on the practice of irrigation is discussed.—A. G. P.

Sulphides; Occurrence of —— in Minnesota peat soils. C. O. Rost. Soil Sci., 1922, **14**, 167—174.

Examination of a large number of Minnesota peat soils showed that the presence of sulphides at all depths is general. Usually there was more sulphide in the lower layer of peat than in the muck substratum. The reaction of both peat and muck depended more on the conditions permitting the oxidation of sulphides to sulphuric acid than on the actual amount of sulphide present. The lower peat layers contained sulphide equivalent to 0·06—0·16% H_2S and the muck substrata 0·002—0·013%. —A. G. P.

Iron pyrites; Oxidation of —— by sulphur-oxidising [soil] organisms, and their use for making mineral phosphates available. W. Rudolf. Soil Sci., 1922, **14**, 135—146.

From studies of pyrites-soil composts inoculated with sulphur-oxidising organisms, it was shown that the pyrites can be oxidised to sulphate. In the presence of small quantities of sulphur the process was considerably accelerated. The solution of rock phosphates in soil-sulphur-phosphate composts proceeded normally in the presence of pyrites; when ammonium sulphate was added, the production of available phosphoric acid was considerably increased by pyrites, which appeared to have some catalytic action. Composts of pyrites-sulphur-phosphate were not benefited by aeration unless ammonium sulphate was present. The addition of sulphurous acid to the composts produced merely a sterilising action.—A. G. P.

Fungi in soil; Growth of ——. S. A. Waksman. Soil Sci., 1922, **14**, 153—157.

The gelatin plate method of studying fungi in soil is inadequate, since it does not give a true representation in species or in numbers of the soil flora. Two acid media are described in which fungi but not bacteria or actinomyctes will develop. (1) 25 g. of agar is dissolved in a solution prepared by beating 60 g. of raisins with 1000 c.c. of tap water for 1 hr., the reaction is adjusted to p_H 4·0, and the liquid filtered and sterilised. (2) Sufficient $N/1$ sulphuric or phosphoric acid is added to a mixture of 10 g. of dextrose, 5 g. of peptone, 1 g. KH_2PO_4, 0·5 g. $MgSO_4$ and 1000 c.c. of water to give a p_H value 3·6—3·8. 25 g. of agar is dissolved in the solution, which is then filtered and sterilised. A definite correlation between the number of fungi present in a soil, and its treatment and reaction has been established.—A. G. P.

Fungi and actinomycetes in soil; Microscopical method for demonstrating ——. H. J. Conn. Soil Sci., 1922, 14, 149—151.

A small portion of soil (10 mg. or less) is placed on a microscope slide, and moistened with a few drops of water. One drop of methylene blue solution is added and the whole covered with a slip, sand grains being removed. The mount should appear distinctly blue to the naked eye. By thus obviating the drying of the mount, actinomycete filaments and mycelium are not destroyed and can be easily observed. By this technique fragments of mycelium were found in many soils, though not in great quantity; their presence was more frequent in soils containing large quantities of undecomposed organic matter.—A. G. P.

Denitrification with formates. Influence of the cation. J. Groenewege. Biedermann's Zentr., 1922, 51, 219—220.

Denitrification with *Bact. denitroformicicum* (n. sp.) does not take place where calcium formate is the exclusive source of carbon in culture solutions containing potassium monohydrogen phosphate owing to the formation of calcium phosphate and free formic acid. If the culture solution is maintained neutral or slightly alkaline, denitrification only takes place on aeration. If, however, the calcium formate is replaced by potassium or sodium formate, denitrification takes place even under anaerobic conditions.—G. W. R.

Arsenic; Some relations of —— *to plant growth.* J. Stewart. Soil Sci., 1922, 14, 111—118.

The solubility of lead arsenate in water is considerably increased by the addition of salts commonly found in the soil solution. The most effective are acid salts and those producing an alkaline solution. The solubility in soils of lead arsenate is roughly proportional to the amount of soluble salts in the soil. (*Cf.* J.C.S., Dec.)
—A. G. P.

Arsenic; Some relations of —— *to plant growth. II.* J. Stewart and E. S. Smith. Soil Sci., 1922, 14, 119—136.

Distinct stimulative effects were observed in plants grown in soil treated with sodium arsenate. The accumulation in soils of arsenic from sprays, may be beneficial rather than injurious, since the amount of soluble arsenic is limited by the solubility of lead arsenate, which is normally below the toxic point.
—A. G. P.

Protein content of grain; Differences effected in the —— *by applications of nitrogen made at different growing periods of the plant.* W. F. Gericke. Soil Sci., 1922, 14, 103—109.

The protein content of wheat and other grains and the hardness of the grain are not entirely hereditary characteristics, but to a large extent affected by environment. The addition of sodium nitrate to soils carrying spring wheat, increased the protein content of the matured grain to an extent varying according to the period elapsing between the sowing of the seed and the time of adding the fertiliser. (*Cf.*, J.C.S., Dec.)—A. G. P.

Urea and hippuric acid as nutrient materials for plants. T. Bokorny. Biochem. Zeits., 1922, 132, 197—209.

In higher strengths than 0·09% hippuric acid is toxic to plant cells, urea at 1·0% being harmless.
—H. K.

Patent.

Calcium cyanamide; Method of granulating ——. Stockholms Superfosfat Fabriks Aktiebolag. E.P. 168,070, 22.8.21. Conv., 21.8.20.

Calcium cyanamide is ground and kneaded in a steam-jacketed worm conveyor under the action of a spray of warm dilute nitric acid, 25% of 5—20% acid being used on the weight of calcium cyanamide. The mass is then fed into steam-jacketed rotating cylinders wherein it meets a counter current of hot air. The granules so produced do not disintegrate on storage.—C. I.

XVII.—SUGARS; STARCHES; GUMS.

Sugarhouse [evaporator] syrups; Precipitate formed in —— *[after clarification].* J. F. Brewster and W. G. Raines, jun. J. Ind. Eng. Chem., 1922, 14, 946—947.

Juice clarified by treatment with kieselguhr and decolorising carbon (*cf.* Zerban, J., 1921, 21 A) and then concentrated to a density of about 30° B. (sp gr. 1·262) was found to contain a precipitate consisting of about 75% of mineral matter, mainly SiO_2, CaO, and SO_3. Small-scale experiments, using different methods of clarification, indicated that the precipitate is due to a greater or less extent to the use of juice derived from cane to which a considerable amount of soil still adhered, the amount of precipitate obtained from the juice of washed cane being often much less. In the case of juice clarified by the defecation or sulphitation processes, in addition to the cause suggested, the formation of the precipitate may be due to the chemicals used, which partly enter into solution; and to substances originally present in the juice, which are precipitated on concentration.—J. P. O.

Sugar purity determinations. W. D. Horne. J. Ind. Eng. Chem., 1922, 14, 944—945.

The apparent purity may be rapidly ascertained by determining the sucrose by direct polarisation after clarifying with Horne's dry lead subacetate, and the dry substance from a density reading, using a special Brix hydrometer provided with a thermometer, against the scale of which is placed a table giving temperature correction readings. Having these two data, the purity may then be immediately read from a table mounted on movable rolls easily exposing the desired portion.—J. P. O.

Glucose; Determination of the p_H value as a substitute for the candy test as an indication of commercial ——. O. A. Sjostrom. J. Ind. Eng. Chem., 1922, 14, 941—943.

Determination of the p_H value by the colorimetric method using methyl red gives a more reliable indication of the acidity available for inversion of commercial glucose destined for use in confectionery manufacture than the results given by the "candy test," in which the amount of invert sugar formed on heating the samples with sucrose and water under certain conditions is determined. Using samples of commercial glucose diluted to 22° B. (sp. gr. 1·18), it was found that the extreme limit of safety is represented by p_H 4·3.—J. P. O.

Tetralævoglucosan and tetraglucosan. H. Pringsheim and K. Schmalz. Ber., 1922, 55, 3001—3007.

Tetralævoglucosan is readily converted by acetic anhydride in the presence of zinc chloride into the dodeca-acetate, an amorphous hygroscopic substance, $[\alpha]_D^{20} = +69{\cdot}59°$ in glacial acetic acid solution; it is completely methylated by two treatments with sodium hydroxide and methyl sulphate at 70° C., yielding dodecamethyl-lævoglucosan, which is hydrolysed by boiling dilute sulphuric acid (5%) to tetramethylglucose and a dimethylglucose. Under similar conditions, tetraglucosan yields a dodeca-acetate, $[\alpha]_D^{20} = +70{\cdot}82°$ when dissolved in glacial acetic acid, and dodecamethyltetraglucosan. The behaviour of the polymerised anhydro-sugars is thus sharply differentiated from that of the polyamyloses hich cannot be completely methylated and suffer epolymerisation when acetylated with acetic anydride in the presence of zinc chloride. (*Cf.* J.C.S., lec.)—H. W.

mylodextrin; Oxidation of ——. W. Syniewski. Roczniki Chem., 1922, 2, 83—94.

EXTRIN (from starch) when oxidised by means of romine in the presence of barium carbonate (to revent the hydrolysis of the molecule) yielded a hite non-crystalline product with an acid reaction nd rotatory power $[\alpha]_D^{20}$=191·09°. Its reducing ower was 23·24% of that of maltose. A solution of the roduct reduced alkaline silver solution and gave he "Molisch" reaction with α-naphthol, but the olour was not violet, as with starch and the sugars, ut carmine-red. A concentrated solution of the ubstance gave a beautiful reddish colour on warmng with hydroxylamine hydrochloride and potasium hydroxide. Analysis gave C 42·71%, H 5·33%. The product is an acid, the barium salt containing 5·06% BaO; the author calls it amylodextrinic cid. Amylodextrin is considered to have the ormula $C_{216}H_{372}O_{186}$ and to be composed of twelve naltose residues connected together by the carbonyl roups, leaving only the CH_2OH groups free. The H_2OH groups are converted into carboxyl groups y oxidation, so that the acid oxidation product vill have the formula, $C_{216}H_{348}O_{198}$, which is in good greement with the results of analysis.—W. T.

PATENT.

Extraction of sugar. E.P. 186,756. *See* XIXA.

XVIII.—FERMENTATION INDUSTRIES.

Diastatic power; Determination of ——. W. Windisch, W. Dietrich, and P. Kolbach. Woch. Brau., 1922, 39, 213—214, 219—222, 225—226.

HE divergent values for the diastatic power of a alt obtained by the iodometric method when fferent starches are used depend to some extent variations in the hydrogen-ion concentration and egree of dispersion of the starch solutions. Since e malt extracts obtained from different malts vary t slightly in acidity and since also but little of e extract is used in determining the diastatic ower, the value of p_H for the mixture of starch lution and malt extract depends almost entirely on e acidity of the starch. Samples of soluble starch pplied by different makers gave 2% (on dry atter) solutions varying in p_H from 3·7 to 6·2, the alues after addition of one and the same cold-water alt extract ranging from 4·1 to 6·1 and the umbers obtained for the diastatic power from 126 95 (or for a second malt, from 133 to 95); when, owever, the values of p_H were made equal in all e cases to 4·9 by addition of a buffer solution, the astatic powers found varied only from 124 to 113 31 to 121). That one of the starches gave lower lues for the diastatic power after addition of the uffer solution is due to the fact that the optimum lue of p_H for diastatic action is not 4·9, as stated Adler, but 4·26. Although the activity of diasse is not appreciably less for p_H 5·8, which is the erage value for unboiled wort, than it is for p_H 3, yet adjustment of the hydrogen-ion concentraon may result in increase of the yield of extract the brewery by as much as 2%. This increase is e to the fact that increase of the acidity (to p_H 5) vours the action of the proteolytic enzymes and nce not only renders a greater proportion of the oteins permanently soluble but also renders the arch granules more readily accessible to the action the diastase. The increased acidity also lowers e danger of subsequent protein-turbidity, proces a better "break" of the wort, and improves flavour of the resulting beer. A method of determining diastatic power, in which the iodine used by the starch and the p_H value of the starch solution are taken into account, is described. The same starch must be employed in all cases, Kahlbaum's soluble starch being recommended; the starch solution must be prepared in a definite way and, since the course of the conversion depends on the degree of dispersion, must be used fresh. By addition of a suitable quantity of a buffer solution containing sodium acetate and acetic acid, the p_H of the solution is brought to 4·3±0·1. Details of the procedure and of the method of calculation of the results are given.—T. H. P.

Hydrogen-ion concentration in the brewery. IV. W. Windisch, W. Dietrich, and P. Kolbach. Woch. Brau., 1922, 39, 145—148, 151—153, 157—162, 165—166, 171—172, 177—179, 183—186.

DETAILS are given of a number of investigations, by both the electrometric and the graphic titrimetric methods, of the titration acidity, hydrogen-ion concentration, and buffer effect in worts and beers of various types. The essential result achieved is a proof that indications of sufficient accuracy for practical purposes are obtained if the rectilinear colorimetric titration curve is used in place of the p_H curve.—T. H. P.

Yeast and bacteria; Influence of hydrogen-ion concentration on the development of —— *and on the stability of beer.* M. H. van Laer. Petit J. Brasseur, 1922, Nos. 1193 and 1194. Woch. Brau., 1922, 39, 226—227.

IN Pasteur's solution, containing its nitrogenous nutriment in the form of ammonia, which is assimilable with difficulty by yeast, the latter exhibits its greatest multiplication at p_H 6·8, that is, in the neighbourhood of absolute neutrality; in unhopped and hopped worts prepared from 50% of malt and 50% of raw grain, however, the optimum values of p_H are 4·6 and 6·0 respectively. Hence, the richer the liquid is in nutriment, the higher is the acidity which the yeast is able to withstand. If the culture solution is not perfectly suited to the food requirements of the yeast, the latter is more sensitive towards increase of the alkalinity than towards increase of the acidity. For Frohberg and for distillery yeast the optimum value of p_H is also 4·6, whereas, as might be expected, for lambic yeast it is not higher than 3·8. For two of the most common disease organisms of Belgian beers, namely *Bacillus viscosus bruxelliensis* and *Saccharobacillus*, the optimum values of p_H are respectively 5·5 and 6·8. It is, therefore, evident, that, with unhopped wort, the optimum p_H for the disease organisms is nearer to the natural reaction of the wort than is that for yeast, whilst with hopped wort the reverse is the case. The importance of hopping for the stability of the beer is thus emphasised. Moreover, when Frohberg yeast and *Saccharobacillus* are sown together in hopped wort, the bacteria do not develop appreciably if the p_H of the liquid is below 5·4. Thus, the actual acidity of wort and beer constitutes an important factor in the stability, the highest infection being without results in a sufficiently acid wort.—T. H. P.

Fermentation and yeast; Action of ultraviolet rays on ——. P. Lindner. Woch. Brau., 1922, 39, 166—167.

USING a bottom-fermentation brewery yeast, the author finds that the velocity of fermentation of dextrose is increased by the influence of ultraviolet light to even greater extents than were observed by R. and R. de Fazi (J., 1916, 191) in the case of top-fermentation beer yeast. Thus, fermentation of a solution of 30 g. of dextrose in 300 c.c. of water for 24 hrs. yielded 119 c.c. of carbon dioxide, whereas when the fermenting liquid was exposed to the light of a mercury vapour lamp 2743 c.c. of gas was evolved. The original yeast and that obtained from the latter solution contained little glycogen, which was, however, present in large proportion in the yeast from the solution not exposed to the ultraviolet light. Most of the yeast cells from the radiated solution were in active condition, about 20—30% being dead. Fermentation experiments with wort furnished similar results. Although exposure of yeast to ultraviolet light in a liquid fermenting under ordinary conditions favours the fermentation, exposure of the cells in a shallow layer of liquid to the light for any length of time produces fatal results.—T. H. P.

Yeast; Destruction of lactic acid by ——. O. Fürth and F. Lieben. Biochem. Zeits., 1922, **132**, 165—179.

The disappearance of lactic acid observed on shaking yeast suspensions in a current of oxygen could not be attributed to formation of simple derivatives, such as acetaldehyde, β-hydroxybutyric acid, etc. One half of the carbon of the lost lactic acid does, however, appear as carbon dioxide, the other half possibly being utilised in the building up of tissue.—H. K.

Yeast; Behaviour of some amino-acids towards oxygenated ——. F. Lieben. Biochem. Zeits., 1922, **132**, 180—187.

Unlike lactic acid, amino-acids are not quickly destroyed by oxygenation of their solution in presence of yeast cells.—H. K.

Fermentation; Activators of ——. E. Lindberg. Biochem. Zeits., 1922, **132**, 110—134.

The activating influence of yeast water, yeast co-enzyme, and milk has been determined on washed and unwashed dried yeast and also the influence of abietic acid, amyrin, and cholesterol. The former group accelerate, but the latter group are without action. Pyruvic acid was fermented more rapidly than dextrose, but lactic acid was practically unaffected.—H. K.

Invertase. III. R. Willstätter, J. Graser, and R. Kuhn. Z. physiol. Chem., 1922, **123**, 1—78.

Preparations of autolysed yeast change with age in such a way that the invertase becomes practically completely precipitable by lead acetate. This in combination with the methods previously used—particularly adsorption with aluminium hydroxide, and dialysis—gives a means of obtaining extremely reactive invertase preparations. The precipitation by lead acetate is affected also by other factors, such as substances present in the invertase solution, particularly phosphates. The phosphorus content of these very highly active invertase preparations is very low. The activity of invertase appears to be independent of the other compounds which accompany it, and also independent of the state of aggregation. Incidental impurities are, however, of importance, the very pure preparations being much less stable. Invertase preparations can be protected by the addition of, for example, calcium chloride or yeast gum. Purified invertase has an optimum activity at p_H 4·6.—W. O. K.

Saccharase [invertase] preparations; Phosphorus content of purified ——. H. von Euler and O. Svanberg. Ark. Kem. Min. Geol., 1922, **8**, [12], 1—13.

By estimating the concentration of silver ions electrometrically, the dissociation constants of the silver salts of various nucleic acids and related acids have been determined, and it is concluded that the presence in the invertase molecule of components of the nature of nucleic acids may explain the poisoning of the enzyme by silver salts, as these acids have a strong affinity for silver ions. Purified invertase solutions after dialysis leave an ash which can be completely accounted for by the phosphoric acid present, indicating the absence of any corresponding metal as base. (*Cf.* J.C.S., Dec.)

—W. O. K.

Reductases. I. Some conditions of the activity of starch reductase. I. A. Smorodincev. Z. physiol. Chem., 1922, **123**, 130—144.

Estimations made of the amount of nitrite produced from nitrate by an extract of potatoes in presence of acetaldehyde, indicate an increase in the reaction with increase of the amount of enzyme used, but not nearly so marked an increase with increasing amount of aldehyde. Neither formaldehyde nor vanillin is as efficient as acetaldehyde. With acetaldehyde, the reaction ceases after 30—60 mins. Atmospheric oxygen does not appear to be harmful, and very dilute acid is favourable, although greater concentrations markedly retard the reaction.—W. O. K.

Ethyl alcohol from western larch (*Larix occidentalis, Nuttall*). E. C. Sherrard. J. Ind. Eng. Chem., 1922, **14**, 948—949.

The western larch contains 8·17% of water-soluble galactan which on hydrolysis with dilute acid gives galactose. This sugar was successfully fermented by a Hungarian beer yeast, *Saccharomyces cerevisiæ*; of the total of 29% of reducing sugar available, 70—80% was fermented with a yield corresponding to 33 galls. of 95% alcohol per ton of dry wood. The wood was digested in an autoclave for 15 min. at 115 lb. steam pressure with 1·8—2·5% of its weight of sulphuric acid, moistened, extracted with water, and the sugar solution neutralised and evaporated. The temperature of fermentation should be 85°—90° F. (30°—32° C.) and the initial acidity not more than "5°."—C. I.

Alcohol; Preparation of industrial absolute — and its application to the preparation of liquid fuel. C. Mariller and Van Ruymbeke. Comptes rend., 1922, **175**, 588—590.

Alcohol of 98·5—99% strength may be prepared by distillation of alcohol-water mixtures, the vapours passing upwards through a column which is traversed in the opposite direction by anhydrous glycerol. Distillation may by this method be carried out more rapidly than in the ordinary processes of preparation of 96% alcohol. The mixture of glycerol and water which is obtained may readily be dehydrated for further use by heating first in air, then *in vacuo*. To obtain alcohol of a purity greater than 99%, a dehydrating salt—such as potassium carbonate, zinc chloride, calcium chloride—is dissolved in the glycerol, the regeneration of which is unaffected by the solute. The difficulty of direct solution of the salt in the glycerol is obviated by adding it in aqueous solution and obtaining a clear anhydrous solution by vacuum evaporation. It is stated that anhydrous glycerin containing 30% of potassium carbonate yields alcohol of 99·9% purity.—H. J. I

Decomposition of citric acid by bacteria. Kickinger. *See* XIXA.

Vitamin B. Blohm and others. *See* XIXA.

Proteolytic enzymes. Pincussen. *See* XXIII.

Patents.

Lactic acid; Production of* —— *from rotte potatoes. **Byk-Guldenwerke Chem. Fabr. A.-G G.P. 358,110, 18.12.19.**

Rotten potatoes are washed with water, and th liquor, after agitation, is allowed to settle. Th

upper and lower portions of the liquor, containing respectively light and heavy impurities, are withdrawn, and the middle layer alone is employed for the production of starch for conversion into lactic acid by fermentation.—L. A. C.

Fermentation residues; Process for utilising nitrogenous material in ——. Reichsausschuss für pflanzliche und tierische Oele und Fette G.m.b.H. G.P. 358,118, 7.6.17.

Residues, *e.g.*, vinasse and yeast, obtained after distilling off alcohol produced by fermentation processes, are employed together with material containing carbohydrates for cultivating fat-forming fungi, and, after separation of the fat, are again fermented with yeast. Yeast residues are autolysed before use as above. Vinasses from cellulose waste liquors may be employed either alone or mixed with material containing carbohydrates, for cultivating the fungi.—L. A. C.

XIXa.—FOODS.

Flours; A new method of determining and identifying —— in bakery products and foods by examining the crude fibre. A. Fornet. Chem.-Zeit., 1922, **46**, 969—970.

The degree of milling and the value of flours can be judged by a comparison of their colours with those of standard samples according to Pekar's method, but this method cannot be applied to bakery or food products prepared from flours. The only component of flours unchanged by the baking process is the crude fibre, which can be isolated and compared with standard samples under the microscope. Samples of crude fibre obtained from bakery products agree exceedingly well with those obtained from the original flours, and it is possible to judge from their appearance what kind of flour was used in the preparation of a given food. Photographs are shown of standard samples of crude fibre from 94%, 85%, and 30% wheat flour, isolated from the flour and bread respectively. The method can be extended to the examination of spice, starch, and chocolate powders.—H. C. R.

Citric acid of cow's milk; Decomposition of —— by some bacteria. H. Kickinger. Biochem. Zeits., 1922, **132**, 210—219.

The citric acid content of milk is unchanged when the milk is boiled or pasteurised, but falls off on long standing. In fractionally sterilised milk the citric acid content falls during the first day but remains constant after the third sterilisation. This is not due to bacteria forming lactic acid, but to peptonising bacteria (*B. subtilis, Proteus vulgaris*).—H. K.

Organic bases of the flesh of swine. Materials extracted from muscles. XXI. I. A. Smorodincev. Z. physiol. Chem., 1922, **123**, 116—129.

Using over 2 kg. of pig's flesh, the following approximate figures were found for the content of organic bases: creatine, 0·228%; purines, 0·086%; carnosine, 0·289%; methylguanidine, 0·032%; carnitine, 0·032%. As compared with other animals investigated, the flesh of the pig is particularly rich in creatine and carnosine.—W. O. K.

Silage; Determination of acids in ——. W. Zielstorff and F. Benirschke. Chem.-Zeit., 1922, **46**, 939.

100 g. of the finely chopped silage is boiled with distilled water for 3 hrs. under a reflux condenser in a 2-l. flask in order to destroy any moulds, and afterwards made up to the mark. 100 c.c. of the filtrate, after filtering through a cloth, is heated with kieselguhr for a few minutes under a reflux condenser and filtered through a pleated paper. In most cases a colourless filtrate is obtained and is made up to 200 c.c. and an aliquot part titrated boiling with $N/50$ sodium hydroxide using phenolphthalein as indicator to obtain the total acids. If the filtrate is dark coloured it is diluted until the colour change can be observed. The free volatile acids are obtained by distilling in steam until a drop of the distillate, tested with Congo red, is free from acid. The combined volatile acids are sometimes not completely distilled over even when 800—900 c.c. of distillate has been collected. They are liberated equally well by sulphuric acid and by phosphoric acid.—H. C. R.

Vitamin A from carrots; Researches with ——. H. von Euler. Ark. Kem. Min. Geol., 1922, **8**, [18], 1—7.

The residue of the benzene extract of carrots is very effective in increasing the growth of mice fed on a diet lacking vitamin A. A mixture of the phosphatides, phytosterol, and daucosterol from carrots is also effective.—W. O. K.

Vitamin A; Conditions of activity of ——. H. von Euler. Ark. Kem. Min. Geol., 1922, **8**, [19], 1—10.

A mixture of the dry residues from the benzene extracts of carrots and of butter is more efficient as a source of vitamin A than either residue separately. The efficiency of vitamin A is increased by discontinuous additions of vitamin B.—W. O. K.

Vitamin B; Physiological researches on —— and water-soluble biocatalysts. G. J. Blohm, C. G. Santesson, and H. von Euler. Ark. Kem. Min. Geol., 1922, **8**, [13], 1—27.

Various preparations from yeast and malt which accelerate the growth of yeast lower the blood-pressure if injected into rabbits, reduce the pulse rate, and also affect the breathing. However, they are only very slightly less active after inactivation as biocatalysts by heating, except in the case of specially pure preparations, where the difference is more marked.—W. O. K.

Humidity equilibria. Wilson and Fuwa. *See* I.

Measurement of low temperatures. Darling. *See* XXIII.

Thermometric lag. Griffiths and Awbery. *See* XXIII.

Proteolytic enzymes. Pincussen. *See* XXIII.

Patents.

Fruit juices, conserves or other products [sugar] from fruits, vegetables, and the like; Manufacture of ——. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 186,756, 30.7.22.

Fruits and vegetables, in the presence of either natural or added water are passed through a colloid mill (E.P. 155,836; J., 1922, 357 a). By varying the concentration, the degree of dispersion, and the precipitating agent it is possible to favour selectively the retention or removal of desired substances. Afterwards the purified solution can be concentrated, preserved, or dried by suitable processes. It is claimed that with this treatment a maturing or ripening is effected, due to the high degree of dispersion causing chemical reactions between the various constituents of the fruit, and that the aroma of the juices is uninjured and sometimes even improved. The specification gives examples of the application of this process in the production of a clear wine from grapes, cider free from alcohol, apple conserve or apple butter from apples, a practically quantitative yield of sugar from beetroot, and a valuable cocoa powder free from the valueless cellulose and lignin substances from the cacao bean.—S. G. U.

Desiccator [*for milk powder*]. W. O. Rew, Assr. to California Central Creameries. U.S.P. 1,392,656, 4.10.21. Appl., 17.4.18.

The apparatus comprises a helical pipe built up of short cylindrical sections connected together so that sharp edges are formed inside the pipe at the joints. Sticky particles of partially dried milk from a desiccator of the usual type are fed into the helical pipe and are circulated therein, together with hot air drawn in through a separate inlet, by means of a centrifugal fan. The milk particles are dried by the hot air and are pulverised by repeated contact with the sharp edges of the joints of the pipe. The outlet opening is in the inner wall of the helix, and particles not sufficiently finely ground are driven by the centrifugal force towards the outer wall and past the outlet, through which finely ground milk powder is discharged.

Vegetable material, especially green foodstuffs; Process for preserving ——. R. Aurich. G.P. 357,409, 28.10.20.

Vegetable material is subjected to the action of an electric current while maintained under a high and gradually increasing pressure, whereby the moisture is distributed uniformly throughout the mass, and the electrical conductivity of the material is increased.—L. A. C.

Food for animals; Manufacture of a ——. American Cotton Oil Co., Assees. of C. O. Phillips. E.P. 178,073, 7.2.22. Conv., 5.4.21.

See U.S.P. 1,410,345 of 1922; J., 1922, 343 A.

Pectous material and process of making the same. F. G. Beylik, Assr. to N. W. Schwartzlose. U.S.P. 1,393,660, 11.10.21. Appl., 23.9.20.

See E.P. 184,081 of 1921; J., 1922, 781 A.

Casein-oil composition and process of making same. H. V. Dunham, Assr. to Dry Oil Products, Ltd. U.S.P. 1,431,937, 17.10.22. Appl., 20.9.19. Renewed 4.3.22.

See E.P. 169,276 of 1920; J., 1921, 787 A.

Pulverulent shortening agent and process of making same. H. V. Dunham, Assr. to Dry Oil Products Co., Ltd. U.S.P. 1,431,938, 17.10.22. Appl., 27.10.19. Renewed 4.3.22.

See E.P. 169,493 of 1920; J., 1921, 867 A.

Odourless and colourless oil and flour; Process of preparing —— *from* [*soya*] *bean.* Y. Yamamoto, Assr. to I. Mizusawa and T. Kano. U.S.P. 1,433,168, 24.10.22. Appl., 26.11.19.

See E.P. 179,776 of 1921; J., 1922, 509 A.

Nutritious fats. E.P. 160,840. *See* XII.

Fat resembling butter. G.P. 357,877. *See* XII.

XIXb.—WATER PURIFICATION; SANITATION.

Solubility of calcium carbonate. Osaka. *See* VII.

Fumes from chlorate explosives. Kast and Haid. *See* XXII.

Analysis by measuring degree of supersaturation. Höppler. *See* XXIII.

Patents.

Feed-water for boilers; Process of and device for separating air and gases from liquids, particularly ——. C. Hülsmeyer. E.P. 157,790, 10.1.21. Conv., 11.10.15. Addn. to 157,789.

The treatment with metal turnings or shavings or fibrous material described in the previous patent (*cf.* G.P. 288,158; J., 1916, 435) is carried out in a tank interposed in the suction conduit of the device (pump, injector, pulsometer) for feeding the boiler or the like.

Sludge; Process of withdrawing —— *from septic tanks.* K. Imhoff and H. Blunk. G.P. 358,106, 18.11.21.

Before sludge is withdrawn from a septic tank, it is stored for a time in a heated compartment of the chamber under water. Admixture of the sludge with fresh sludge is thereby prevented, and putrefaction is complete before the sludge is blown out of the chamber, *e.g.*, by means of the gases liberated therein.—L. A. C.

Lead arsenate [*insecticides*]; *Manufacture of* —. R. E. Wilson, Assr. to Pittsburgh Plate Glass Co. U.S.P. 1,393,474, 11.10.21. Appl., 1.3.19.

Lead arsenate precipitated from a solution to which a small quantity of chemically inert organic colloid, *e.g.*, 0·02—0·5% of glue, has been added, will remain suspended in water for a very much longer period than ordinary lead arsenate. Alternatively, precipitated lead arsenate may be treated with a solution or emulsion of the colloid.

Arsenical spray; Production of ——. J. D. Riedel A.-G. G.P. 357,874, 7.6.19. Addn. to 301,686 (J., 1922, 726 A).

Metals such as magnesium, or mixtures of, *e.g.*, zinc and sulphur or ferrosilicon and barium peroxide, are used instead of aluminium for volatilising arsenic in the process described in the chief patent. The arsenic compounds may be separated from the heating mixture by a covering of alumina or metal.
—L. A. C.

Feed water for boilers; Process of and device for separating air and gases from liquids, particularly ——. C. Hülsmeyer. E.P. 157,789, 10.1.21. Conv., 11.11.13.

See G.P. 288,158 of 1913; J., 1916, 435.

Purifying liquids. U.S.P. 1,431,245. *See* XI.

Tannery waste liquor. G.P. 358,105. *See* XV.

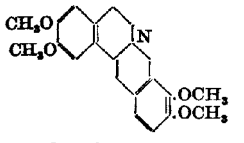
XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Strychnos alkaloids. XXXIV. Preparation of isostrychnine. H. Leuchs and R. Nitschke. Ber., 1922, 55, 3171—3174.

Isostrychnine, $C_{21}H_{22}O_2N_2,3H_2O$ (*cf.* Pictet and Bacovescu, J., 1905, 1123), is conveniently obtained by the action of methyl alcoholic ammonia on strychnine at 140°—160° C. It has m.p. 223°—224° C., $[\alpha]_D = +24 \cdot 1°$ to $+25 \cdot 1°$ in alcohol, $-39 \cdot 47°$ to $-41 \cdot 9°$ in glacial acetic acid. It dissolves in water at 100° C. to the extent of 1 in 130—140 parts. It gives a well-crystallised methiodide, colourless leaflets, m.p. about 223° C. (decomp.) after softening at 215° C., but its other derivatives are generally ill-defined. (*Cf.* J.C.S., Dec.)—H. W.

Alkaloids of the colombo roots; Constitution of the ——. E. Späth and K. Böhm. Ber., 1922, 55, 2985—2995.

Colombamine and jatrorrhizine have been isolated from the colombo root according to the methods of Günzel (J., 1906, 906) and Feist (J., 1907, 1159), but doubts are expressed as to the homogeneity of the fractions which are soluble in potassium carbonate and potassium hydroxide respectively. Complete methylation of the fractions gives identical completely methylated ethers, which on reduction yield the same hydro-derivative, the properties of which are in complete harmony with those of the compounds described by Feist. Somewhat unexpectedly it is found that the methyl ether and its tetrahydro-derivative are identical with palmatine (see annexed formula)



and tetrahydropalmatine, the constitution of which has been established by Späth and Lang (J., 1922, 117 A). The relationships of the various alkaloids of the colombo root appear therefore to be simpler than was expected. There are present, in addition to the completely methylated palmatine, phenolic bases in which probably one or more of the methoxy groups of palmatine are replaced by hydroxy groups or by phenolic oxygen united to a complex capable of being readily eliminated. (*Cf.* J.C.S., Dec.)—H. W.

Greasewood (Sarcobatus vermiculatus); Toxic constituent of ——. J. F. Couch. Amer. J. Pharm., 1922, **94**, 631—641.

The common greasewood of the mountain States, collected in Utah, was investigated for toxic constituents. Toxic alkaloids, glucosides, and saponins were not found in any of the extracts of the plant, and tests for hydrocyanic acid or its compounds were all negative. Large quantities of potassium and sodium oxalates were found, total oxalate calculated as anhydrous oxalic acid amounting to 11·54% of the weight of the dried plant. These compounds are responsible for the cases of poisoning which have occurred amongst sheep that had been grazing on the plant.—G. F. M.

Rhinanthin and aucubin: rhinanthin is impure aucubin. M. Bridel and M. Braecke. Comptes rend., 1922, **175**, 640—643.

The substance obtained in 1870 by Ludwig from seed of *Rhinanthus Crista-galli* and known as "rhinanthin" is not a pure product but a mixture of sucrose and aucubin in different proportions according to its origin. The name "rhinanthin" therefore does not designate a well-defined substance and should no longer be used.—H. J. E.

Saponins. VIII. Saponins from the leaves of Aralia montana, Bl. (Galacturonoid saponins and their magnesium and calcium salts). A. W. van der Haar. Ber., 1922, **55**, 3041—3069.

The powdered leaves and stems of *Aralia montana*, Bl. contain about 1·6% of saponins, which are members of at least three groups. Free saponins are present in addition to their calcium and magnesium salts; these are precipitated by basic but not by normal lead acetate. The amount of saponins appears to be variable. In the isolation of the saponins it is necessary that the extraction with methyl alcohol (95%) should be followed by treatment with ethyl alcohol (45%), since otherwise the salts of the saponins remain undissolved. The saponins are poisonous to fishes and exhibit hæmolytic action; the magnesium salt is about three times as potent as the free saponin. Proximate analyses and quantitative hydrolysis show the saponin to contain: water, 4·8; ash, 1·8; *d*-galacturonic acid, 1·8; *l*-arabinose, 13·3; methylpentoses, 2·1; *d*-glucose, 16·15; *d*-galactose, 2; sapogenin, 50%. Analysis of the magnesium and calcium salts of the saponin gives water, 7·2; ash, 5·3; *d*-galacturonic acid, 7·39; arabinose, 8·64; methylpentose, 6·24; *d*-glucose, 5·6; *d*-galactose, 3; sapogenins, 31·2%. Other saccharides or acids are not present. The crude mixture of sapogenins readily yields araligenin, $C_{25}H_{40}(OH).CO_2H$, which separates from ethyl alcohol with varying amounts of solvent of crystallisation, causing the melting point of the product to vary. A uniform material, having $[\alpha]_D = +71°$ in a mixture of alcohol and pyridine, is obtained when the crystals are heated at 150° C. Distillation of araligenin with zinc dust in an atmosphere of hydrogen gives carbon dioxide, water and a mixture of terpene hydrocarbons which is separable by distillation with steam into a volatile and a non-volatile fraction; the reaction may be represented by the scheme:

$$C_{25}H_{40}(OH).CO_2H = (C_5H_8)_5 + CO_2 + H_2O.$$

(*Cf.*, J.C.S., Dec.)—H. W.

Phytosterols of ragweed pollen. F. W. Heyl. J. Amer. Chem. Soc., 1922, **44**, 2283—2286.

The unsaponifiable fraction of the ether extract of ragweed pollen contains a new phytosterol, ambrosterol, $C_{20}H_{34}O,H_2O$, m.p. 147°—149° C., a phytosterol, $C_{27}H_{44}O$, m.p. 147·5°—148° C, considerable amounts of a more highly oxygenated substance, probably an oxyphytosterol, traces of a hydrocarbon, and appreciable quantities of the higher homologues of the methyl alcohol series, of which cetyl and octadecyl alcohols were identified.—W. G.

Xanthosterol; Identity of —— with lupeol. A. J. Ultée. Bull. Jardin Botan. Buitenzorg, 1922, **4**, 315—316. Chem. Zentr., 1922, **93**, III., 1050.

The identity of lupeol (Cohen, Arch. Pharm., 1907, **245**, 236) with xanthosterol (Dieterle, J., 1920, 81 A) has been demonstrated by chemical and physical tests with the substances themselves and with their acetyl and benzoyl derivatives. The new phytosterol described by Oestling (Ber. deuts. Pharm. Ges., 1914, **24**, 308) is also probably identical with lupeol.
—D. F. T.

Toxins and antitoxins; Chemical nature of ——. E. Salkowski. Biochem. Zeits., 1922, **132**, 84—88.

The author records some unpublished experiments made in 1896 on the preparation of diphtheria antitoxin free from protein. The diphtheria antitoxin serum was saturated with sodium chloride, treated with two volumes of saturated sodium chloride solution, and trichloroacetic acid added so long as a precipitate was formed. The protein precipitate carries the antitoxin down with it. The product is filtered off and triturated with water, which dissolves the antitoxin. The solution is free or practically free from protein. The same process was used by Blumenthal (Z. klin. Med., 1896, **30**) for preparing protein-free toxin from the spinal marrow of a case of tetanus.—H. K.

Thyroid; New constituent of the ——. U. Sammartino. Biochem.-Zeits., 1922, **132**, 293—294.

Fresh thyroids (400 g.) were extracted with hot dilute acetic acid, the solution concentrated and precipitated with basic lead acetate. The filtrate, freed from lead, was concentrated and precipitated with alcohol. The filtrate, on fractional crystallisation with picric acid, gave potassium picrate, then a red picrate which did not melt at 300°, and a picrate of m.p. 255°—295° C. After removal of picric acid from the mother liquors addition of alcohol precipitated a crystalline substance, m.p. 225°—228° C., containing calcium, carbon, nitrogen, and a high percentage of oxygen.—H. K.

Melanin; Formation of —— from organic substances. O. Adler and W. Wiechowski. Ber., 1922, **55**, 3030—3038.

The ability of a very large number of organic substances to form melanin acids has been examined by dissolving or suspending the substance (0·1—0·2 g.) in water (10—12 c.c.) and adding 3—4 drops of $N/1$ ferric chloride solution. The solution is divided into two parts, one of which serves as a control. Hydrogen peroxide (3%, 0·2—0·5 c.c.) is added to the other portion. If the substance is capable of producing melanin acids, a dark, sometimes almost black, coloration is developed after short heating or sometimes even at the atmospheric temperature. Protracted heating is to be avoided as the melanin acids are readily oxidised further to colourless substances. The dark mixture is subsequently rendered alkaline with sodium hydroxide, when the melanin acid dissolves or remains dissolved as the case may be. The test itself must be performed in neutral or faintly acid solution. Under the prescribed conditions melanin acids are produced only from cyclic substances. Compounds belonging to the terpene, triphenylmethane, phenanthrene, anthracene, and pyridine series exhibit little or no tendency towards the formation of melanin acids. Very marked ability is shown by the aniline group, phenylhydrazine and its substituted derivatives, phenols, quinone, aromatic monoaldehydes and ketones, aromatic monocarboxylic, and phenolmonocarboxylic acids, and aromatic amino-acids. A positive reaction is given by *p*-diphenol, benzidine, and tolidine, but scarcely by dianisidine. The naphthols and naphthylamines give melanin acids, whereas naphthalene itself does not. Among heterocyclic compounds, thiophenic acid, pyrrole, coumarone, indole, and tryptophan give melanin acids. Quinoline hydrochloride and the hydroxyquinolines give a faintly and strongly positive action respectively. Positive results are also given by isoquinoline, acridine, and compounds of the tropine, cinchonine, and morphine groups. The entrance of halogen or the arsinic residue into the aromatic nucleus diminishes or destroys the tendency towards the formation of melanin acids, whereas the sulphonic and nitro groups have no restrictive action. The production of melanin acids is facilitated by the presence of amino groups but impeded by the introduction of methyl groups. Positive results are obtained with the methyl or ethyl esters or methyl ethers of substances which themselves give the melanin reaction, whereas a negative result is produced if a cyclic group is involved in the formation of the ester or ether or if an inorganic component is present.—H. W.

Arsphenamine [salvarsan]; Sulphur content of —— and its relation to the mode of synthesis and toxicity. III. W. G. Christiansen. J. Amer. Chem. Soc., 1922, **44**, 2334—2342.

In reducing 3-nitro-4-hydroxyphenylarsonic acid, $C_6H_3(NO_2)(OH)AsO_3H_2$, to salvarsan the formation of relatively toxic products with a high sulphur content is not due to impurities in commercial sodium hydrosulphite. The salvarsan base is fairly uniform in regard to toxicity and sulphur content irrespective of the period of formation during the reduction. Aminohydroxyarseno compounds in general contain the fewest sulphur atoms when prepared from the amino-acids. The hydroxyl hydrogen atom ortho to the nitro group seems to play an important part in the formation of arseno compounds of the type under consideration, and fixation of the hydroxyl hydrogen atom in the nitrohydroxyarsonic acids tends to make the hydrosulphite reduction abnormal, and the products, when they can be isolated, contain more sulphur than analogous substances prepared without fixation of this hydrogen atom. A number of new arsonic acids are described. (*Cf.* J.C.S., Dec.)—W. G.

Botanical chemical notes. E. O. von Lippmann. Ber., 1922, **55**, 3038—3041.

During an exceptionally warm summer drops of nectar fell from the garden foxglove; these solidified readily and contained large quantities of sucrose. Trehalose has been isolated from a sample of material similar to ergot, found on wild oats grown near Kessingen (*cf.* Tanret, J., 1922, 345 A). An exudation from the stems of a quince tree which had been damaged by smoke and was nearly dead consisted of a viscous white gum which was very rapidly and almost completely hydrolysed by dilute acid to *i*-galactose. Malic, citric, tartaric, and succinic acids have been isolated from the berries of the mountain ash; the nature and relative amounts of the acids appear to depend on the ripeness of the berry and the particular variety.—H. W.

Guanidine formation in fused mixtures of dicyanodiamide and ammonium salts; Mechanism of ——. J. S. Blair and J. M. Braham. J. Amer. Chem. Soc., 1922, **44**, 2342—2352.

When dicyanodiamide $(H_2CN_2)_2$, is fused with ammonium thiocyanate the amount of diguanide thiocyanate, $H_2NC(:NH)NHC(:NH)NH_2,HCNS$, in the fused mass increases at first with the time of fusion and then reaches a maximum and slowly diminishes. On the other hand guanidine thiocyanate $H_2NC(:NH)NH_2,HCNS$, does not make its appearance until the diguanide thiocyanate has nearly reached its maximum concentration. Further when diguanide nitrate is fused with ammonium nitrate the greater part of it is converted into guanidine nitrate. These results support the view as to the cyanoguanidine structure for dicyanodiamide, $H_2NC(:NH)NHCN$, and also for the formation of the diguanide salt as a necessary intermediate compound in the formation of guanidine salts from dicyanodiamide by fusion with an ammonium salt.—W. G.

Cyclohexanol; Preparation of ——. A. Brochet. Comptes rend., 1922, **175**, 583—585.

The preparation of cyclohexanol by hydrogenation of phenol in presence of nickel must be carried out under pressure, with constant shaking. The theoretical yield is obtained by working at temperatures between 100° and 150° C. under a pressure of 10—15 atm. The product is filtered to remove nickel and washed first with dilute caustic soda, then with water. It may be distilled without preliminary dehydration; water comes over first with only a little hexanol, and almost the whole of the latter then distils at 160°—161° C. The activity of the catalyst diminishes with repeated use and it is preferable to use a considerable quantity to avoid constant renewal.—H. J. E.

Tartaric acid; Neutralisation of ——, by potash in presence of alkaline-earth chlorides. L. J. Simon and L. Zivy. Comptes rend., 1922, **175**, 620—622.

A mixture of tartaric acid and a strong acid may be estimated by two titrations with standard alkali using phenolphthalein for one determination and methyl orange for the other. The former gives an end-point when the normal tartrate is formed, the latter on formation of the acid tartrate. Chlorides of alkaline-earth metals interfere with the estimation when methyl orange is used but not with phenolphthalein. In the case of excess of calcium chloride, each molecule of tartaric acid behaves as if it were replaced by two molecules of hydrochloric acid; when the chloride is less than equivalent to the tartaric acid each molecule acts quantitatively. —H. J. E.

Isopropyl alcohol; Oxidation of —— with potassium permanganate. W. L. Evans and L. B. Sefton. J. Amer. Chem. Soc., 1922, **44**, 2271—2276.

In the presence of potassium hydroxide isopropyl alcohol is oxidised by potassium permanganate to give carbon dioxide, and oxalic and acetic acids. No acetone is obtained unless the temperature does not exceed 25° C. and the concentration of the alkali 2·12 g. per litre. The amounts of oxalic and acetic acids produced increase and decrease respectively as the initial concentration of the alkali increases from zero to 0·1—0·2 *N*. The general effect of rise in temperature is to increase the amount of carbon oxidised to carbon dioxide to slightly more than one atom per molecule of alcohol.—W. G.

Acetone; Oxidation of —— with potassium permanganate. W. L. Evans and L. B. Sefton. J. Amer. Chem. Soc., 1922, **44**, 2276—2283. (*Cf. supra.*)

By the oxidation of acetone with potassium permanganate in neutral or alkaline solution at 25°, 50°, or 75° C., the sole products are oxalic and acetic acids and carbon dioxide. The yield of oxalic acid increases with rise in temperature and the concentration of the alkali, while that of acetic acid diminishes with decrease in temperature and with rise in the concentration of the alkali. The production of carbon dioxide increases with rise in temperature.—W. G.

Amines; Decomposition of —— in the vapour stage. F. W. Upson and L. Sands. J. Amer. Chem. Soc., 1922, **44**, 2306—2310.

When ethylamine vapour is passed over kaolin at 700° C. the chief products are ammonia, hydrogen cyanide, and a substance which is probably acetonitrile, together with smaller quantities of hydrogen and nitrogen. At 500° C. no hydrogen cyanide is produced, a larger amount of ammonia is formed, and the gaseous products contain relatively large amounts of unsaturated hydrocarbons. At 1000° C. the nitrogen appears exclusively as free nitrogen and much of the hydrogen as free hydrogen. The hydrocarbons are almost entirely saturated and to a large extent consist of butane. The decomposition of propylamine under similar conditions at 700° C. proceeds in a similar manner to that of ethylamine. —W. G.

Ethylene; Absorption of —— by sulphuric acid. Production of ethyl alcohol, diethyl sulphate, and liquid hydrocarbons. A. Damiens. Comptes rend., 1922, **175**, 585—588.

Absorption of ethylene by sulphuric acid in presence of cuprous sulphate gives rise to diethyl sulphate, ethylsulphuric acid, and a mixture of saturated hydrocarbons of the nature of petrol, the products depending on the conditions. In both cases the first stage of the reaction, formation of the complex Cu_2SO_4,nC_2H_4, is identical, but the decomposition of the complex may take place in two directions. Absorption in the cold with 1—5% of catalyst present results in an almost theoretical yield of ethylsulphuric acid, but if the acid is below 97% concentration, diethyl sulphate is formed in addition. If the catalyst is heated with the acid and the ethylene subsequently absorbed cold in presence of mercury or mercurous sulphate, a mixture of hydrocarbons of sp. gr. 0·77 and b.p. 110° C. and upwards is obtained.—H. J. E.

Nitro-compounds; Detection of ——. H. J. Prins. Perf. Essent. Oil Rec., 1922, **13**, 355.

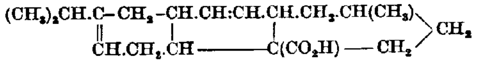
The accelerating effect of nitrobenzene on the reaction velocity of metals with weak acids is applied to the detection of this substance in benzaldehyde. The reaction is not exclusively specific for nitro-compounds, as organic peroxides have the same property, but only oils rich in terpenes which contain peroxides through exposure to air show the reaction, and then only feebly. Wormseed oil contains the peroxide, caridol, which shows the reaction in a marked degree, but this can hardly give rise to confusion, as 5% of nitrobenzene in benzaldehyde reacts more rapidly then pure wormseed oil. Benzaldehyde peroxide does not show the nitrobenzene reaction at all. The reaction is carried out as follows: A solution of 2 c.c. of the oil in 6 c.c. of 80% acetic acid is heated for 1 min. with a small piece of tinfoil. In presence of 5% of nitrobenzene the tin disappears immediately on boiling, with 1% the tin turns dark and disappears about 10 mins. after the mixture is heated, with 0·1% the tin turns black after about 10 mins., with 0·01% the tin becomes grey black after standing over night, and with pure benzaldehyde the tin retains its bright surface. In a similar manner the presence of 0·1% of artificial musk in perfumes can be detected.—G. F. M.

Nitrobenzene (mirbane oil); Detection of —— [in benzaldehyde]. A. Reclaire. Perf. Essent. Oil Rec., 1922, **13**, 356.

The pink to red coloration with a very dilute alcoholic solution of caustic soda described by Pickering (Chem. Trade J., 1922, **70**, 144) as characteristic of nitrobenzene is not a reaction of this substance at all, but of dinitrothiophene, which is often present in commercial nitrobenzene. The detection of nitrobenzene by its odour after dissolving the benzaldehyde as its bisulphite compound is possible, but a determination by this method is only fairly correct if 10% or more is present in the aldehyde, as nitrobenzene dissolves in aqueous aldehyde bisulphite solution to a certain extent, and if less than 5% is present it does not appear as a second layer at all. The method of Pinoff (Pharm. Zentralh., 1921, **62**, 610) depending on the formation by formaldehyde-ammonia of an emulsion with benzaldehyde but not with nitrobenzene, does not appear satisfactory, as no difference could be observed with mixtures containing 1—10% of nitrobenzene.—G. F. M.

Abietic acid. A. Madinaveitia. Anal. Fís. Quím., 1922, **20**, 185—189.

Analyses of abietic acid were in agreement with the formula $C_{19}H_{28}O_2$ (*cf.* Sureda Blanes, J., 1915, 878). The results of the hydrogenation of the ethylenic linkages by Willstätter's method indicate that the carboxyl group is attached to a tertiary carbon atom, and since the nucleus of the molecule must be retene, which is formed by the catalytic dehydrogenation of abietene, the following formula for abietic acid is suggested:



$$\begin{array}{l}(CH_3)_2CH.C\!-\!CH_2\!-\!CH.CH{:}CH.CH.CH_2.CH(CH_3)\diagdown \\ \qquad\quad \| \qquad\qquad\quad | \qquad\qquad\qquad\quad | \qquad\qquad\qquad\qquad\quad > CH_2 \\ \qquad\quad CH.CH_2.CH \text{————} C(CO_2H) \text{—} CH_2 \diagup \end{array}$$

—G. W. R.

d-Camphor; Catalytic reduction of ——. I. S. Komatsu and B. Masumoto. Mem. Coll. Sci. Kyoto, 1921, 5, 225—232.

When camphor was passed with hydrogen over reduced nickel heated to 175°—185° C., and the product fractionated, a hydrocarbon, $C_{10}H_{18}$, was obtained, which seems to be identical with the isocamphane obtained by Lipp (Annalen, 1911, **382**, 279) by the catalytic hydrogenation of camphene. In addition to this substance, some *d*-borneol was obtained. The same *l*-isocamphane was obtained by catalytic reduction in the same manner of both *d*- and *l*-borneol.—E. H. R.

Sandalwood oil; Solubility of West Australian ——. H. V. Marr. Perf. Essent. Oil Rec., 1922, **13**, 366.

In reference to the statements made by Somerville regarding the solubility of West Australian sandalwood oil (J., 1922, 647 A), it is pointed out that the opalescence which is produced on diluting solutions in 70% alcohol is not a peculiar feature of the oil from *Santalum cygnorum* but is typical also of the oil from *S. album*. In fact in all cases where the solubility of the two oils in 70% alcohol has been compared, that of the West Australian variety has always proved superior, and it has remained miscible on the addition of a greater number of volumes of 70% alcohol before opalescence occurred than any samples of *S. album* oil examined, the range of solubility in the former cases being about 4·5 to 11 vols. and in the latter about 6—10 vols. —G. F. M.

Citronella oil; [Determination of] total geraniol content of ——. M. S. Salamon. Perf. Essent. Oil Rec., 1922, **13**, 357—358.

A criticism of the paper by De Jong and Reclaire (J., 1922, 836 A). It is pointed out that the equivalent of 0·1 c.c. of $N/2$ KOH is 0·0075 g. of geraniol and not 0·075 g. as stated. The importance of accurately measuring the volumetric solution is emphasised, as a difference of 0·1 c.c. of $N/2$ KOH represents a difference of 0·8% in geraniol content. As the acetylated oil is somewhat dark it is not considered possible to neutralise it accurately with $N/2$ KOH by dissolving 1·5 g. in only 2 c.c. of alcohol, and 20 c.c. of $N/2$ KOH is not considered sufficient to provide an adequate excess in the saponification of 1·5 g. of acetylated oil. Attention is drawn to the influence of chlorides in the acetic anhydride used for acetylation, experiments indicating that an anhydride containing chloride may increase the so-called geraniol content by as much as 2·5%.—G. F. M.

Citronella oil; [Determination of] total geraniol content of ——. De Jong and A. Reclaire. Perf. Essent. Oil Rec., 1922, **13**, 358.

If the acetylated oil is accurately washed out and if pure sodium acetate free from carbon and tarry matter is used for the acetylation the oil is not dark and the neutralising gives no trouble. As saponification often darkens the oil, 50 c.c. of water is added as a medium for the titration. The use of 20 c.c. of $N/2$ KOH for the saponification is an excess of 45% above the theoretical amount, and there is no object in using more.—G. F. M.

Oil of lemon; Adulteration of —— *with terpenes.* G. Ajon. Giorn. Chim. Ind. Appl., 1922, **4**, 389—391.

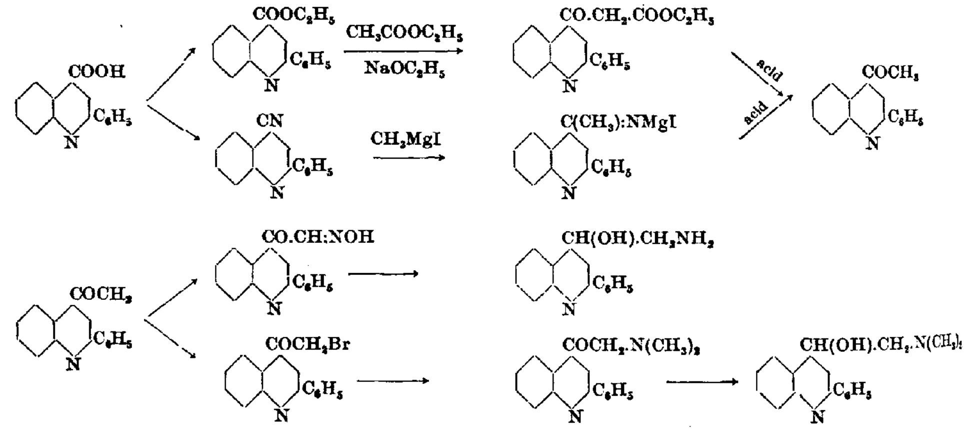
The methods ordinarily used for the estimation of citral in lemon oil yield, not the citral alone, but the whole of the carbonyl compounds present, calculated as citral; to this figure the author gives the name "analytical citral." Certain of these carbonyl compounds (citral) react with dilute sodium sulphite solution to form sulphonic compounds, whereas others (citronellal, methylheptenone) do not thus react. Lemon oil adulterated by added citral and terpenes will show a higher content of methylheptenone than the corresponding genuine oil, so that treatment with sodium sulphite will reveal differences between the genuine and the adulterated oil. Experiment shows, indeed, that the first distillates of an oil of lemon adulterated in the above way give, for the content of "analytical citral," figures higher than those yielded by the corresponding genuine products, whilst the last distillates, in which more especially the citral and citronellal are collected, are greatly impoverished by treatment with the sulphite. These conclusions are confirmed by the numerical and graphical results given.—T. H. P.

Urea. Pincussen. *See* XXIII.

Patents.

Aminoalcohols of the quinoline series; Manufacture of ——. O. Y. Imray. From Soc. Chem. Ind. in Basle. E.P. 185,913, 20.7.21.

Aminoalcohols derived from 2-phenylquinoline-4-carboxylic acid are obtained by converting the acid, its ester, or nitrile, into a 2-phenylquinolyl-4-alkylketone, and either reducing the latter through its isonitroso-compound to the 2-phenylquinolyl-4-aminoalcohol, or causing the ketone halogenised in the alkyl group to react with an amine, and reducing the 2-phenylquinolyl-4-alkylaminoketone thus produced to the corresponding amino-alcohol. The series of reactions is represented by the following scheme:



2-Phenyl-4-quinolylmethylketone forms yellow crystals, m.p. 75° C., and the preparation and properties of its hydrobromide, m.p. 240° C., its isonitroso-compound, m.p. 182°., and the bromo-derivative, m.p. 91° C., are described in detail. By the reduction of the isonitroso-compound with zinc dust and formic acid 2-phenylquinolyl-4-aminoethanol dihydrochloride is obtained in yellowish crystals, m.p. 145° C. The free base is somewhat unstable. Substituted aminoethanol derivatives are obtainable only from the bromo-ketone, which reacts for example with dimethylamine in benzene solution to give the hydrobromide of 2-phenylquinolyl-4-dimethylaminoethanone, m.p. 260° C., and this sub-

stance on reduction with hydrogen in presence of platinum black is converted into the corresponding 2-phenyl-4-quinolyldimethylaminoethanol, the dihydrochloride of which is a feebly yellowish powder soluble in water, m.p. 175° C. (with decomp.). The dihydrochloride of the corresponding diethylamino-compound melts at 180° C., and of the piperididoethanol at 199° C. These compounds are all stated to be of therapeutic value. (*Cf.* J. S.C., Dec.)
—G. F. M.

Crotonic acid; Production of —— from crotonaldehyde. Elektrizitätswerk Lonza. E.P. 165,728, 27.6.21. Conv., 2.7.20.

THE oxidation of crotonaldehyde to crotonic acid by means of oxygen is greatly accelerated by using a manganic salt, preferably manganic acetate in solution in glacial acetic acid, as catalyst. A manganous salt can be used initially if desired, but it is preferable to oxidise it to the manganic state, as it is only under those conditions immediately operative. *Example*: 1·5% of potassium permanganate is gradually added to a 10% solution of manganous acetate in glacial acetic acid at 115° C. The solution is then diluted with acetic acid to a manganese content of 0·1—0·2%, and 20 litres is stirred with 15 kg. of crotonaldehyde whilst oxygen is led through the mixture. When no more oxygen is absorbed the acetic acid is distilled off and a residue of crotonic acid in 98—99% yield remains and can be purified by recrystallisation.—G. F. M.

Ethylene and other unsaturated hydrocarbons; Process of preparing ——. W. H. Ross, Assr. to W. L. Evans. U.S.P. 1,392,852, 4.10.21. Appl., 1.6.20.

A NICKEL catalyst prepared from nickel nitrate (preferably with addition of an alkaline-earth compound or other impurity which minimises sintering of the nickel during reduction) by distribution on pumice, heating, and reduction in hydrogen, is treated repeatedly with acetylene, followed by exhaustion of the reaction products, until all the adsorbed hydrogen is removed from the catalyst. A mixture of equal parts of acetylene and hydrogen is then passed over the catalyst, at a temperature below 150° C., whereby a product containing 80—90% of ethylene is obtained.

Aldehydes and other oxidation products; Process of making ——. C. H. Bibb, Assr. to J. T. Bibb, sen. U.S.P. 1,392,886, 4.10.21. Appl., 27.10.19.

HYDROCARBONS are converted into alcohols, aldehydes, alcohols, and other oxidation products by heating with oxygen and a small quantity of a gaseous catalyst containing oxygen (*e.g.*, nitrogen oxides). The process is described as applied to the preparation of formaldehyde from methane (natural gas).

4-Dimethylamino - 1-phenyl-2.3-dimethyl-5-pyrazolone; Preparation of a derivative of —— readily soluble in water. Akt.-Ges. für Anilin-Fabr., Assees. of M. Bachstez. G.P. 357,751, 25.9.20.

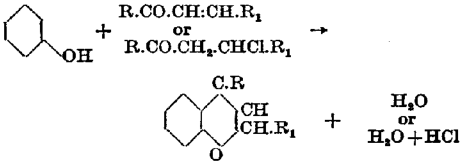
AN aqueous solution containing the sodium or other water-soluble salt of 4-ethoxyphenylmalonamic acid and 4-dimethylamino-1-phenyl-2.3-dimethyl-5-pyrazolone in equimolecular proportions is evaporated to dryness at 100° C., yielding an oily product which crystallises on rubbing. The product possesses therapeutic value as a febrifuge and sedative, and can be applied as subcutaneous injections.
—L. A. C.

Quinine; Preparation of a derivative of ——. Akt.-Ges. für Anilin-Fabr. G.P. 357,753, 19.10.20.

THE 4-ethoxyphenylmalonamic acid salt of quinine, m.p. 72°—73° C., which has therapeutic value as an analgesic and febrifuge, is prepared either by melting together equimolecular proportions of quinine and 4-ethoxyphenylmalonamic acid and crystallising the product from hydrolysing solvents, or by reaction between equimolecular proportions of the component compounds or their salts in the presence of hydrolysing solvents.—L. A. C.

Condensation products of α,β-unsaturated ketones and phenols; Preparation of ——. Chem. Fabr. vorm. Weiler-ter Meer. G.P. 357,755, 27.3.20.

α,β-UNSATURATED ketones, or their acid addition products, condense with phenols in the presence of acid condensing agents in accordance with the equations:—



If highly reactive phenols, such as resorcinol or N-substituted *m*-aminophenol, are employed, the reaction is nearly quantitative, yielding coloured products suitable for the preparation of dyestuffs and for use in medicine. Examples are given of the preparation of products from phenols such as phenol, resorcinol, pyrogallol, and *m*-dimethylaminophenol, and ketones such as benzalacetone, benzalacetophenone, *m*-hydroxybenzalacetone, etc.
—L. A. C.

[Carbamic] ester of trichloroethyl alcohol; Production of a ——. Farbenfabr. vorm. F. Bayer und Co. G.P. 358,125, 14.9.20.

CARBAMIC acid trichloroethyl ester, m.p. 64°—65° C., a soporific of which the toxic dose is much greater than the effective dose, is prepared either by prolonged reaction between ethereal solutions of trichloroethyl alcohol and urea chloride, with subsequent separation of the ester by evaporation and crystallisation of the product from petroleum ether, or by the action of carbonyl chloride on a solution of trichloroethyl alcohol in benzene in the presence of quinoline, and subsequent treatment of the trichloroethyl alcohol chlorocarbonate thus produced with ammonia.—L. A. C.

Thyroid gland; Preparation of a serum for treating diseases of the ——. J. Dreising. G.P. 358,148, 24.9.13.

ANTITHYROID serum (*e.g.*, the antithyreoidin of Möbius) is mixed with dilute sodium chloride solution and a solution of paranephrin (Merck) in 0·1% hydrochloric acid, a small quantity of phenol is added, and the mixture is concentrated at a low temperature under such conditions that no precipitate is formed. An anæsthetic, *e.g.*, novocaine, is added to the solution, which is then filtered through a bacteria filter, and preserved in bottles. Sterilisation of all materials which come in contact with the serum is essential. The product is considerably more active than ordinary antithyroid serum.

Depilatory. P. Fröschel and R. Weiss. G.P. 358,149, 1.8.18. Conv., 26.7.18.

METALLIC salts which yield insoluble or sparingly soluble hydroxides are added to depilating agents containing alkali or alkaline-earth sulphides. For example barium sulphate, strontium sulphide, pulverised dry vegetable mucilage, and crystallised aluminium sulphate are triturated so as to form a uniform mixture, which is mixed to a creamy mass with water when required for use. The mixture does not injure the skin.

Aminopyridines; Preparation of —— Chem. Fabr. auf Actien (vorm. E. Schering), H. Emde, and H. Horsters. G.P. 358,397, 4.8.20.

Aminopyridines are prepared by the action of ammonia on pyridine or its homologues in the presence of alkali metals. For example, anhydrous pyridine is added slowly to toluene at 80° C. containing finely divided sodium in suspension, and ammonia is simultaneously passed into the solution. When the sodium has been used up, the solution is maintained at 130° C. until no more ammonia is absorbed; the bases are then extracted with ether, and, after separating the solvent, the product is distilled *in vacuo*. 2-Aminopyridine distils at 103°—110° C., and 4.4′-dipyridyl at 170°—180° C., both under 20 mm., while 4-aminopyridine separates from the residue. 6-Amino-2-methylpyridine (α′-amino-α-picoline), b.p. 120°—130° C., under 20 mm., is prepared in a similar manner from 2-methylpyridine (α-picoline).—L. A. C.

Diaminodi-p-xylylmethane; Preparation of —— from commercial xylidine. Farbw. vorm. Meister, Lucius, und Brüning. G.P. 358,398, 4.7.20. Addn. to 270,663 (J., 1914, 474).

Sufficient formaldehyde is added to a solution of commercial xylidine hydrochloride to convert the *p*-xylidine present into diaminodi-*p*-xylylmethane, the product is neutralised with alkali, distilled in a current of steam, and then treated as described in the chief patent.—L. A. C.

Optically active aromatic amino alcohols; Manufacture of ——. O. Y. Imray. From Society of Chemical Industry in Basle. E.P. 187,129, 4.10.21.

See U.S.P. 1,423,101 of 1922; J., 1922, 878 A.

XXI. — PHOTOGRAPHIC MATERIALS AND PROCESSES.

Photographic sensitivity; Studies in ——. *I. Distribution of sensitivity and size of grain in photographic emulsions.* E. P. Wightman, A. P. H. Trivelli, and S. E. Sheppard. J. Franklin Inst., 1922, **194**, 485—520.

The sensitivity of the halide grains of a photographic emulsion is discussed from the points of view of distribution of a photocatalyst among the grains, and of a discrete structure of the radiation energy. The work of Slade and Higson is criticised (*cf.* J., 1921, 324 A). An approximate theory of the density-exposure function for certain limited conditions is developed. It is shown that under certain conditions the first derivative of the density exposure function may correspond with the intensity-variation function. The results of determinations of grain size-frequency curves for various emulsions are given (*cf.* J., 1922, 119 A) and compared with the sensitometric characteristics of the emulsions. The relation of grain size to sensitivity is considered from the points of view of the "quantum" theory of sensitiveness and of the "emulsification-nucleus" hypothesis. So far, a crucial distinction cannot be made between these two theories.—W. C.

Photographic emulsions; Sensitometry of —— and a survey of the characteristics of plates and films of American manufacture. R. Davis and F. M. Walters, jun. U.S. Bureau of Standards, Sci. Paper 439, 1922. 120 pages.

About 90 different brands of sensitive plates and films were investigated for speed, development factors, colour sensitiveness, filter factors, scale, and resolving power, and the curves and figures for each of these factors are given for 86 different brands of sensitive material. The paper includes a review and description of the various properties of plates and films and their measurement; a detailed description of the apparatus and methods employed in the standard systems of measurement; and a full account of the experimental results of the tests.—W. C.

Photographic plates; Study of the "threshold value" of —— by counting the grains. W. Noddack, F. Streuber, and H. Scheffers. Sitzungsber. Preuss. Akad. Wiss. Berlin, 1922, 210—213. Chem. Zentr., 1922, **93**, IV., 980.

The source of light used was of wave-length 436 μμ, the brightness being $4{\cdot}44\times10^{-7}$ Hefner candles. Plates were exposed for varying times, the longest exposure being that required to produce just visible blackening on development (50—100 secs. at 1 m.), the other exposures being less by a factor of 2 in each case. After development and fixing, the grains were counted in the microscope or on photomicrographs, and the "fog" grains in unexposed parts of the plates were subtracted. The "threshold value" can be easily ascertained by this method. The increase in number of developed grains is not proportional to the intensity of the light, but is less than required by direct proportionality with increasing exposure. This is explained by the fact that with increasing exposure a greater number of grains would be hit by several quanta, and the probability of one grain being hit by several quanta will increase with its size. This accounts for the fact that very sensitive (coarse-grained) plates give a flatter curve than small-grained emulsions.—W. C.

Photographic exposure; Quantum theory of ——. L. Silberstein and A. P. H. Trivelli. Phil. Mag., 1922, **44**, 956—968.

Additional experiments on the authors' light quatum theory of photographic exposure (*cf.* Phil. Mag., 1922, **44**, 257). This theory assumes the distribution of active centres in the halide crystals according to the laws of chance, and the occurrence of light "darts" of definite cross-section, a grain being made developable only when fully struck by a light dart. A clump of silver halide grains behaves as a photographic unit, since if one of the component grains is made developable, the whole clump may be reduced by a sufficiently long development. In a number of observations the targets were classified, according to the number of grains in the clump, but in the later experiments a new method of division of the targets into broad classes according to area was adopted. The effect of length of exposure to a constant light source, and the number of clumps made developable is in agreement with the authors' theory.—W. E. G.

Photographic print-out images; Colour change of —— on fixing. F. Formstecher. Phot. Ind., 1921, 590. Chem. Zentr., 1922, **93**, IV., 999.

The reversible colour change produced on immersing a print in distilled water is probably due to an alteration in the distance between the grains as a result of swelling of the film. Irreversible colour changes are produced by the action of ions on the film, causing a coagulation of colloidal silver to coarse-grained yellow-brown silver. The medium exerts an important influence on this change. Since the colour of a print varies between red and blue according to the composition and degree of ripening of the emulsion, the fixed image also takes on different tints. The bluer the copy the greater is the deviation from the normal yellow-brown colour of coagulated silver, and the redder are the tones obtained on fixing. The colours of Poitevin photochromes depend on the optical resonance of the silver ultramicrons, and each contact with solutions brings about coagulation and so alters the colours.—W. C.

inacyanols. König. *See* IV.

Patent.

elluloid [photographic] films; Reducing the inflammability of ——. E. Grimpe. G.P. 357,484, 11.12.19.

ELLULOID photographic films are steeped in a bath ontaining *e.g.*, 85 pts. by volume of water-glass, —13 pts. of glycerin, and 2–5 pts. of gum arabic, ith or without the addition of powdered mica. —L. A. C.

XXII.—EXPLOSIVES; MATCHES.

and test for detonators; Modifications of the ——. W. M. Dehn. Chem. and Met. Eng., 1922, 27, 784—787.

A MODIFIED apparatus was employed for carrying out his test. 500 g. of standard sand was used so that nough should be present to enable the detonator o exert its maximum crushing effect. The sand used was rounded and sand recovered from one test was not used again. The confinement of the sand was effected by a heavy weight of special design, and the whole was tamped down to a maximum compression, the detonator being in the centre of a ball-like mass of sand. Only sand passing a 30-mesh and remaining on a 100-mesh sieve was weighed, that passing 100-mesh being calculated by difference. Different weights of the same detonating substance, or indeed equal volumes of the same substance differing in density of packing did not exert crushing effects on sand directly proportional to the weights used. Comparison of the strengths of different detonators as determined by the sand test are therefore only approximate.—H. C. R.

Chlorate explosives; Toxicity of the fumes from ——. H. Kast and A. Haid. Z. ges. Schiess- u. Sprengstoffw., 1922, 17, 145—149.

A SMALL quantity of carbon monoxide is produced in the detonation of chlorate explosives even when sufficient oxygen is present for complete oxidation. This behaviour is shared by ammonium nitrate explosives. If the fumes are collected, they may be found to contain 0·1% of carbon monoxide, which might under unfavourable circumstances exercise a toxic action. Oxides of nitrogen are formed in small quantity during the combustion of chlorate explosives containing nitro-compounds, and the powerful toxic action of these gases might affect the respiratory organs in localities where a local concentration of the fumes had occurred. The effect would be intensified by the irritating action of the alkali chlorides and soot in suspension in the fumes. The fumes of burning ammonium nitrate explosives and of nitro-compounds are very much more toxic than those of chlorate explosives owing to the presence of greater quantities of nitric oxide, but chlorate explosives are much more prone to burn instead of detonate than either ammonium nitrate or nitro-compounds.—H. C. R.

Patents.

Detonating compositions for detonators or primers; Manufacture of ——. E. von Herz. E.P. 187,012, 11.7.21.

A DETONATING mixture is composed of lead azide and lead trinitroresorcinate, the two substances being precipitated together, from solution, or either salt being separately precipitated in the presence of the other. Thus the mixture may be precipitated by causing a solution of sodium azide and magnesium trinitroresorcinate to flow slowly into a solution of lead nitrate slightly acidified with acetic acid at a temperature not below 60° C. Preferably lead trinitroresorcinate is suspended in an aqueous solution of lead acetate and a dilute solution of sodium azide added at atmospheric temperature. The proportions employed are preferably such as to yield a mixture containing about 40—50% of lead azide. —J. S. G. T.

Explosive. W. Rintoul, T. J. Nolan, and O. W. Stickland, Assrs. to Nobel's Explosives Co., Ltd. U.S.P. 1,392,851, 4.10.21. Appl., 19.10.20.

See E.P. 166,277 and 166,502 of 1919; J., 1921, 639A.

XXIII.—ANALYSIS.

Brass weights; Protection of ——. J. J. Manley. Phil. Mag., 1922, 44, 948—950.

THE method introduced by Faraday for the protection of iron from rust, has been employed for protecting brass weights. A satisfactory method of procedure is to cover the weight with a thin film of linseed oil, and heat in a "vitreosil" crucible or a muffle furnace until the weight assumes a golden tint. The protecting film which is formed is tough and may be polished. The weight of 1 sq. cm. of normal film is 0·00005 g.—W. E. G.

Cold; Generation and utilisation of ——. [*Measurement of low temperatures.*] C. R. Darling. Faraday Soc., 16.10.22. [Advance proof.]

THE thermal junction method of low temperature measurement is advocated because of the quick response such instruments give to temperature changes and their adaptability for use in confined spaces. The recent checking of an old instrument made of a flexible couple of Hoskins' alloy and capable of reading to −200° C. has shown that such instruments maintain their accuracy. Resistance thermometers are recommended as the best available method of temperature recording in a cold storage installation, since several instruments can be placed at different points in a factory and coupled through a switchboard with a common indicator.—S. G. U.

Thermometric lag with especial reference to cold storage practice. E. Griffiths and J. H. Awbery. Faraday Soc., 16.10.22. [Advance proof.]

EXPERIMENTS were carried out with a mercury glass themometer with wooden sheath and lagging, a spirit thermometer, a mercury in steel thermometer, and a resistance thermometer, in order to determine the magnitude of some possible sources of error, when mercury or spirit thermometers are removed from the hold to the deck of a ship for reading, and to obtain information regarding the error introduced by the time lag when the cold storage temperature is rapidly changing. After calibration the time lag was determined by inserting the thermometers in a carefully insulated cubical box (2 ft. edge) within which was a rectangular spiral of iron piping through which circulated expanded ammonia to maintain a constant temperature, recorded by a freely suspended thermo-junction. From observations taken curves connecting temperature above surroundings and time were plotted. From these a second set of curves, connecting the logarithm of temperature excess above that of the enclosure and time were derived. These proved to be straight lines and the slopes denoted by $-1/L$ gave the relative time lags of the thermometers. L is a convenient constant, the value of which, if known for a particular thermometer is sufficient to determine the behaviour of that instrument under any circumstance as regards time lag. When the thermometer is introduced into an enclosure the temperature of which is changing uniformly this

thermometer records the temperature which existed in the chamber L minutes previously.
—S. G. U.

Colorimetric researches; Application of coloured glasses instead of liquids in ——. K. Sondén. Ark. Kem. Min. Geol., 1922, **8**, [7], 1—10.

Combinations of coloured glasses may be conveniently used as standards in colorimetry. The coloured glasses are suitably prepared by dyeing the gelatin film on a photographic plate from which the silver has been removed by treatment with thiosulphate.—W. O. K.

Supersaturation; Quantitative analysis by measurement of the degree of ——. E. F. Höppler. Chem.-Zeit., 1922, **46**, 957—958.

The time elapsing between the addition of a reagent and the formation of a precipitate or coloration can be utilised as an approximate quantitative measure of traces of substances in solution. The method is particularly applicable to water analysis. SO_3 and CaO can be estimated in this way between the dilutions of 2·3 and 100 mg. per litre, N_2O_3 can also be estimated by this means when in not greater concentration than 0·5 mg. per litre.—H. C. R.

Precipitation analysis; Application of conductometric methods to ——. V. Titrations with barium salts. I. M. Kolthoff. Z. anal. Chem., 1922, **61**, 433—448.

Sulphates may be titrated conductometrically with barium chloride rapidly and exactly if some alcohol is added to the solution. Mineral acids and iron, aluminium, and calcium salts interfere but nitrates do not. The method is inapplicable to the determination of sulphates in drinking water. Carbonates, chromates, oxalates, tartrates, citrates, and malates in the presence of sufficient alcohol, are capable of exact conductometric titration with barium chloride but not phosphates, pyrophosphates, succinates, benzoates or salicylates. (*Cf.* J.C.S., Dec.)—A. R. P.

Calcium; Volumetric estimation of ——. A. Vürtheim and G. H. C. Van Bers. Chem. Weekblad., 1922, **19**, 450—452.

After addition of excess of ammonium oxalate and ammonia, the solution is filtered and an aliquot part titrated with permanganate; blank titrations must be carried out, as ammonium oxalate solutions vary rapidly. The results agree well with gravimetric estimations. (*Cf.* J.C.S., Dec.)—S. I. L.

Magnesia; Separation of ferric oxide and alumina from —— by the nitrate method. A. Charriou. Comptes rend., 1922, **175**, 693—695. (*Cf.* J., 1922, 81 A, 351 A.)

Ferric oxide or alumina may be quantitatively separated from magnesia by precipitation with ammonia solution in presence of ammonium nitrate. The precipitate is dried at a temperature below 150° C., so that the nitrate is not decomposed, then boiled with ammonium nitrate solution, and finally treated with boiling water. The author states that no trace of aluminium or iron is found in the solution after treating with the nitrate. It is difficult to remove the oxides from the crucible for weighing, and a tared crucible should therefore be used. The magnesium may be estimated in the solution and washings.—H. J. E.

Nickel; Gravimetric determination of —— as nickel dioxide. W. Vaubel. Chem.-Zeit., 1922, **46**, 978.

Nickelous hydroxide is precipitated from the solution with sodium hydroxide, collected, washed, and ignited. The ignited precipitate is further washed until free from alkali metals, dried, and dissolved in nitric acid. The excess of nitric acid is evaporated and the crucible heated for 30 mins. in an air bath at 280°—330° C. Pure black nickel dioxide is left. The oxide, Ni_2O_3, does not exist, the known oxides of nickel being NiO, Ni_3O_4 and NiO_2.—H. C. R.

Nickel; Electrometric determination of —— with silver nitrate. E. Müller and H. Lauterbach. Z. anal. Chem., 1922, **61**, 457—464.

Nickel may be determined by adding a known amount of standard potassium cyanide solution to the neutral nickel solution and determining the excess by conductometric titration with silver nitrate whilst vigorously agitating the solution. The results agree closely with those obtained by Moore's method (Chem. News, 1895, **72**, 92; Z. anal. Chem., 1909, **48**, 778). (*Cf.* J.C.S., Dec.)—A. R. P.

Arsenic, antimony and tin; Separation of ——. F. L. Hahn. Z. anorg. Chem., 1922, **123**, 276.

The separation of antimony by oxidation to pyroantimonate (*cf.* Hampe, J., 1895, 302) can be employed for the estimation of antimony in the presence of arsenic and tin.—W. T.

Analytical chemistry; Contradictions and errors in ——. I. Precipitation of aluminium by thiosulphate and its separation from iron. II. Ageing of volumetric thiosulphate solutions. F. L. Hahn, G. Leimbach, and H. Windisch. Ber., 1922, **55**, 3161—3165.

The precipitation of aluminium by thiosulphate under the customary conditions is far from complete; it is almost quantitative when the solutions are boiled for a short time, and the aluminium still in solution is precipitated by bases. An almost complete separation of aluminium from iron can be effected if a very weak base, preferably phenylhydrazine, is used. The addition of a very small amount of alkali enables thiosulphate solutions to be preserved without alteration in strength from the first day. The change which they otherwise suffer appears to be caused by the faintly acid reaction of distilled water; it certainly does not involve the formation of sulphite or sulphide.
—H. W.

Copper; Catalytic reaction for the detection and a method for the estimation of the smallest traces of ——. F. L. Hahn and G. Leimbach. Ber., 1922, **55**, 3070—3074.

When a solution of a ferric salt is added to a solution of sodium thiosulphate a dark violet coloration is developed which gradually disappears as the ferric salt becomes reduced and the sodium thiosulphate is converted into tetrathionate. The reaction is greatly accelerated by the presence of copper salts and its completion can be made more obvious by the addition of ammonium thiocyanate to the mixture; the latter substance has also the advantage of retarding the action. The following solutions are required: copper sulphate solution (3·9 g. of the pentahydrate per litre, of which 1 c.c. is diluted to 1 litre before use); ferric solution (5 g. of iron alum and 25 c.c. of 2 *N* hydrochloric acid per litre); 5 M ammonium thiocyanate solution; *M*/15 sodium thiosulphate solution. For the recognition of the minutest traces of copper, two litres of the iron solution should be mixed with 10—20 c.c. of thiocyanate solution; for the estimation of larger amounts, more thiocyanate (up to 200 c.c.) may be used. For the estimation a solution of the substance under investigation (as neutral as is possible) is placed in a beaker of about 500 c.c.

capacity and known quantities of the copper solution are brought into a series of similar beakers. The solutions are made up to a fixed volume with distilled water and to each is added 100 c.c. of the iron thiocyanate solution. Simultaneously (by means of a row of test tubes fastened to a rod which can be rotated horizontally) 25 c.c. of sodium thiosulphate solution is added to each beaker and the contents are well mixed. The times required for decolorisation (conveniently 10—20 mins.) are then compared. The velocity of the reaction depends so largely on the ratio of the concentrations, iron: thiocyanate: thiosulphate, on the degree of acidity and the temperature that it is scarcely possible at present to indicate definite intervals of time for definite quantities of copper. It is necessary to observe the progressive decolorisation in the solution under investigation and in solutions of known copper content simultaneously and to use a sufficient volume of solution (about 100 c.c.) to avoid the effect of local variations in temperature. The smallest amount of copper which can be detected with certainty under these conditions is 0·2 μg. A similar effect on the course of the reaction has not been observed with any other substance yet investigated. Acceleration is caused by relatively large amounts of platinum, but the effect is so little marked that a confusion with copper is impossible. Aluminium, zinc, nickel, and arsenic, in particular, retard the action especially in strongly acid solution. If such metals are to be investigated with regard to their copper content, it is essential that an equal weight of "foreign" metal should be added to the comparison solutions; in this manner, the presence of 0·001% of copper in nickel can be detected with rapidity and certainty.—H. W.

Bismuth; Estimation of —— as metal. A. Kurtenacker and F. Werner. Z. anorg. Chem., 1922, **123**, 166—170.

The authors found that dissolving in ferric salt and titrating the ferrous salt produced by potassium permanganate was a reliable method for the estimation of metallic bismuth, the reaction being $3Fe^{\cdots}+Bi=Bi^{\cdots}+3Fe^{\cdot\cdot}$. Ferric chloride is more suitable than the sulphate. Reduction of bismuth nitrate by formaldehyde, hypophosphorous acid, and alkali stannite gave results 5% too low. The weight of precipitate (Bi) was a fraction of 1% too high. The low result by titration is due to a small amount of bismuthous oxide being found in the precipitate ($Bi^{\cdot\cdot}+Fe^{\cdots}=Bi^{\cdots}+Fe^{\cdot\cdot}$), this requiring only one-third of the amount of iron required by the metal. Conditions for complete reduction to the metal could not be found.—W. T.

Sulphuric acid; Determination of —— as barium sulphate. Evidence of the existence of a complex barium sulphuric acid. D. Balarew. Z. anorg. Chem., 1922, **123**, 69—82.

The sources of error in the estimation of sulphuric acid as barium sulphate are given as occlusion of salts, *e.g.* barium chloride, by the precipitate, occlusion of mother liquor, and the formation of the complex ion $[Ba_5(SO_4)_6]$, the last-named being the chief source of error. The author isolated the potassium salt of this complex anion $[Ba_5(SO_4)_6]K_2$. Error due to this cause is reduced to a minimum by precipitating slowly from a dilute, boiling solution acidified with hydrochloric acid. Crystals of precipitated barium sulphate have various forms; the prismatic form corresponds to the simple salt. The chlorine content of barium sulphate is not caused by the salt, $BaClSO_4,BaCl$.—W. T.

Phosphoric acid; Use of benzidine in the detection of ——. F. Feigl. Z. anal. Chem., 1922, **61**, 448—454.

The solution is treated with ammonium molybdate solution and, whether a precipitate forms or not, filtered through a close-textured ashless filter paper. The paper is treated with a solution of benzidine hydrochloride containing acetic acid and then held over an ammonia bottle. If phosphoric acid is present a blue to almost black colour is produced which is apparent even when the original solution contains only 1 part of P_2O_5 in 300,000 of water. The method serves to distinguish phosphomolybdates from arsenomolybdates and from molybdic acid, both of which may be co-precipitated under certain conditions. (*Cf.* J.C.S., Dec.)—A. R. P.

Phosphoric acid; Iodometric micro-estimation of ——, and of phosphorus in organic compounds. O. Svanberg, K. Sjöberg, and G. Zimmerlund. Ark. Kem. Min. Geol., 1922, 8, [10], 1—17.

An improvement on Neumann's method for the micro-estimation of phosphorus is described, in which the phosphorus is precipitated as ammonium phosphomolybdate, and the nitrogen in the precipitate is determined by Bang's micro-Kjeldahl method, the excess of acid remaining after absorption of the ammonia being estimated by adding excess of potassium iodide and potassium iodate, and titrating the liberated iodine with thiosulphate. 0·05—1·00 mg. of phosphorus may be estimated to within 2—3%.—W. O. K.

Boric acid; Titration of ——, in presence of phosphoric acid. I. M. Kolthoff. Chem. Weekblad, 1922, **19**, 449—450.

The phosphoric acid is titrated first with sodium hydroxide in presence of excess of sodium citrate, using phenolphthalein as indicator. Mannitol is then added, and the boric acid titrated in the usual way; the pink coloration must persist for 3 minutes. Calcium and magnesium do not interfere. (*Cf.* J.C.S., Dec.)—S. I. L.

Nitrous acid; Titration of —— alone and in the presence of arsenious acid. A. Klemenc and F. Pollak. Z. anal. Chem., 1922, **61**, 448—454.

An excess of potassium permanganate solution and sulphuric acid is placed in a stoppered flask carrying two tubes with stopcocks, one tube leading below the surface of the liquid. The flask is filled with carbon dioxide, then partially exhausted, and cooled in ice. The neutral nitrite solution is run in and the contents of the flask are shaken and slowly heated to 40° C. The excess of permanganate is determined by titration with oxalic acid. Under these conditions arsenious acid is quantitatively oxidised to arsenic acid. If present in the solution it may be determined in another portion by titration with iodine in the presence of excess of sodium bicarbonate. Nitrous acid is then found by difference. (*Cf.* J.C.S., Dec.)—A. R. P.

Gases; Portable apparatus for the analysis of [determination of carbon dioxide in] —— by the dry method. H. Strache and K. Kling. Feuerungstech., 1922, **11**, 13—15.

A double-acting pump is arranged to deliver a fixed quantity of gas for analysis into an absorption flask of constant volume, after removing an equal volume of gas free from carbon dioxide. The carbon dioxide is removed from the sample by means of solid potash, and the fall in pressure gives a measure of the amount present. The walls of the flask are kept moist to prevent reduction of pressure due to absorption of moisture. The apparatus is enclosed in a small box which is quite portable. Only one tap is used, this having three sets of borings, controlling the flow of gas through nine leading tubes. Each analysis takes from 10 to 20 secs.—W. P.

Gas analysis; Apparatus for exact ——. K. A. Schaller and W. Berndt. Chem.-Zeit., 1922, **46**, 972—973.

The apparatus consists of a manometer, a measuring tube immersed in a water jacket with air agitation, and a detachable absorption vessel with its own adjustable mercury reservoir. The passage of the mercury from the manometer into the measuring tube is prevented by a special U-tube containing at its lowest point either a constriction or a throttle-cock. All the operations of gas analysis can be carried out in this apparatus except explosions, for which the absorption vessel is replaced by a eudiometer. The procedure for determining carbon dioxide, heavy hydrocarbons, oxygen, carbon monoxide, and the combustion of hydrogen, methane, and ethane is described. —H. C. R.

Analytical notes. III. [Detection of urea, and determination of proteolytic enzymes.] L. Pincussen. Biochem. Zeits., 1922, **132**, 242—244.

Urea is best detected in a fluid free from ammonia by addition of urease at p_H 7·0—7·2, keeping at 55° C. for 15 minutes, then adding two drops of saturated sodium carbonate solution and detecting the liberated ammonia by litmus paper. If the liquor contains ammonia originally it is removed by shaking with permutite (0·2 g. per c.c.). A quantitative method for estimating proteolytic enzymes is described which depends on the micro-Kjeldahl estimation of the non-protein nitrogen formed by digestion. Unchanged protein is removed by colloidal iron.—H. K.

Bingham viscosimeter; Drainage error in the ——. W. H. Herschel. J. Ind. Eng. Chem., 1922, **14**, 724.

An instrument similar to the Bingham viscosimeter was so arranged that the drainage error could be measured by calibration with liquids of various viscosities, and the results are embodied in a graph, from which correction factors may be taken to correct the results obtained with liquids having higher viscosities than the calibrating liquid. The time of flow to render the drainage error negligible is also shown.—H. M.

See also pages (A) 928, *Metallurgical coke* (Kenney and Perrott). 932, *Coke residue of creosote oils* (Reeve and Yeager); *Pernitric acid as analytical reagent* (Trifonow); *Anthraquinone* (Nelson and Senseman); *β-Naphthylamine* (Leo and Jones). 933, *H-Acid and intermediates* (Lynch). 934, *Wood* (Mahood and Cable). 935, *Alkali-resistant cellulose* (Waentig). 936, *Piezo-micrometer* (Strachan). 937, *Phosphoric acid and phosphates* (Moerk, also Moerk and Hughes). 940, *Titanium in ferrous products.* 944, *Fat-constants* (Lund); *Separating solid and liquid fatty acids* (Meigen and Neuberger). 946, *Fineness and bulk of pigments* (Gardner and others). 950, *Fungi and actinomycetes in soil* (Conn); *Sugar purity* (Horne). 951, *Diastatic power* (Windisch and others). 953, *Flours* (Fornet); *Acids in silage* (Zielstorff and Benirschke). 956, *Tartaric acid* (Simon and Zivy). 957, *Nitro-compounds* (Prins); *Nitrobenzene in benzaldehyde* (Reclaire). 958, *Citronella oil* (Salamon); *Lemon oil* (Ajon).

Patents.

Gas analysing apparatus. Svenska Aktiebolaget Mono. E.P. 162,249, 19.4.21. Conv., 23.4.20.

In a gas analysing apparatus of the type described in E.P. 103,812 (J., 1918, 447 A), wherein two or more series of analyses are carried out and a determination of one or more constituents of the mixture included in all the analyses, means are provided for obtaining a single common record of the successive alternate analyses, the record consisting of a number of adjacent lines extending in the same direction. Thus the device may be applied to the analysis of smoke in such manner that in every alternate analysis the percentage of carbon dioxide is recorded, while in the others, the percentage of carbon dioxide, carbonic oxide, hydrocarbons and hydrogen is recorded.—J. S. G. T.

Pyrometer; Optical —— for measuring high temperatures. M. Lockhoven. G.P. 357,975, 5.12.20.

Rays of light from a sheet of refractory material suspended at a place at which it is desired to measure the temperature are transmitted through a long tube to a polariser and thence through a plate of quartz or other optically-active material to an analyser. The degree of rotation of the plane of polarisation of the transmitted light affords a means of estimating the temperature of the sheet of refractory material.—L. A. C.

Calorific value of gases; Method and apparatus for determining the ——. C. H. Lanphier. U.S.P. 1,432,472, 17.10.22. Appl., 23.6.19.

See E.P. 184,025 of 1921; J., 1922, 791 A

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given; they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Barbet et Fils et Cie. Distillation and rectification. 31,846. Nov. 21. (Fr., 21.11.21.)

Bewsher. Valves for acids etc. 31,329. Nov. 16.

Bradley Pulverizer Co. Grinding-mills. 30,975–6. Nov. 16. (U.S., 16.11.21.)

Braithwaite and Co., and Smith. Crystallisation of matter in solution from liquids. 31,877–8. Nov. 22.

Farbw. vorm. Meister, Lucius, u. Brüning. Apparatus for absorbing gases etc. by means of charcoal. 31,373. Nov. 16. (Ger., 30.12.21.)

Fraisse. Concentrating liquids by evaporation. 31,372. Nov. 16. (Fr., 5.12.21.)

Fullerton, Hodgart, and Barclay, and Holmes. Evaporators etc. 31,320. Nov. 16.

Gas Light and Coke Co., Shannan, and Siderfin. Conduct of chemical reactions involving use of gases etc. under pressure. 31,596. Nov. 18.

Gas Light and Coke Co., Shannan, and Siderfin. Crystallisation. 31,597. Nov. 18.

Harper and Lamplough. Retorts or stills. 31,156–7. Nov. 14.

Jung. Filter etc. press. 32,160. Nov. 24. (Ger., 19.5.22.)

Kilner and Stevens. Separation and storage, conveyance of solids and liquids, and production of composite fuel. 31,126. Nov. 14.

Lacy. Apparatus for recovering solvents by distillation. 31,901. Nov. 22.

Laing and Nielsen. 31,807. *See* II.

Lancaster, Langford, and Winget, Ltd. Machine for mixing or washing viscous, plastic, etc. substances. 31,719. Nov. 20.

Lockhart. Centrifugal separators. 32,111. Nov. 23.

Lockhart. Hydraulic separators. 32,112. Nov. 23.

Monson. Treatment of liquid and fatty substances. 31,458. Nov. 17.

Morgan, and Thermal Industrial and Chemical Research Co. Method of distillation. 31,012. Nov. 13.

Ward. Filtering liquids etc. 31,933. Nov. 22.

Wood. Drying-apparatus. 31,785. Nov. 21.

Complete Specifications Accepted.

13,161 (1921). Nitrogen Corp. Production of catalysts. (163,046.) Nov. 22.

16,547 (1921). Rigby. Heating or cooling liquids or admixed solids and liquids in evaporative or like treatment. (188,703.) Nov. 29.

18,395 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Filter press. (188,362.) Nov. 22.

19,240 (1921). Sutcliffe and Raper. Recovery of gases or vapour from charcoal etc. (188,723.) Nov. 29.

21,926 (1921). Lambert. Manufacture of absorbents or adsorbents of condensible gases and vapours. (188,786.) Nov. 29.

22,703 (1921). Stehmann. Rotary calcining furnaces. (188,424.) Nov. 29.

26,347 (1921). Seedorff, Barfred, and George. Tunnel furnaces or kilns. (188,488.) Nov. 22.

30,874 (1921). Timm. Filtering apparatus. (188,539.) Nov. 22.

301 (1922). Frankenberger. Dry grinding cylinders. (188,581.) Nov. 22.

23,911 (1922). Rigby. Preheaters for evaporators etc. (188,623.) Nov. 22.

II.—FUEL; GAS; MINERAL OILS AND WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Algem. Norit Maatsch. and General Norit Co. Production of decolorising-carbon. 31,686. Nov. 20. (Holland, 19.11.21.)

Amato. Treatment of petroleum etc. 32,059. Nov. 23.

Appleby and Bentley. Gas producers, retorts, etc. 31,122. Nov. 14.

Davidson. Gas purification. 32,317. Nov. 25.

Dunstan and Thole. Utilisation of alcohol in production of liquid fuel. 31,314. Nov. 16.

General Norit Co. and N. V. Algem. Norit Maatsch. Apparatus for revivifying finely-divided decolorising-carbon etc. 31,008. Nov. 13. (Holland, 14.11.21.)

Goldman. Producing carbon-black etc. 31,004. Nov. 13.

Haller and McLaren. Utilising waste gases from furnaces. 31,940. Nov. 22.

Harper and Lamplough. 31,156–7. *See* I.

Kilner and Stevens. 31,126. *See* I.

Koppers. Apparatus for degasifying or distilling gas from non-coking bituminous materials at low temperatures. 31,962. Nov. 22.

Laing and Nielsen. Rotary retorts, kilns, etc. 31,807. Nov. 21.

Levy. 31,235. *See* XXIII.

Loriette. Production of liquid fuel mixtures with alcohol as basis. 31,786. Nov. 21. (Fr., 21.11.21.)

Lucas, and V. L. Processes, Ltd. Treatment of hydrocarbons and their derivatives. 32,219. Nov. 24.

McLaren, Thomas, and Powdered Fuel Plant Co. Drying pulverulent fuel. 31,231. Nov. 15.

Masterman and Weygang. 31,172. *See* XII.

Robertson (Power Specialty Co.). Distilling oil. 32,108–9. Nov. 23.

Simmance. 31,235 and 31,450. *See* XXIII.

Wilkinson. Chemical process for facilitating combustion of coal dust in furnaces etc. 32,120. ov. 24.

Complete Specifications Accepted.

13,758 and 20,968 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Extraction of hydrocarbons from shale, wood, etc. (188,686.) Nov. 29.

14,153 (1921). Bergh and Larsson. Furnaces for utilising bituminous shale by distillation and subsequent combustion. (188,693.) Nov. 29.

16,806 (1921). Siemens Bros. and Co., and Le Maréchal. *See* X.

18,092 (1921). Burnie (Bitumul-Matita Soc. Anon. Romana). Manufacture and treatment of bitumen. (188,354.) Nov. 22.

18,441 (1921). Technical Research Works, and Pelly. Lubricants. (188,364.) Nov. 22.

21,321 (1921). Walker. Fractional distillation of crude naphtha. (188,402.) Nov. 22.

22,460 (1921). Hart. Production of carbon. (188,807.) Nov. 29.

25,181 (1921). Nicholls and Brown. Manufacture of liquid fuel from peat. (188,469.) Nov. 22.

28,900 (1921). Hovey. Obtaining light hydrocarbon distillates from heavier hydrocarbons. (188,928.) Nov. 29.

34,846 (1921). China and others. *See* III.

4745 (1922). Egeling. Saturators for use in recovering salts from gases of dry distillation. (175,649.) Nov. 22.

5118 (1922). Beswick and Rambush. Manufacture of producer-gas and recovery of high yields of by-products. (188,607.) Nov. 22.

19,703 (1922). Elektrizitätswerk Lonza. *See* XX.

III.—TAR AND TAR PRODUCTS.

Applications.

Lucas and others. 32,219. *See* II.

Vivian. Treatment of tar etc. 32,174. Nov. 24.

Complete Specification Accepted.

34,846 (1921). China, and Burt, Boulton, and Haywood. Apparatus for distilling coal tar, petroleum, etc. (188,575.) Nov. 22.

IV.—COLOURING MATTERS AND DYES.

Applications.

Bloxam (Chem. Fabr. Griesheim-Elektron). Manufacture of azo dyestuffs. 32,080. Nov. 23.

Gas Light and Coke Co., Lewcock, and Voss. Manufacture of sulphurised dyes. 31,595. Nov. 18.

Holliday and Co., and Clayton. Colouring-matters. 31,413 and 31,427. Nov. 17.

Holliday and Co., and Stokes. Colouring-matters. 31,406. Nov. 17.

Imray (Soc. Chem. Industry in Basle). Manufacture of azo dyestuffs. 31,254. Nov. 15.

Complete Specification Accepted.

29,289 (1921). British Dyestuffs Corp., and Wyler. Manufacture of phenylglycine compounds. (188,933.) Nov. 29.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

Applications.

Bacon and Sindall. Sizing and hardening paper etc. 31,469. Nov. 17.

Göransson. 31,331. *See* XV.

COMPLETE SPECIFICATIONS ACCEPTED.

18,501 (1921). Wade (Barrett Co.). Manufacture of fibrous material. (166,886.) Nov. 29.

23,354 (1921). Steinhilber. Recovery of cellulose from reeds etc. (188,828.) Nov. 29.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

APPLICATIONS.

Ashworth. Machines for dyeing etc. yarns in hanks etc. 31,198. Nov. 15.

British Dyestuffs Corp., Green, and Saunders. Dyeing artificial silk etc. 31,382. Nov. 16.

British Dyestuffs Corp., Green, and Saunders. Printing fabrics containing fibres of acetate silk. 31,383. Nov. 16.

Moseley. Agents for scouring, bleaching, dyeing, etc. 31,078. Nov. 14.

COMPLETE SPECIFICATIONS ACCEPTED.

22,512 (1921). Deutsche Gold- u. Silber-Scheideanstalt, and Schaidhauf. Bleaching textile fibres. (188,811.) Nov. 29.

7884 (1922). Bloxam (A.-G. f. Anilinfabr.). Dyeing furs, hairs, etc. (189,046.) Nov. 29.

10,913 (1922). Bloxam (A.-G. f. Anilinfabr.). Dyeing furs, skins, hairs, feathers, etc. (189,054.) Nov. 29.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

APPLICATIONS.

Blattner (Grouchkine). Manufacture of caustic alkali. 31,370. Nov. 16.

British Cyanides Co., and Rossiter. Manufacture of caustic alkali and metallic chlorides. 32,294. Nov. 25.

Cocksedge. Production of a sodium compound. 31,184. Nov. 15.

Daniels. Manufacture of crystallised carbonate of soda. 30,964. Nov. 13.

Fairweather (Federal Phosphorus Co.). Production of phosphoric acid and ferrophosphorus. 31,973. Nov. 22.

Jackson (Koppers Co.). Treatment of alkali salt solutions. 31,848. Nov. 21.

Lever Bros., Tainsh, and Thomas. Manufacture of caustic soda. 31,516. Nov. 17.

Lever Bros., Thomas, and Williams. Manufacture of caustic soda. 31,517. Nov. 17.

Llewellyn, Spence, and Spence and Sons. Production of aluminous compounds. 31,211. Nov. 15.

Nicholson. Neutralising ammonium sulphate. 32,134. Nov. 24.

Thompson (Atack and Jacobson). Manufacture of aluminium chloride. 30,933. Nov. 13.

COMPLETE SPECIFICATIONS ACCEPTED.

13,162 (1921). Nitrogen Corp. Preparation of mixtures of nitrogen and hydrogen suitable for the production of ammonia. (163,047.) Nov. 29.

13,813 (1921). Nitrogen Corp. Production of hydrogen or mixtures of nitrogen and hydrogen. (163,703.) Nov. 29.

16,743 (1921). Mau. Manufacture of concentrated hydrogen peroxide solution. (167,156.) Nov. 29.

22,393 (1921). L'Air Liquide Soc. Anon. Synthesis of ammonia. (171,970.) Nov. 22.

23,740 (1921). L'Air Liquide Soc. Anon. Synthesis of ammonia. (171,972.) Nov. 29.

24,586 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Obtaining alkali salts from felspar and like minerals. (188,454.) Nov. 22.

25,219 (1921). Plauson's (Parent Co.), Ltd. (Plauson). Manufacture of colloidal sulphur. (188,854.) Nov. 29.

25,937 (1921). Wetzlar (Pauling). Converting into sulphates by means of nitric acid, metals and alloys insoluble or only gradually soluble in sulphuric acid. (188,868.) Nov. 29.

27,188 (1921). West, Jaques, and Tully. Manufacture of hydrogen or gases rich in hydrogen. (188,494.) Nov. 22.

31,941 (1921). Aktieselskabet Labrador. Precipitation of iron in mineral acid alumina solutions. (172,944.) Nov. 29.

32,859 (1921). Bichowsky and Harthan. Production of titanium nitrogen compounds. (188,558.) Nov. 22.

712 (1922). Royston. Apparatus for neutralising sulphate of ammonia in wet state. (188,587.) Nov. 22.

4745 (1922). Egeling. *See* II.

21,997 (1922). Ephraim. Production of sulphides and hydrosulphides of the alkali metals. (184,795.) Nov. 29.

VIII.—GLASS; CERAMICS.

APPLICATIONS.

Heathcote and Mawson. Enamel. 32,261. Nov. 25.

Salerni. Abrading materials. 32,310. Nov. 25.

COMPLETE SPECIFICATIONS ACCEPTED.

19,149 and 19,851 (1921). Parsons, Peddle, and Duncan. Manufacture of optical glass. (188,721.) Nov. 29.

24,466 (1921). British Thomson-Houston Co. (General Electric Co.). Manufacture of silica glass. (188,451.) Nov. 22.

IX.—BUILDING MATERIALS.

APPLICATIONS.

Cloke. Compound for surfacing roads etc. 31,970. Nov. 22.

Commin and Hughes. Asbestos compositions. 31,020. Nov. 13.

Pearlman. Composition for coating stonework. 31,217. Nov. 15.

Spence and Wake. Binding-material for road-making etc. 31,819. Nov. 21.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

APPLICATIONS.

Barron, Halliwell, and Hindley. Cementation of iron or steel etc. articles. 31,180. Nov. 15.

Blower. Brazing flux. 31,553. Nov. 18.

Campbell. Production of steel alloys having low content of carbon. 31,011. Nov. 13.

Carbonex, Ltd., and Rodwell. Materials for hardening iron or steel. 31,939. Nov. 22.

Coley. Apparatus for reducing ores or oxides. 31,321. Nov. 16.

Coley. Apparatus for manufacture of zinc etc. 31,322. Nov. 16.

Corning Glass Works. Steel for mould materials. 31,146. Nov. 14. (U.S., 17.11.21.)

Diehl. Preparation and smelting of ores, slags, etc. 31,127. Nov. 14.

Edwards. Treatment of oxidised ores etc. 31,685. Nov. 20.

Eureka Metallurgical Co. Flotation processes. 31,843. Nov. 21. (U.S., 4.3.22.)

Eustis. Electrolytic iron. 31,935–6. Nov. 22.

Evans and Hamilton. Manufacture of iron and steel alloys. 31,052. Nov. 14.

Fairweather. 31,973. *See* VII.

Foxley. Alloys. 31,990. Nov. 22.

Golby (Luckenbach Processes, Inc.). Concentration of ores. 30,968. Nov. 13.

Hall and Ransford. Rustproofing metals. 31,599. Nov. 18.

Hall and Ransford. Colouring metal sheets etc. 31,600. Nov. 18.

Sunderland and Sutcliffe. Annealing or heating furnaces etc. 31,539. Nov. 18.

Wagner. Extraction of metals from ores etc. 31,791. Nov. 21.

Complete Specifications Accepted.

16,263 (1921). Bloxam (Aluminium Co. of America). Aluminium alloys. (188,699.) Nov. 29.

16,806 (1921). Siemens Bros. and Co., and Le Maréchal. Production of tungsten and tungsten filaments. (188,706.) Nov. 29.

18,857 (1921). British and Foreign Chemical Producers (Vogel). Pickling iron or iron alloys. (188,713.) Nov. 29.

20,533 (1921). Lenegre. Manufacture of pig iron. (167,475.) Nov. 22.

25,818 (1921). Wetzlar (Pauling). Extraction of metals from ores with nitric acid. (188,865.) Nov. 29.

26,351 (1921). Dubreul. Treatment of compound minerals. (169,990.) Nov. 22.

28,288 (1921). Hess. Recovery of light metals from chippings, residues, and ashes. (175,242.) Nov. 22.

32,002 (1921). Vulkan-Werk Reinshagen u. Co. Blast and cupola smelting furnaces. (183,418.) Nov. 22.

1600 (1922). Harris. Refining lead. (189,013.) Nov. 29.

XI.—ELECTRO-CHEMISTRY.

Applications.

Baumgartner. Electrodes. 31,430. Nov. 17. (Ger., 12.5.22.)

Bianco. Zinc electrolytes. 31,376. Nov. 16. (Austria, 17.1.22.)

Eustis. 31,935–6. *See* X.

Jacobacci. Lead storage batteries. 31,357. Nov. 16.

Rennerfelt. Method of heating materials, and electric furnace therefor. 31,689. Nov. 20.

Complete Specification Accepted.

20,437 (1921). Vesme. Increasing the output of gas from electrolytic apparatus. (188,370.) Nov. 22.

XII.—FATS; OILS; WAXES.

Applications.

Dujardin. 31,632. *See* XIX.

Hughes. Soaps etc. 31,988. Nov. 22.

Masterman and Weygang. Treatment of oils and fats for fuel, soap, etc. 31,172. Nov. 14.

Monson. 31,458. *See* I.

Complete Specifications Accepted.

20,707 (1921). Lobell. Expression of vegetable oils from natural products. (167,487.) Nov. 22.

28,548 (1921). Rocca, Tassy, et de Roux. Extraction of palm kernel oil. (171,680.) Nov. 29.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Applications.

Behr and Co., and Crupi. Waterproof, flexible, abrasive-holding composition etc. 30,984. Nov. 13.

Goldman. 31,004. *See* II.

Goldschmidt A.-G. Production of amorphous finely-divided litharge. 31,248. Nov. 15. (Ger., 15.11.21.)

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Applications.

Bolton and Cuthbe. Manufacture of rubber compounds. 31,837. Nov. 21.

Tanner and Tarver. Products obtained from rubber-containing latex. 31,301. Nov. 16.

Tanner and Tarver. India-rubber products. 32,147. Nov. 24.

Complete Specification Accepted.

25,263 (1921). Hubbard and Crouch. Preparing rubber goods for vulcanisation. (188,856.) Nov. 29.

XV.—LEATHER; BONE; HORN; GLUE.

Application.

Göransson. Manufacture of impregnated leather, pasteboard, etc. 31,031. Nov. 16.

Complete Specifications Accepted.

21,296 (1921). Peradotto. Tanning-apparatus. (167,771.) Nov. 22.

10,913 (1922). Bloxam. *See* VI.

XVII.—SUGARS; STARCHES; GUMS.

Complete Specification Accepted.

33,719 (1921). Reychler. Preparation of solutions of starch. (188,992.) Nov. 29.

XVIII.—FERMENTATION INDUSTRIES.

Applications.

Barbet et Fils et Cie. Production of alcohol. 31,258. Nov. 15. (Fr., 15.11.21.)

Bexon and Church. Brewing. 31,695. Nov. 20.

Lazarus. Extraction of malt for brewing. 31,445. Nov. 17.

Marmite Food Extract Co. (Sevang). Manufacture of yeast. 31,609. Nov. 18.

Marmite Food Extract Co. (Sevang). 32,212. *See* XIX.

XIX.—FOODS; WATER PURIFICATION; SANITATION.

Applications.

Becco Engineering and Chemical Co., and Grant. Treatment of waters containing alkaline bicarbonates etc. 31,977. Nov. 22.

Boby, Boby, and Froude. Water-softener. 32,172. Nov. 24.

Broadbent. Mustard. 31,069. Nov. 14.

Brogdex Co. Treatment of fruit etc. 31,297. Nov. 16. (U.S., 16.11.21.)

Dietrich, Ruppel, and Elektro-Osmose A.-G. Purification of water. 31,698. Nov. 20.

Dujardin. Manufacture of cattle-feeding cakes and oil. 31,632. Nov. 20.

Fairrie. Manufacture of fish meal etc. 31,781–3. Nov. 21.

Gerstenberger. Food product. 31,103. Nov. 14.

Marmite Food Extract Co. (Savang). Manufacture of foodstuffs from yeast. 32,212. Nov. 24.

Munton and Baker, and Townsend. Production of cereal foods. 31,716. Nov. 20.

Complete Specifications Accepted.

13,276 (1921). Mills. Blood coagulation media. (171,959.) Nov. 22.

19,265 (1921). Henneberg. Separation of micro-organisms from liquids. (188,724.) Nov. 29.

21,013 (1921). Leo. Production of a jelly base containing pectin. (188,387.) Nov. 22.

21,828 (1921). Jones and Smith. Antifouling and non-corroding mixtures for treatment of water. (188,778.) Nov. 29.

23,530 (1921). Threlfall and King. Manufacture of products useful as food or medicine. (188,437.) Nov. 22.

31,164 (1921). Activated Sludge, Ltd., and Coombs. Treatment of sewage and like liquid. (188,958.) Nov. 29.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Applications.

Nobel Industries, Ltd. (Du Pont de Nemours and Co.). Production of urea derivatives. 32,095. Nov. 23.

Pereira. Manufacture of dioxyperylene. 31,257. Nov. 15. (Austria, 7.1.22.)

Soc. Chim. Usines du Rhône. Manufacture calcium salt of acetylsalicylic acid. 31,384. Nov. 1 (Ger., [illegible])

Complete Specifications Accepted.

20,758 (1921). Klages, and Saccharinfabr. A.- vorm. Fahlberg, List u. Co. Production of aromat cyan-mercury compounds. (188,376.) Nov. 22.

21,763 (1921). Wolvekamp. Salts of oxidis protalbinic and lysalbinic acids. (188,772.) Nov. 2

23,530 (1921). Threlfall and King. *See* XIX.

29,042 (1921). Napp (Hoffmann-La Roche & Co. Manufacture of a compound of CC-isopropylally barbituric acid. (188,521.) Nov. 22.

19,703 (1922). Elektrizitätswerk Lonza. Manu facture of metaldehyde and obtaining fuel bodi therefrom. (189,074.) Nov. 29.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Application.

Cohen. Phoographic films. 31,262. Nov. 15.

Complete Specification Accepted.

14,031 (1921). Lage. Production of coloure photographs on paper etc. (188,692.) Nov. 29.

XXII.—EXPLOSIVES; MATCHES.

Application.

Pickett. Freeing metal casings of ammunitio from gas fillings, and treatment of such fillings 32,083. Nov. 23.

XXIII.—ANALYSIS.

Applications.

Levy and Simmance. Gas analysis. 31,235 Nov. 15.

Scott, Ltd., and Woodroffe. Apparatus for determining volumetric proportion of gases in mixtures. 32,136. Nov. 24.

Simmance and Wood. Indicating or recording apparatus for gas analysis. 31,450. Nov. 17.

I.—GENERAL; PLANT; MACHINERY.

Colloids; Rôle of the hydrogen ion concentration in the precipitation of ——. H. V. Tartar and Z. J. Gailey. J. Amer. Chem. Soc., 1922, 44, 2212—2218.

Acids cause the precipitation of mastic and gamboge sols at the same hydrogen ion concentration irrespective of the concentration of the colloid; and negative ion is without effect. Potassium and ammonium salts precipitate the sols at the same concentration provided that the hydrogen ion concentration is kept approximately constant. The precipitating values of the salts vary directly as the concentration of the colloid at the same hydrogen ion concentration. The stabilising or peptising effect of the ion bearing a charge similar to that of the colloidal particle is shown to be very limited if it exists at all.—J. F. S.

Volatile substances in air. Fritzmann and Macjulevitsch. *See* XIV.

Patents.

Acids or other liquids; Apparatus for delivering measured quantities by volume of ——. R. Moritz. E.P. 172,011, 22.11.21. Conv., 23.11.20.

An apparatus for measuring and delivering liquids comprises a main measuring vessel within which is a series of smaller measuring vessels of known capacity, open at the top, each fitted with a draw-off tap. The liquid flows from a supply tank through a three-way valve into the bottom of the main measuring vessel and fills the latter and the smaller measuring vessels. The capacity of the main vessel may be adjusted by introducing resistant filling material. By emptying the main measuring vessel through the three-way valve and the desired number of the smaller vessels by means of their respective taps, the required volume of liquid can be run off.—H. R. D.

Tunnel dryer with air circulation. Maschinenfabrik F. Haas Ges. Neuwerk, Assees. of A. Schüssler. E.P. 173,234, 21.12.21. Conv., 23.12.20.

The dryer consists of a tunnel of rectangular cross-section provided with double vertical walls. The spaces between the inner and outer walls on either side of the tunnel are fitted with heating tubes and subdivided by vertical partitions into a number of heating chambers. On the inner wall of each chamber, near the roof of the tunnel, is fixed a fan, and outlet openings are cut in these walls near the floor of the tunnel. The fans and the outlet openings are so arranged that the drying air is admitted at one bottom corner of the drying chamber and is withdrawn by the fan at the opposite top corner. This fan is situated in the next heating chamber and forces the air through its outlet into the next drying chamber. These chambers are formed by a number of trucks which can pass between the inner walls of the tunnel and carry the articles to be dried either on shelves or rods. Tunnels are made to contain from two to five trucks, and the larger the number of trucks the greater is the overlap of the heating chamber over the drying chamber. Air is admitted at the discharging end of the plant and passes through heating and drying chambers alternately until it is discharged at the charging end of the plant.—S. G. U.

Dry kiln. J. F. Hirt. U.S.P. 1,432,248, 17.10.22. Appl., 29.10.21.

A dry kiln has a separate drying chamber and heating chamber, and separate condensing chambers, heating units, intake ducts for fresh air, humidifiers, and exhaust stacks, the four last mentioned being capable of control from outside the apparatus. The heat given off from the top of the drying chamber is transmitted to the main stream of the circulating drying medium, which is then passed over the goods and downwards to the condensing and heating chambers.—B. M. V.

Dryer. J. H. Walsh, Assr. to Johns-Manville, Inc. U.S.P. 1,432,270, 17.10.22. Appl., 27.5.21.

An air-heating chamber and a drying chamber are combined with a heat regenerator which is arranged above the drying chamber with the interposition of a removable screen. The regenerator communicates through passages with an outlet from the drying chamber. Fresh air is drawn into contact with walls of the regenerator outlet passages to preheat it, passes thence to the heating chamber, and is circulated through the chambers, passages, and connexions.—H. H.

Scale in steam boilers, evaporators, economisers, and the like; Method of preventing the formation of ——. K. Schnetzer. E.P. 174,905, 15.12.21. Conv., 29.1.21.

The negative pole of a source of direct current is connected to the boiler or other apparatus at one or more points, and the positive pole of the source of current is left insulated, so that the electrical circuit is never closed.—B. M. V.

Settings for stills and similar purposes. P. Mather. E.P. 186,849, 1.11.21.*

The setting particularly relates to tall vertical stills that it is desired to heat uniformly and in adjustable zones (*cf.* E.P. 175,666; J., 1922, 284 A). The brickwork setting for a vertical cylindrical still, shown in cross-section in the figure, is of substantially the same form as the still and is divided to form a series of annular flues, b, within the still casing, a. A series of liquid fuel or gas burners, k, are arranged on one side of the setting and a vertical flue, s, connected with the annular flues on the other. A layer of non-conducting material, f, is placed between the firebrick lining, g, of the annular flues and the ordinary brickwork backing of the setting, h. The casing of the still opposite the burners is protected by firebrick, o.—T. A. S.

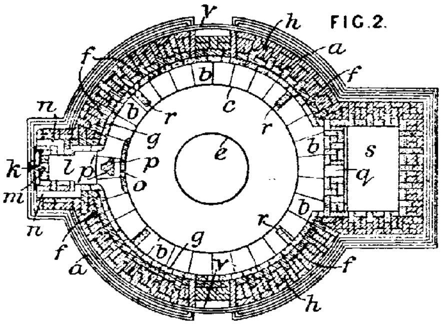


FIG. 2.

Gases, oil vapours, or gaseous mixtures; Method and apparatus for treatment of ——. J. F. Ward, H. Neilsen, and B. Laing. E.P. 186,945, 31.3.21.*

The gas or vapour is introduced tangentially and at high velocity by the pipe, c, into the jacketed chamber, a, fitted with a bottom valve. The cover of the chamber carries a conical deflector, e, a baffle plate, and an outlet pipe, d. Bevel gearing drives a hollow shaft, *f*, bell-mouthed at its lower end, which passes through the centre of the cover. This shaft carries a number of vanes, *g*, and nozzles, *j*, and a perforated basket, *h*. Below the bell-mouth is a nozzle, *m*, coupled to a compressor, *n*, which forces a portion of the gas or other vapour into *f*, thus raising the liquid medium, which may contain solids in mechanical or colloidal suspension, catalysts, or oxidising agents, from the bottom of the chamber, *a*, through the nozzles, *j*. This finely divided liquid having been thrown by centrifugal force against the basket, ultimately falls to the bottom of the chamber and can be again circulated through the nozzles. The gas entering the chamber by *c* is gradually forced downwards until it meets the vanes, *h*, which give it an upward motion through the finely divided liquid in the mixing basket. It then flows into the space above the deflector, where any particles of liquid carried over are caught on the baffle plate, the gas itself entering the outlet pipe. The plant can be used for the hydrogenation of oils or for the desulphurisation, hydrogenation and oxidation of gases or oil vapours. —S. G. U.

---

* The illustrations in the abstracts marked * are reproduced from the Illustrated Official Journal (Patents), by kind permission of the Controller of H.M. Stationery Office.

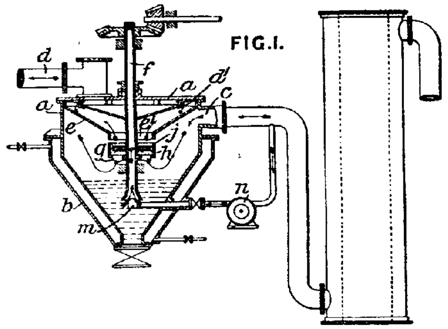


FIG.I.

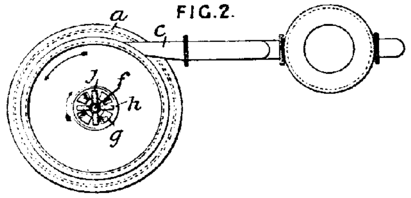


FIG.2.

Chemical apparatus for precipitation purposes. The British Thomson-Houston Co., Ltd. From General Electric Co. E.P. 187,090, 29.8.21.*

The invention relates to a kettle which can be evenly heated and readily kept at a constant temperature, and into which the chemicals required for the reaction can be admitted continuously and from which the precipitate and the mother liquor formed can be withdrawn. Inside a carefully lagged vessel, fitted with a steam coil, pipes for admission and withdrawal of the heating liquid, and a thermometer, is placed a stoneware kettle, 15, having a wooden cover, 28. This cover has a number of openings for the following connexions: a pipe, 29, terminating in a spraying nozzle, through which enters one of the solutions, a pipe (not shown in the figure) through which enters the other solution required for the reaction, a pipe, 33, to admit steam or air for agitating the contents of the kettle, an air-lift, 42, for removing the precipitate and the mother liquor, a fume ejector (not shown), a thermometer pocket, and a device, 47 and 48, for indicating the level of the contents of the kettle. In working the plant a liquid, preferably one which will permit recovery of the contents of the kettle if broken, is introduced into the space between the kettle and the outer vessel and heated by the steam coil. A solution containing, *e.g.*, a soluble tungsten compound is sprayed into the kettle through 31, and the precipitating solution (in this case hydrochloric acid) is admitted by the other pipe, the mixture being agitated by air or heated as found necessary. The precipitate formed and the mother liquor are removed from the bottom of the kettle by the air-lift, the delivery pipe of which is fitted with an air vent, whilst the air, steam, and gases formed during the reaction are removed by the fume ejector. —S. G. U.

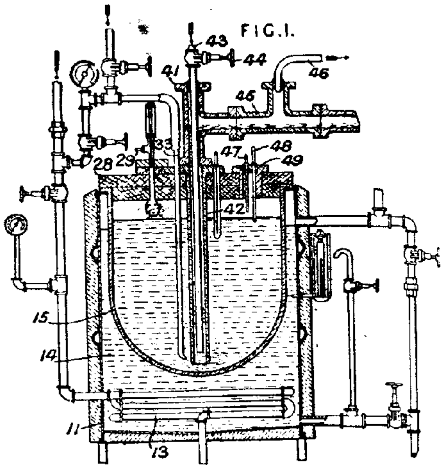


FIG.I.

Heating and cooling of liquids or admixed solids and liquids in evaporative or like treatment thereof; Method of and apparatus for the ——. T. Rigby. E.P. 187,260, 10 and 26.5.21.

In the evaporation of such liquors as brine for the recovery of salt, two or more multiple-effect evaporators are used, the initial and final temperatures in each set being about the same, but the number of stages in the second being less than in the first, so that the temperature range per stage is greater in the second set than in the first; this is to compensate for the raising of the boiling point of the liquor, which is subdivided and passed through the effects of one set in parallel, then, if desired, cooled for crystallising by flashing off vapour, and re-evaporated in the second multiple effect, the liquor again passing through the effects in parallel. The flashing off may be done in stages so as t provide vapour at different temperatures, which i passed to evaporating effects at similar temperatures. The liquors for crystallisation may be removed from the plant to a more suitable location i containers on wheels.—B. M. V.

Evaporating liquids; Method of continuously ——. E. S. Sandberg. U.S.P. 1,433,040, 24.10.2 Appl., 5.9.18.

The liquid to be evaporated is forced under pressu into a heating element where it is heated but whe ebullition is prevented by the pressure. It the passes through a throttled outlet to a low-pressu evaporating chamber, the vapour from which compressed and used as the heating agent. —B. M. V.

vaporation of liquids and drying of substances; Device for the ——. C. R. Mabee. U.S.P. 1,433,141, 24.10.22. Appl., 15.12.13. Renewed 1.3.19.

N evaporating and drying apparatus comprises a bstantially hemispherical heated container, with tary conveyor members arranged adjacent to the terior wall thereof and having a continuous eldable surface of contact with the wall. The all of the container may be maintained at a mperature different from that of the material to treated.—J. S. G. T.

eat-interchanging apparatus. E. L. Pease. E.P. 187,353, 30.7.21.

a heat exchanger embodying plates eccentrically ounted on one or more tubular elements, the lates are so arranged that the longer plate surces are encountered by the fluid to be heated efore the latter comes in contact with the tubular ements conveying the heating fluid. The object to maintain a constant difference of temperature etween the plates and the fluid being heated.
—H. H.

ashing material which has been separated by entrifugal action; Apparatus for ——. Chem. Fabr. Griesheim-Elektron, and F. Sander. E.P. 187,429, 24.9.21.

HE washing liquid, which is specifically lighter han the mother-lye, is supplied through radial ipes to an annular space within the outer all of the drum and bounded on its inner side by ltering material carried by ribs on the drum wall. he lengths of the pipes are so much greater than he thickness of the layer of solids to be washed hat the centrifugal force of the washing liquid vercomes that of the mother-lye, and the washing iquid passes therefore through the solids from the eriphery to the axis of the drum. Instead of the nnular space a series of connected annular pipes ith outlets for the washing liquid may be used, nd these pipes may be so spaced that on removing he outer wall of the drum the washed solids may e removed outwardly by centrifugal action. The over of the drum may be provided with openings rranged in concentric circles, any one of which can e opened or closed as desired to enable the distance t which the separated liquid is discharged and the hickness of the layer of solids to be regulated.
—H. H.

entrifugal separator. A. Gorneau, Assr. to C. and S. Gorneau. U.S.P. 1,432,242, 17.10.22. Appl., 21.1.20.

The basket or separating element of a centrifugal machine is provided with a bearing between its bottom and the bottom of a surrounding container, and with driving means situated entirely outside and above the basket, the driving means being connected to the basket by curved arms forming an arch, like the handle of an ordinary basket.
—B. M. V.

Crushing and grinding mill. F. Wriedt, Assr. to Milo Machinery Co. Proprietary, Ltd. U.S.P. 1,432,046, 17.10.22. Appl., 7.6.22.

A stationary casing or support is provided with a concave cylindrical grinding surface against which work convex grinding elements, which are provided with means for drawing in the material between, and for displacing it transversely to the motion of, the grinding elements.—B. M. V.

Grinding mill. J. B. Sedberry. U.S.P. 1,433,042, 24.10.22. Appl., 4.5.20.

A shaft is journaled within a drum and has one set of grinding elements or beaters fixed to it, while another set of beaters are pivoted on the fixed set. The rigidly fixed and swinging beaters are interchangeable.—B. M. V.

Filter. E. J. Sweetland. U.S.P. 1,432,134, 17.10.22 Appl., 30.4.19.

A movable filter element, mounted within a tank, is provided with means for advancing it step by step.—H. H.

Feeding material to [airtight] treating chambers; System of ——. J. T. Fenton. U.S.P. 1,432,170, 17.10.22. Appl., 29.3.21.

Entrained air is displaced from finely-divided solid material by means of an inert elastic fluid, and the solid is then injected into an apparatus for subsequent treatment by means of a high-pressure jet of elastic fluid.—B. M. V.

Absorption and cooling apparatus. A. B. Jones, Assr. to Clark, MacMullen, and Riley. U.S.P. 1,432,698, 17.10.22. Appl., 18.2.21.

The apparatus is built up of sections each in the form of a hollow body with upper and lower walls inclined downwards. Gas inlet and outlet connexions to the interior of the body are provided; and each section is provided with means for distributing a liquid over its exterior surfaces.
—H. H.

Abstracting heat from fluids; Apparatus for ——. P. R. McCrary. U.S.P. 1,432,705, 17.10.22. Appl., 14.5.19.

A cap is mounted on a shell which is mounted on a base and the parts are held together by a stand-pipe. The shell is provided with adjustable air inlet orifices, and the stand-pipe with adjustable liquid-ejecting orifices. Means are provided for forcing liquid into the stand-pipe, for withdrawing liquid from the base, and for withdrawing air from the shell and a coiled pipe surrounding the stand-pipe within the shell.—H. H.

Acid or alkaline reductions; Process for carrying out ——. W. O. Mitscherling, Assr. to Atlas Powder Co. U.S.P. 1,432,775, 24.10.22. Appl., 21.3.22.

A reducing metallic medium is introduced into a rapidly rotating tube through which is passed the solution to be reduced. The rate of rotation is such as to place the solution under pressure due to centrifugal force.—H. H.

Electric precipitator; Self-cleaning ——. H. F. Fisher, Assr. to Research Corp. U.S.P. 1,433,266, 24.10.22. Appl., 26.11.19.

An electrical precipitator comprises a discharge electrode, a collecting electrode movable in the direction of its length, an abutment in the path of movement, and means for moving the collecting electrode against and away from the abutment.
—J. S. G. T.

Drying apparatus. P. Fleury, Assr. to D. L. Robertson. U.S.P. 1,433,608, 31.10.22. Appl., 21.11.19.

See E.P. 151,488 of 1919; J., 1920, 761 A.

Steam, compressed air and gases; Separating apparatus for [removing water, dust, etc. from] ——. O. Loss, and D. Grove A.-G. E.P. 187,791, 8.9.21.

Sorting, washing or classfying mixed materials of different specific gravities or volumes; Process and plant for ——. M. Croquet. E.P. 187,874, 1.12.21.

Crusher rolls [; Sectional ——]. J. Y. Johnson. From Pennsylvania Crusher Co. E.P. 187,904, 15.2.22.

Pulverising apparatus. R. E. H. Pomeroy. E.P. 188,173, 13.10.21.

See U.S.P. 1,427,322 of 1922; J., 1922, 796 A.

Drying pulverulent material. E.P. 187,320. *See* VII.

IIa.—FUEL; GAS; MINERAL OILS AND WAXES.

Carbon and coal; Oxidation of different varieties of —— by chromic acid. D. Florentin. Bull. Soc. Chim., 1922, **31**, 1068—1072.

An attempt to replace the older methods of analysis by oxidation by means of a mixture of sulphuric and chromic acids in the case of determinations of carbon in fuel, leads to the conclusion that the method is not sufficiently trustworthy without some modification. Experiments were made on oxalic acid, tartaric acid, lampblack, graphite, coke, anthracite, hard coal, and bituminous coal; with the exception of the two first-named substances, the carbon dioxide obtained corresponded to a deficiency in the carbon content varying from 0·60% to 27·50%. In each case the carbon deficiency represented carbon which had been oxidised to carbon monoxide; this was converted into dioxide by being passed over copper oxide heated to redness and a value for carbon in accordance with the true carbon content thus obtained. The suggestion is made that the precaution of oxidising carbon monoxide should be taken in all sulpho-chromic oxidations, particularly in the case of estimations of carbon in iron and steel.—H. J. E.

Peat; Removal of water from —— below 100° C. Wo. Ostwald and A. Wolf. Kolloid-Zeits., 1922, **31**, 197—200.

Heating peat to 100° C. for several hours leads to the separation of water and changes in the degree of dispersion and other colloid-chemical properties. The changes are similar to those observed in the ten Bosch process which is carried out under pressure and at high temperatures (*cf.* J., 1922, 318 A, 319 A).—J. F. S.

Producer-gas equilibrium at high pressures. K. Jellinek and A. Diethelm. Z. anorg. Chem., 1922, **124**, 203—229.

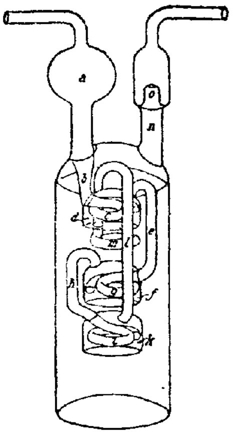
The electric oven employed was a modification of that used by Nernst (Z. Elektrochem., 1907, **13**, 52); it allowed measurements to be carried out at 1300° C. and at 150 atm. The reaction $C+CO_2 \rightleftarrows 2CO$ was investigated between 800° and 1000° C. at pressures up to 50 atm. Various forms of charcoal were employed, and the equilibrium, which was well defined, was practically the same in each case, and again the same in the case of graphite; the law of mass action was obeyed at all pressures. The integration constant of the reaction isochore of producer gas equilibrium was found to be 3·876; this agrees well with the value (3·80) calculated by means of Nernst's heat theorem. The authors show that the maximum work of this important reaction is equal to the heat effect if the reaction is carried out isothermally and reversibly and if the excess of oxygen has the same pressure as the carbon dioxide formed. —W. T.

Moisture content of producer gas; Estimation of ——. E. Maase. Feuerungstech., 1922, **11**, 27—28.

The apparatus used consists of a vessel provided with stopcocks above and below and fitted with a thermometer and manometer. This vessel is surrounded by a water jacket which can be heated by means of a steam coil. The temperature is raised above the dew point of the moist gas, and a sufficient quantity of the gas passed through the inner vessel to ensure all air being expelled. The stopcocks are then closed and the pressure and temperature read off. Cold water is then passed through the water jacket and the temperature and pressure again read; from the difference between these and the first values the moisture content of the gas can be calculated.—W. P.

Benzol in coal gas; Determination of ——. A. Thau. Chem. Age, 1922, **7**, 636—638.

Naphthalene and water vapour are removed from coal gas by passage at a rate of 50 l. per hour through a solution of picric acid and through previously heated calcium chloride contained in a series of U-tubes immersed in a mixture of ice and salt. Benzol is then absorbed in medicinal petroleum oil contained in a wash-bottle, cooled to −15° C., or −20° C., and determined by the gain in weight. The gas leaving the bottle is passed through a meter. If a commercial oil is used as an absorbent it should be heated to 120° C. in open dishes before use and then it should retain a constant weight while passing dry air through it. The wash-bottle (see fig.) contains a series of coiled tubes and bells and is filled with oil to the top of the bell, *d*, before starting a test. The gas bubbles through the oil from the open ends of the coils, *c*, *g*, *i*, and *m*, successively.—H. Hg.



Methane; Concentration of —— in mine-damp. E. Berl and O. Schmidt. Z. angew. Chem., 1922, **35**, 633.

The quantity of methane discharged daily into the air from a mine rich in firedamp may amount to as much as 250,000 cub. m. The concentration of methane can be increased from its initial value of 1—2% to over 10%, and a gas capable of being utilised for the production of heat, mechanical or electrical energy, obtained, by absorption of the gas mixture in active charcoal, followed by fractional expulsion of the adsorbed gas, *e.g.*, by heating first to 100° C., then to 175° C. and treating with steam.—H. C. R.

Ignition of gases. II. Ignition by a heated surface. Mixtures of methane and air. W. Mason and R. V. Wheeler. Trans. Chem. Soc., 1922, **121**, 2079—2091.

In order to determine the most readily ignited mixtures of methane and air, mixtures of known composition, varying from 2 to 14% of methane, were admitted rapidly to an evacuated cylindrical quartz vessel of 81 c.c. capacity, which was heated in an electrical tube furnace. The lowest temperature to which the walls of the vessel had to be heated in order that a given mixture should ignite when admitted to it was taken as the ignition temperature. The mixtures most readily ignited contained 5—6% of methane, the relative temperature of ignition being 695° C. The most explosive mixture, containing 9·5—10% of methane, is more difficult to ignite in this manner. Mixtures containing proportions of methane outside the limits of inflammability at atmospheric temperatures can propagate flame at much higher temperatures near their ignition temperatures. The value for the ignition temperature is not identical with the temperature existing in the mixture the moment flame appears; there must be a pre-flame period during which the rate of reaction is rapidly increasing. The "lag" or pre-flame period diminishes with rise of temperature and is of the shortest duration in mixtures containing the lowest percentage of methane. At temperatures above about 1200° C., the ignition of any of the mixtures would be nearly instantaneous. In order to ignite a given mixture the source of heat must be maintained in contact with the mixture during the pre-flame period, otherwise acceleration will be retarded. The "incendivity" of a heated surface depends on its temperature, its duration of contact with the mixture, and the catalysing power of the surface to induce flameless combustion.—J. B. F.

Naphthenic acids. I. Isolation of petroleum acids and pure naphthenic acids from waste lyes of neutral distillate refining. Y. Tanaka and S. Nagai. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, 25, 1031—1044. (*Cf.* T. Yoshimura, Petroleum Times, March, 1921.)

A crude mixture of petroleum acids was obtained by acidifying the waste lyes produced in the refining of a petroleum distillate from Kurokawa, Akita Prefecture. (The authors have specially used the term petroleum acids for the crude mixed acid.) It was a thick, dark liquid, sp. gr. 0·9853 at 15°/4° C., acid value 68·8, having an offensive odour, and formed a stable emulsion with water, mainly owing to the presence of alkylsulphuric acids. It also contained naphthenic acids, hydrocarbons, esters of alkylsulphuric acids, phenols, etc. The neutral impurities were removed by converting the crude petroleum acids into potassium soap, repeatedly shaking with petroleum ether (b.p. below 55° C.), and decomposing the soap with dilute hydrochloric acid. To facilitate the extraction, it is necessary to add alcohol (15—40% of the total volume of the soap solution) to the soap solution. The alkylsulphuric acids were decomposed and the decomposition product removed, by adding a quantity of copper oxide almost equivalent to the combined sulphuric acid and then distilling under 8—9 mm. pressure. The distillate was again converted into potassium soap, the neutral substances were extracted with petroleum ether, and the soap solution was decomposed with dilute hydrochloric acid. The resulting crude naphthenic acid had sp. gr. 0·9936 at 15°/4° C., n_D^{15}=1·4875, and acid value 230·4. It did not form an emulsion with water. It was fractionally distilled under reduced pressure, about 84% distilling at 170°—220° C. at 8·9—9 mm. The lower-boiling distillates (110°—170° C.) contained phenolic substances. The crude naphthenic acids were converted into their methyl esters, and pure naphthenic acids were obtained by saponifying the esters. The product was a colourless viscid liquid, having a very slight peculiar but not offensive smell, and the following characters: sp. gr. 0·9918 at 15°/4° C., n_D^{15} 1·4824, acid value 254·3, iodine value 0, mean molecular weight 220·9. —K. K.

Alcohol; Manufacture of industrial —— and alcohol motor fuel in the Philippine Islands. H. I. Cole. Philippine J. Sci., 1922, 21, 17—48.

The nipa palm and molasses offer cheap and easily manipulated sources of alcohol for use as a motor fuel. Alcohol alone cannot be used successfully with the present type of petrol engine, but in admixture with benzene or ether it forms an advantageous and efficient substitute for petrol, only minor alterations of the carburettor and spark being required. In the Philippines, where benzol is not available, the alcohol-ether mixture would be the most economical to produce. A satisfactory mixture for motor purposes should contain 40—45% of ether, together with 0·5—1% of pyridine, which acts both as a denaturant and as a means of neutralising the traces of acid produced by combustion. A summary of previous papers on the utilisation of nipa sap as a source of alcohol is appended.—G. F. M.

Boring and cooling oils. Braun. *See* XII.

Drainage error in Bingham viscosimeter. Herschel. *See* XXIII.

Patents.

Smokeless fuel and coke; Production of ——. S. R. Illingworth. E.P. 187,328, 18.7.21.

Coal containing 14—20% of volatile matter and in which most of the resinic matter decomposes at or above 400° C. without the evolution of a large proportion of volatile matter, is heated to 600° C. Coal containing 12—14% of volatile matter and with a coking index of not less than 4 may be heated similarly in layers 2—3 in. thick. The smokeless fuel thus formed may be heated to higher temperatures for the production of coke.—H. Hg.

Fuel. H. J. Franklin and J. Pettingall. E.P. 187,351, 30.7.21.

Ten parts of asphalt or pitch is dissolved in 800 pts. of heated fuel oil and incorporated with 25 pts. of shale and 45 pts. of coal or coke, previously pulverised and mixed in the presence of steam; 160 pts. of tar and 20 pts. of peat impregnated with fuel oil may also be added. The mixture is moulded into blocks.—H. Hg.

Artificial fuel and method of making same. C. J. Greenstreet. U.S.P. 1,432,178, 17.10.22. Appl., 23.7.19.

Finely-divided solid fuel is temporarily suspended in liquid fuel, the viscosity of which is then increased by oxygenation so as to keep the solid fuel in permanent suspension.—B. M. V.

Destructive distillation of coal and like carbonaceous materials. F. J. and F. West (Legal representatives of J. West), H. D. Madden, F. Boardman, and West's Gas Improvement Co., Ltd. E.P. 187,263, 10.2.22.

Steam and air are supplied simultaneously or alternately to the lower part of a vertical retort in which coal is being distilled, being introduced through the centre of the worm extractor shaft and the barrel of the worm. The air may be induced by the steam, or each may be admitted through a three-way cock controlled by the rod which actuates the extractor.—H. Hg.

Carbonisation of coal. J. Roberts. E.P. 187,336, 20.7.21.

Caking coal is mixed with non-caking coal containing 20—45% of volatile matter in such proportion that the non-caking coal utilises the excess of binding material in the caking coal during carbonisation, thus preventing expansion and securing a product with a bright and hard outer layer. The mixture is crushed to pass a 0·1-in. screen and is carbonised at 600°—760° C. The non-caking coal may be prepared from caking coal by heating it to 100°—350° C. in the presence of air. Coke breeze may be substituted for part of the non-caking coal. —H. Hg.

Carbonaceous char; Method of making finely-divided ——. H. Rodman, Assr. to Rodman Chemical Co. U.S.P. 1,433,039, 24.10.22. Appl., 9.9.18.

Coking coal is powdered and heated slowly to a coking temperature while exposed to the air, and with sufficient agitation to maintain the mass of coal in powdered form.—B. M. V.

Combustible gas and method and apparatus for generating and burning the same. S. Biddison. E.P. 162,646, 6.4.21. Conv., 29.4.20.

Oil and steam are passed into a tubular superheater, each element of which contains a longitudinal partition terminating short of its rear end. The steam boiler and the superheater are arranged above a pan in which oil is burnt to start the process and above burners in which part of the gas produced is subsequently burnt. The superheater is thus heated to 1000°—2500° F. (about 540°—1370° C.). When using crude oil this is mixed with the steam before entering the superheater. Water is supplied to the boiler from a float chamber through a non-return valve which is provided with a by-pass tube arranged below it, so that a constant water level is maintained within the boiler.—H. Hg.

Carburetted water-gas; Manufacture of ——. Fuller-Lehigh Co., Assees. of G. H. Kaemmerling and H. W. Benner. E.P. 171,079, 7.7.21. Conv., 2.11.20.

During the early part of the steam-blasting stage of water-gas manufacture, powdered bituminous coal is introduced into the upper part of the generator. Part of the water-gas is compressed into a vessel from which it is admitted intermittently into a coal container which communicates with the generator, so that the coal dust is carried forward in a series of puffs. During the introduction of coal the steam supply is restricted so as not to carry the coal out of the generator; steam is then supplied at the normal rate during the remainder of the blasting period, and the water-gas produced may or may not be mixed with the carburetted gas produced during the introduction of coal. The water-gas may be produced entirely from the coke derived from the coal or partly from other non-volatile fuel fed to the generator.—H. Hg.

Suction gas producer plants with special reference to vehicle driving. J. I. Thornycroft and Co., Ltd., and J. E. Thornycroft. E.P. 187,022, 12.7.21.

In order to allow gas to escape directly to the atmosphere and to maintain the suction at low load, an exhauster is fitted which does not influence the producer at full load but only acts at low load. —W. P.

Gasification of coal and other carbonaceous material; Methods and means for the ——. A. S. Foster. E.P. 187,076, 15.8.21.

The plant comprises a retort chamber above a producer. The retort is heated by external gas flues, and the bottom of the retort can be steamed. A steam superheater and distributor is arranged in conjunction with or adjacent to the producer grate, so that two parts of the grate may be steamed alternately, enabling one part to be steamed for the production of water-gas whilst the other is subjected to the air blast, thus allowing continuous working. —W. P.

Gas generators. E. Turner. E.P. 187,277, 16.6.21.

A stream of liquid or powdered solid fuel is directed downwards on to the apex of a cone. Air is admitted separately for the combustion of any non-volatile deposit upon the cone, whereby the cone is heated. Steam may be mixed with the air. The gases thus formed pass downwards through an annulus formed by the cone and the inner wall of an outer chamber, and then upwards through the chamber. There may be a water-seal at the bottom of the annulus for the reception of ash and the generation of steam. The cone may be heated internally by waste gases from a furnace or engine or by the combustion of oil or gas; in the latter case the products of combustion pass through perforations into the lower part of the annulus. The cone may be heated externally also by a burner provided around its base or by electrical means. The gases may be enriched with oil in the outer chamber. The admission of fuel, air, steam, and water to the producer may be controlled by the pressure in the gas delivery main.—H. Hg.

Gas producer for firing or heating purposes. J. H. Marlow. E.P. 187,282, 20.6.21.

Air and steam are admitted under the grate of a producer through a T-piece the branches of which are so shaped as to direct the air and steam towards the fuel bed. Secondary air is preheated by passage through conduits arranged in the brickwork of the producer.—H. Hg.

Alcohol-ether mixtures [*motor fuels*]; *Manufacture of* ——. H. Wade. From F. E. Lichtenthaeler. E.P. (a) 187,051 and (b) 187,052, 27.7.21.

(a) The difficulty of preparing alcohol-ether mixtures when the ether is separately prepared is considerable owing to the high volatility of the ether. The necessity for the provision of special condensing and refrigerating plant has been overcome by passing the vapours obtained in the manufacture of ether from alcohol and sulphuric acid through a scrubber containing alkali and thence through an absorbing tower within which a stream of alcohol is flowing in the opposite direction. A certain amount of the ether is condensed before the vapours enter the absorbing tower and this is added to the weak alcohol-ether mixture, obtained in the tower, to produce a mixture suitable for motor fuel. By this means the handling of the ether as such is avoided and the alcohol-ether mixture has no more fire risks than ordinary petrol (b) Alcohol-ether mixtures are prepared direct from raw material containing sugars or starches, alcoho never being stored as such in bulk. Fermente mash is distilled and the alcohol concentrated in continuous still up to approximately 95%. portion of the alcohol so obtained is led off to a ether apparatus and converted into ether. Th remainder of the alcohol from the continuous sti is taken to an absorbing tower to absorb the purified ether vapours.—T. A. S.

Fuel for internal-combustion engines. H. R. Giles From D. F. Field. E.P. 187,326, 18.7.21.

Alcohol-ether fuels, owing to the formation acetic acid and other causes, are unsatisfactory. Th difficulties are overcome by the addition of rosin o and a small proportion of caustic soda dissolved i alcohol. A mixture consisting of alcohol (66 ove proof) 36·75%, ether 62%, rosin oil 1%, saturate solution of caustic soda in alcohol 0·25%, is satisfactory when used in a carburettor normal adjusted to use petrol.—T. A. S.

Alcohol fuels. S. W. Blake. E.P. 187,335, 19.7.21.

In the process described in E.P. 178,498 (J., 1922, 454 a) for the preparation of a fuel of high volatility and calorific value by treating a mixture of commercial alcohol and acetone in a pressure vessel with calcium carbide, the acetylene formed being absorbed, other monohydric alcohols, *e.g.*, amyl, butyl, and propyl alcohols, may be used instead of ethyl alcohol and yield satisfactory fuels. It is advantageous to retain approximately 10% of water in the fuel and to remove all lime. The alcohol used should be of low strength, *e.g.*, 90—92%. The presence of water in the fuel keeps the engine cooler and prevents carbonisation and consequent knocking. When preparing the fuel from the heavier alcohols, the water should be added to the acetone and the acetone-water mixture then added to the alcohol. The proportion of acetone is from 5 to 40% and the proportion of calcium carbide used from ¼ to ½ lb. per gall. The removal of lime is effected by adding ammonia and then passing carbon dioxide through the solution.—T. A. S.

Petroleum and petroleum distillates; Treatment of ——. A. E. Dunstan and F. B. Thole. E.P. 186,955, 9.5.21.

Substances having a highly adsorptive surface are prepared by the dehydration of natural or artificial inorganic gels. Many natural hydrated silicates and hydroxides come within this category but only few possess the necessary surface energy for effective employment. Varieties of fullers' earth, such as floridin, and bauxite are particularly useful, and suitable artificial gels may be prepared from gelatinous colloidal metallic hydroxides, such as iron and aluminium hydroxides. When petroleum distillates are filtered through the dehydrated gels the sulphur compounds are removed by adsorption. The amount of material required for desulphurisation of benzine may be readily determined, 4 lb. of floridin or 9 lb. of bauxite per gallon having been found sufficient in certain cases.—T. A. S.

[Oil] still. E. W. Isom and J. E. Bell, Assrs. to Sinclair Refining Co. U.S.P. 1,432,067, 17.10.22. Appl., 12.5.21.

The still consists of a heating unit through which oil is pumped and a larger receptacle. The support for the pump is flexible to permit movement with expansion and contraction of the pipework.

—T. A. S.

Oil shales; Method for distilling ——. P. Danckwardt. U.S.P. 1,432,101, 17.10.22. Appl., 8.3.20.

Highly heated waste shale and raw shale are continuously fed into a still. The heat derived from the waste shale distils off the volatile matter from the raw shale.—T. A. S.

[Oil] vapours; Process of filtering ——. W. C. and F. E. Wells. U.S.P. 1,433,050, 24.10.22. Appl., 15.2.19.

Oil is heated in a still, permanent neutral gas being passed through it. The resulting vaporous mixture is passed upwards through a filtering material, such as fuller's earth, which removes colour and bituminous material. The filtering material is maintained at a lower temperature than the oil and after passing through it the vapours are condensed.—T. A. S.

Oils, pitch, and the like; Process of obtaining* —— *from shales, coal, wood, etc. W. C. and F. E. Wells. U.S.P. 1,433,051, 24.10.22. Appl., 30.8.19.

The shale or other material is continuously fed into an annular retort, both surfaces of which are heated. A neutral heated gas is passed into the bottom of the retort and carries away the vapours.—T. A. S.

Petroleum, shale oil, coal tar, and the like, commonly classed as hydrocarbons; Process of refining ——. W. C. and F. E. Wells. U.S.P. 1,433,052, 24.10.22. Appl., 27.10.19.

The oil is heated in a still the bottom of which is covered with an inert fusible material. Permanent neutral gas is passed through, and the resulting mixed vapours are passed upwards through fuller's earth, which is maintained at a lower temperature than the oil in the still. The vapours are then condensed. The apparatus can be made to work continuously and the inert gas can be used repeatedly.—T. A. S.

[Hydrocarbon] liquids, fluids and oils; Process for the conversion of —— *into lower-boiling products].* J. H. Adams, Assr. to The Texas Co. U.S.P. 1,433,519, 24.10.22. Appl., 5.12.17.

Lower-boiling hydrocarbons are obtained by passing oil through a succession of heating chambers. Pressure is maintained in each chamber, and the vapours formed are removed.—T. A. S.

Briquetting or drying press. H. Horst, Assr. to Ges. für Maschinelle Druckentwässerung m.b.H. U.S.P. 1,433,619, 31.10.22. Appl., 2.8.20.

See E. P. 174,657 of 1920; J., 1922, 243 a.

[Fuel] gases; Purification of ——. Koppers Co., Assees. of P. L. Jacobson. E.P. 170,572, 6.10.21. Conv., 22.10.20.

See U.S.P. 1,390,037 of 1921; J., 1921, 762 a.

Burners for fluid fuel. J. Bliss. E.P. 188,025, 1.7.21.

Extracting coke from vertical retorts or chambers; Means for ——. R. and J. Dempster, Ltd., and W. F. Rodger. E.P. 187,911, 10.3.22.

Charging and discharging gas retorts; Apparatus for ——. J. G. W. Aldridge. E.P. 188,036, 26.7. and 22.9.21.

Generators, gas producers, shaft furnaces, and the like; Revolving grate for ——. H. Goehtz. E.P. 188,256, 30.12.21.

Gas purifiers [; Mechanism for holding down covers of ——]. R. and J. Dempster, Ltd., and R. Broadhead. E.P. 188,193, 26.10.21.

Fertilising material. E.P. 187,251. *See* XVI.

IIb.—DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Reduction of thorium oxide by tungsten. Smithells. *See* VII.

III.—TAR AND TAR PRODUCTS.

Phenanthrene; Solubility of —— *in various organic solvents.* H. Henstock. Chem. Soc. Trans., 1922, 121, 2124—2128.

The solubility of phenanthrene in purified organic solvents was determined at temperatures between −10° C. and +30° C. by evaporating the solvent from a weighed amount of saturated solution and weighing the solid residue. The results are expressed in curves and tables from which the following typical figures for the solubility in grams of phenanthrene in 100 g. of solvent at 0° and 20° C. respectively are selected:—methyl alcohol 1·20, 3·60, light petroleum (b.p. 60°—85° C.) 2·40, 6·60, ethyl alcohol 2·75, 4·80, glacial acetic acid —,

5·80, carbon tetrachloride 7·60, 19·00, ether 17·44, 36·78, acetone 25·5, 51·94, chloroform 25·50, 46·60, benzene —, 51·70, and carbon bisulphide 37·32, 72·08. The curves for carbon tetrachloride, ether, and acetone show marked breaks at 0°, 10°, and 15° C. respectively, which point to some change in the molecular association of the solvent or solute, probably of the latter, at those temperatures. At −10° C. phenanthrene is insoluble in methyl alcohol.
—G. F. M.

Collidine; Condensation of —— with acetaldehyde. H. Kondô and T. Takahashi. Yakugakuzasshi (J. Pharm. Soc. Japan), 1922, No. 487, 775—780.

By heating a mixture of collidine (10 g.) and paraldehyde (3·63 g.) in a sealed tube at 210° C. for 14 hrs., *αγ*-dimethyl-*α*′-propenylpyridine (2 g.), colourless oil, b.p. 110°—111° C. at 12 mm., was obtained. It gave *αγ*-dimethylpyridine-*α*′-carboxylic acid when oxidised with 25% nitric acid. On reducing with sodium and hot absolute alcohol, the base was converted into *αγ*-dimethyl-*α*′-propylpiperidine, colourless liquid, b.p. 184° C., having a slight nicotine-like odour.—K. K.

Catalytic activity of copper [in preparation of aniline]. O. W. Brown and C. O. Henke. J. Phys. Chem., 1922, 26, 715—727.

In continuation of previous work (J., 1922, 322 A, 406 A) the authors have investigated the catalytic reduction of nitrobenzene to aniline by hydrogen in the presence of copper catalysts prepared by the reduction of the precipitated oxide. Sabatier's conclusion that a catalyst so prepared is more efficient than one prepared from an ignited nitrate was confirmed. By the use of the former catalyst, much lower rates of supply of hydrogen may be used without reduction in yield, and the reaction may be carried out at a much greater rate. The best temperature for carrying out the reduction was found to be about 260° C. A small amount of iron in a copper catalyst prepared from an ignited oxide prevents the rapid decrease in activity of the catalyst. Copper deposited on asbestos was found to be capable of effecting the reduction at a much greater rate per grm. of copper than copper alone, but with high rates of supply of nitrobenzene, it quickly lost its activity. Copper on asbestos is a better catalyst than an equal volume of copper on pumice.—J. S. G. T.

Chlorophenols; Solubility of ——. N. V. Sidgwick and S. L. Turner. Trans. Chem. Soc., 1922, 121, 2256—2263.

The influence of the position of the substituents on the properties of the isomeric chlorophenols is distinctly abnormal, the abnormality being more marked in those properties measured at high temperature (boiling points, critical solution temperature in water) than in those measured at low (solubility in benzene). The differences in the critical solution temperatures in water are considerable and of the usual kind, the value for the ortho compound (173·0° C.) being by far the highest, while those of the meta and para compounds (130·8° and 129·0° C. respectively) come close together. Unexpectedly small differences, though of the usual kind, are observed for the heat of solution in benzene. From the curves representing solubility in water and benzene, the relative lowering of vapour pressure of the solvent can be calculated. The freezing point and vapour pressure of water are more depressed by the meta-compound, whilst for benzene the ortho-compound has the greatest effect.
—P. V. M.

Benzol in gas. Thau. *See* IIA.

Catalytic preparation of aniline. Henke and Brown. *See* IV.

Patent.

Refining coal tar. U.S.P. 1,433,052. *See* IIA.

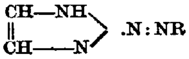
IV.—COLOURING MATTERS AND DYES.

Azobenzene and aniline; Catalytic preparation of ——. C. O. Henke and O. W. Brown. J. Phys. Chem., 1922, 26, 631—638. (*Cf.* J., 1922, 406 A.)

Thallium prepared by the reduction of thallic oxide at 260° C. is an excellent catalyst for the reduction of nitrobenzene to azobenzene; with a rate of flow of 4·1 g. of nitrobenzene per hr. and a 13% excess of hydrogen, a yield of 90·2% of azobenzene and 4·3% of aniline is obtained. The activity of the catalyst decreases very rapidly with use. Gold has a high catalytic activity for producing aniline which decreases with use. Using this metal as catalyst the yield of aniline at 355° C. is almost quantitative.—J. F. S.

Arylazoglyoxalines; Some ——. F. L. Pyman and L. B. Timmis. J. Soc. Dyers and Col., 1922, 38, 269—272.

The arylazoglyoxalines of the type



where R is an aryl group, formed by coupling glyoxaline with diazonium salts in alkaline solution, are produced in widely varying yield according to whether the diazonium compound contains an *ortho*-substituent or not. Thus the percentage of the theoretical yield of 2-benzeneazoglyoxaline is 74%, of 2-*p*-bromobenzeneazoglyoxaline 85%, of 2-*p*-tolueneazoglyoxaline 84%, of 2-*p*-ethoxybenzeneazoglyoxaline 64%, and of 2-*p*-sulphobenzeneazoglyoxaline 52%, as against 26% for 2-*o*-tolueneazoglyoxaline, and 10% for 2-*o*-methoxybenzeneazoglyoxaline. On reduction with stannous chloride the arylazoglyoxalines having *para* substituents in the benzene ring undergo fission with formation of 2-aminoglyoxaline, but here also very varying yields were obtained ranging from 15% only from 2-*p*-tolueneazoglyoxaline to 26% from the *p*-ethoxy-compound, 43% from the *p*-sulpho-compound, and 56% from the *p*-bromo-compound. The compounds not containing a *p*-substituent give 65—75% yields of diaminophenylglyoxalines on reduction with stannous chloride (benzidine transformation). These diamines cannot be tetrazotised, the glyoxaline amino group apparently not reacting normally. 2-Benzeneazoglyoxaline, 2-*p*-sulphobenzenazoglyoxaline, and 2-*p*-sulphobenzeneazoglyoxaline-4.5-dicarboxylic acid dye wool brownish-yellow shades, but the colour is not fast to sunlight or washing. After-chroming rendered the colour with the latter compound fairly fast. 2-*o*-Methoxybenzeneazoglyoxaline gives brighter yellow shades than the other azoglyoxalines.—G. F. M.

Colouring matter of the fruit of Gardenia florida, L. T. Munesada. Yakugakuzasshi (J. Pharm. Soc., Japan), 1922, No. 486, 666—671.

The colouring matter of the fruit of *Gardenia florida*, L., grown in China, was extracted with water according to Kayser's method (J., 1884, 628) and decomposed with dilute hydrochloric acid in a current of carbon dioxide. The product was an amorphous powder, identical with crocetin from saffron (Decker, Arch. Pharm., 1914, 252, 139). It gave a potassium salt, $C_{14}H_{13}O_4K$, orange-yellow crystals, which changed, without melting, to a dark red substance between 270° and 290° C. A sodium salt, short yellowish-red needles, and an ammonium salt, reddish-yellow needles, were also obtained.
—K. K.

Cyanine dyes. Braunholtz and Mills. *See* XXI.

PATENTS.

Thionaphthisatin; Manufacture of ——. O. Y. Imray. From Society of Chem. Ind. in Basle. E.P. 186,859, 1.12.21.

THIONAPHTHISATIN is obtained by the interaction oxalyl chloride and β-thionaphthol in presence or sence of a diluent or a condensing agent. It rms a red crystalline powder, m.p. 153° C., and is valuable dyestuff intermediate. *Example.* 0 pts. of β-thionaphthol is mixed with 635 pts. of alyl chloride, and after stirring for some hours the ordinary temperature the mixture is heated the boiling point. The excess of oxalyl chloride distilled off, and the β-thionaphthisatin ex-acted from the residue with aqueous sodium car-mate, and precipitated with hydrochloric acid. me of the oxalyl chloride may, if desired, be re-aced by carbon bisulphide, and aluminium loride or sulphuric acid may be added as ndensing agents.—G. F. M.

termediates for the production of colouring matters; Manufacture of new ——. [*Nitroso-oxyalkylarylamines, oxyalkylated thiosulphonic acids, etc.*] British Dyestuffs Corp., Ltd., A. G. Green, K. H. Saunders, and E. B. Adams. E.P. 186,878, 30.8.21.

HE oxyalkylamino compound previously described .P. 181,750; J., 1922, 625 A) may be used not ly for the preparation of the "sulphato" dye-uff intermediates, but also for the manufacture of itroso-derivatives by treating them with nitrous cid, and in the case of secondary amines trans-rming the nitrosamine with hydrochloric acid. hese nitroso-compounds are also valuable inter-ediates, as they can be condensed with hydroxy-mpounds to oxazines, or with another amino-mpound to give an intermediate indamine which an be converted into an azine in the usual way. urther, for the manufacture of thiazines the new itroso-derivatives of oxyalkylarylamines etc. an be reduced and treated with sodium thiosul-hate to yield oxyalkylated thiosulphonic acids.
—G. F. M.

Blue] *anthraquinone vat dyestuff; Manufacture of a* ——. E. Kopetschin. G.P. 357,767, 28.7.14. Addn. to 356,922 (J., 1922, 853 A).

-MERCAPTO-2-AMINOANTHRAQUINONE is treated with ondensing agents capable of reacting with the ercapto group, or it is heated to a high tempera-ure, or its salts are condensed with 1-chloro-2-minoanthraquinone, whereby hydrogen sulphide is volved and N-dihydro-1.2.2′.1′-anthraquinone-zine (Indanthrene) is produced.—A. J. H.

V.—FIBRES; TEXTILES; CELLULOSE; PAPER.

ellulose; Studies on ——. *III. Viscosity determination of cellulose* [*solutions*]. M. Nakano. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, 25, 899—910.

PECIAL precautions which must be taken in the reparation of cuprammonium solutions are given. he viscosity of cuprammonium solutions of cellu-ose decreases with time until it attains a constant alue. A dilute solution attains a constant value uicker than a concentrated one; the viscosity of a ery dilute solution is constant from the beginning. With solutions of the same concentration, the ower the viscosity the less is the difference between he final and the initial values. The viscosity in-reases much more quickly than the concentration. he relative viscosity increases with the temperature. No appreciable decrease of viscosity due to loss of ammonia can be observed. Oxygen and light have the greatest effect on the viscosity. The ammonium complex of copper has a strong oxidase-like action on cellulose. Depolymerisation of the molecular aggregate of cellulose is due to the light. Of various previous treatments to which the cellulose was subjected, the most important in its effect on the viscosity was thermal treatment.—K. K.

Cellulose; Reactions of —— *with sodium chloride and other neutral salt solutions.* I. H. Masters. Chem. Soc. Trans., 1922, 121, 2026—2034.

WHEN pure cellulose, in the form of cotton wool free from acidity or alkalinity, is extracted with sodium chloride solution, an acid extract is obtained, and an alkaline extract containing an equivalent amount of alkali when the cotton is subsequently extracted with water. The amount of acid extracted by a 20% sodium chloride solution was on the average the same as that extracted by a $N/10$ solution (3·9 mg. of HCl from 10 g. of cotton), the extract eventually becoming quite neutral, but the phenomenon cannot be attributed to the washing or salting out of acid originally present in the cellulose, as after washing with water until the washings were free from chloride and alkalinity, and again passing sodium chloride through the cellulose, an acid extract was once more obtained. Temperature had no effect on the amount of acid and alkali extracted, nor did the use of boiling water accelerate the removal of alkali from the cotton which had been previously extracted with sodium chloride solution. Other salt solutions behaved in a similar way, the least quantity of acid obtained being 1·2 mg. in the case of the very slightly dissociated cadmium iodide.—G. F. M.

Hydrocellulose. E. Heuser and W. von Neuenstein. Cellulosechem., 1922, 3, 89—96.

THE hydrocellulose prepared from viscose cellulose by the method of Knoevenagel and Busch (J., 1922, 458 A) behaves as a uniform substance. It is completely soluble in caustic alkali solution, and is precipitated again without loss. On repeated methylation it forms dimethylhydrocellulose in quantitative yield, which also behaves as a uniform substance, being completely soluble in cold water and in many organic solvents. On acetylation dimethylhydrocellulose yields a monoacetyl derivative which is also substantially homogeneous. Hence it is concluded that the hydrocellulose of Knoevenagel and Busch is the "true hydrocellulose" in a pure condition. In this sense it differs from ordinary crude hydrocellulose prepared from cotton by Girard's method, which behaves, both towards alkali and on methylation, as a mixture of true hydrocellulose and cellulose. According to recent theories (*cf.* J., 1922, 8 A, 170 A) fibrous cellulose consists of an aggregate of double anhydrocellobiose molecules arranged in crystal symmetry and held together by "crystal valencies." It is assumed that the crystal valencies may be resolved by any process which destroys the fibrous structure without affecting the dimeric anhydrocellobiose units from which the crystal fibre substance was built up. Thus viscose cellulose would consist entirely of such amorphous cellulose without crystal valencies and of relatively low molecular dimensions (4 C_6). As such it would be susceptible to hydrolytic attack as a uniform substance, and the authors suggest that the "true hydrocellulose" is produced from the double anhydrocellobiose molecule by simple opening up of an anhydride position in one of the cellobiose residues, with the formation of a free carbonyl group but without depolymerisation of the dimeric molecule. Further chemical hydrolysis would involve depolymerisation, but the true hydrocellulose is presumed to have the same molecular dimensions as the amorphous cellulose from which it is derived.—J. F. B.

PATENTS.

Cotton bales; Impregnated ——. H. Wade. From International Cotton Protecting Co. E.P. 187,394, 25.8.21.

COTTON bales are rendered permanently proof against fire and bacterial deterioration by impregnating them to a depth of ¾—5 ins. with an aqueous paste containing boric acid and a small quantity (0·25—1·50% of the total weight of the paste) of a non-colouring fixing agent such as a soluble salt of zinc, tin, aluminium, or other suitable metal. The behaviour of cotton in bleaching and dyeing is not affected by this treatment. A suitable paste contains, per 100 galls., 5⅓ lb. of boric acid (prepared by treating borax with sulphuric acid and afterwards washing the product so that it contains a trace but not more than 0·1% of mineral acid) and ½ lb. of a mixture of equal parts of zinc and stannous sulphates.—A. J. H.

Silk fibres; Process for treating [degumming] ——. S. A. Waksman. U.S.P. 1,432,312, 17.10.22. Appl., 3.2.21.

RAW silk is degummed by subjecting it to the action of strongly proteolytic bacteria.—A. J. H.

Cellulose-ether solvent and composition. R. L. Stinchfield, Assr. to Eastman Kodak Co. U.S.P. 1,432,364–5, 17.10.22. Appl., 19.3.21.

A VISCOUS composition for films is made by dissolving a cellulose alkyl ether in a mixture of 97—20 parts by weight of tetrachloroethane with 3—80 parts by weight of (A) a lower monohydroxy aliphatic alcohol, or (B) an ester of a lower monocarboxylic fatty acid and a lower monohydroxy aliphatic alcohol.—W. C.

Cellulose-ether solvent and composition. W. R. Webb, Assr. to Eastman Kodak Co. U.S.P. 1,432,373–4, 17.10.22. Appl., (A) 5.4.21, (B) 16.11.21.

A VISCOUS fluid composition suitable for films consists of (A) an alkyl ether of cellulose dissolved in a solvent containing 90—10 parts by weight of ethylene chlorobromide and 10—90 parts of a lower monohydroxy aliphatic alcohol; or (B) a water-insoluble ethylcellulose dissolved in a mixture of 10—90 parts of methyl acetate and 90—10 parts of methyl alcohol.—W. C.

Composite material formed with condensation products; Manufacture of ——. Metropolitan-Vickers Electrical Co., Ltd., Assees of H. C. P. Weber. E.P. 169,451, 22.9.21. Conv., 24.9.20.

CELLULOSIC material, such as paper, is parchmentised by treatment with caustic soda, sodium zincate, or other suitable substance, and is then impregnated successively or simultaneously, and before or after removal of the parchmentising agent, with a phenol and formaldehyde and subjected to heat and pressure, whereby a condensation product intimately incorporated with the fibres is obtained. Alternatively, the fibrous material is parchmentised and impregnated at the same time with a mixture containing the parchmentising substance, phenol, and formaldehyde. For example, paper is continuously passed through a parchmentising bath containing 20% caustic soda (10—15% of sodium chloride is added to prevent excessive shrinkage), then in succession through a bath containing phenol and a chamber containing formaldehyde vapour and between hot rollers under pressure. It is afterwards washed and dried.—A. J. H.

Rosin material for sizing. J. A. De Cew, Assr. to Process Engineers, Inc. U.S.P. 1,433,124, 24.10.22. Appl., 28.9.20.

A ROSIN having superior sizing properties is produced by dissolving rosin and a rubber product in a suitable solvent and afterwards removing the solvent by distillation.—A. J. H.

Paper; Process for recovery of material for manufacture of ——. S. Kumagae and T. Chiba. E.P. 187,805, 26.9.21.

SEE G.P. 356,742 of 1921; J., 1922, 855 A.

Spinning nozzles. E.P. 166,533. *See* VIII.

Ore concentrator tables. E.P. 187,296. *See* X.

Printers' ink. E.P. 187,537. *See* XIII.

Artificial leather. E.P. 171,360. *See* XV.

VI.—BLEACHING; DYEING; PRINTING; FINISHING.

Mordants. III. Chrome. W. D. Bancroft. J. Phys. Chem., 1922, **26**, 736—772.

THE author reviews critically a part of the literature, more especially the work of Liechti and Hummel (J., 1893, 241) concerned with the use of chromic oxide as a mordant in dyeing wool, cotton, and silk, and bases thereupon a number of conclusions as to the *modus operandi* of the process, the chief being that the mordanting is due to adsorption, there being no evidence of the formation of a definite compound. (*Cf.* J. Chem. Soc., Jan., 1923.)—J. S. G. T.

Mordanting of wool with potash alum. W. W. Paddon. J. Phys. Chem., 1922, **26**, 790—793.

EXPERIMENTS are described from which it is concluded that, contrary to the opinion of Knecht (Knecht, Rawson, and Lowenthal, "Manual of Dyeing," 1910, 237), the mordanting of wool with potash alum does not lead to the formation of definite chemical compounds on the fibre, but is strictly an adsorption phenomenon, in which both alumina and sulphuric acid are involved.
—J. S. G. T.

Hypochlorite solutions. Dienert and Wandenbulcke. *See* VII.

PATENTS.

Dyeing animal or mixed fibres; Process for ——. Akt.-Ges. f. Anilin-Fabrik. E.P. 171,981, 1.11.21. Conv., 26.11.20.

DYESTUFFS which are precipitated by acids and have therefore hitherto been considered unsuitable for dyeing animal fibres in acid baths, may be satisfactorily used for this purpose provided that sulphite-cellulose waste liquor or the active substances contained therein (sodium ligninsulphonate, cell pitch, sugars) are added to the dye liquor. This addition also allows the conjoint use of dyes belonging to different classes, *e.g.*, substantive and acid dyes, and moreover, the elasticity, gloss, and handle of the animal fibre are preserved during dyeing. For example, wool is dyed in a bath containing 3% of Alkali Blue 4B, 10% of sodium sulphate crystals, 5% of sulphite-cellulose waste liquor of 28° B. (sp. gr. 1·24), and 2% of concentrated sulphuric acid. A similar proportion of sulphite-cellulose waste liquor is also used in a metachrome process of dyeing.—A. J. H.

Yarns; Apparatus for the treatment of —— *with dyes or other liquids.* L. N. La Fayette. E.P. 182,758, 7.12.21. Conv., 2.7.21.

THE apparatus consists of a vat having a false bottom perforated with holes over which are mounted vertical telescopic perforated tubes. Bundles of yarn, wound on hollow compressible cores, are piled one above the other on these tubes and by means of a spring contained therein are subjected to suitable pressure. By means of a pump, dye or other liquid is forced from the vat, through the bundles of yarn, downwards through the perforated telescopic tubes and through the false bottom. Alternatively, the liquor is circulated in the opposite direction.—A. J. H.

Dyeing apparatus. J. D. Henon. U.S.P. 1,433,276, 24.10.22. Appl., 3.9.21.

A DYEING apparatus consists of a vat divided, by means of a partition, into two compartments in one of which is a means for circulating the dye liquor through the vat. A deflector or baffle, semi-oval in cross-section, is fixed to the inner faces of the walls of the vat and the partition for the purpose of deflecting the dye liquor out of the lines of flow of least resistance.—A. J. H.

Indigo fermentation vat; Manufacture of stable concentrated preparations suitable for the ——. Farbw. vorm. Meister, Lucius, und Brüning. G.P. (A) 356,411, 25.12.13, (B) 357,087, 14.1.14, and (C) 357,680, 15.2.14. Addns. to 354,946 (*cf.* E.P. 22,148 of 1914; J., 1915, 1245 A).

(A) IN preparations described in the chief patent, maltose or maltodextrins instead of other water-soluble carbohydrates, are mixed with albuminous substances; before concentration of the product, indigo or indigo-white or further quantities of water-soluble carbohydrates may be incorporated with it. (B) To the preparations described above and during or after their manufacture, invertase or yeast is added, since these substances improve the subsequent working of the vat and also invert sugars which are present. (C) In preparations as described above, invertase or materials containing invertase, such as yeast, sterilised yeast and the like, are incorporated with either or both of indigo or indigo-white and water-soluble carbohydrates or their related products. In this case the addition of albumin is not necessary.—A. J. H.

Textile materials; Apparatus for dyeing or bleaching ——. J. Gott and F. Wallis. E.P. 187,669, 12.7.21.

VII.—ACIDS; ALKALIS; SALTS; NON-METALLIC ELEMENTS.

Hydrocyanic acid; Preparation of —— *in large quantities in the laboratory.* E. Fritzmann. J. Russ. Phys.-Chem. Soc., 1920, 52, 227—234.

THE amounts of sulphuric acid and water with which potassium ferrocyanide is usually heated for the preparation of hydrocyanic acid are greater than is necessary and equally good yields of the acid are obtained with the same rapidity with 10 pts. of the ferrocyanide, 5 of sulphuric acid, and 8 pts. of water. The apparatus used for preparing, purifying, and condensing the acid is described.
—T. H. P.

Nitrogen, carbon and sodium carbonate; Reversibility of reaction between ——. C. K. Ingold and D. Wilson. Trans. Chem. Soc., 1922, 121, 2278—2286.

THE behaviour of the system nitrogen, carbon, and sodium carbonate can, for a wide range of temperature be represented by the equation,

$$x^2/(1-x)\times(1-p)^2/p=K^1,$$

where x is the proportion of combined sodium present in the liquid phase as sodium cyanide (*i.e.*, the yield of sodium cyanide reckoned as a fraction of the theoretical), and *p* is the partial pressure of the nitrogen calculated as a fraction of the total pressure of nitrogen and carbon monoxide, assumed to be constant at 1 atm., and K^1 is a derived constant ($K^1=K.p_{Na_2CO_3}.p^4_C/p^2_{NaCN}$). The heat of reaction and the latent heats of vaporisation of sodium carbonate, carbon, and sodium cyanide can be considered constant, hence $\log_e K^1$ is equal to $\alpha+\beta/T$, and, by combining this with the equation given above,

$$\log_{10}(x^2/(1-x)\times(1-p)^2/p\times\pi^2)=\alpha+\beta/T$$

where $\alpha=23{\cdot}91$, $\beta=-3118°$, π=the total pressure of nitrogen and carbon monoxide. This formula represents the behaviour of the system to a degree of approximation of 1% in x or p, equivalent to about 2° C. in T. The form of the function is shown by a diagram, where x is plotted against p for the temperatures 850°, 900°, and 950° C. A table of values of 100 x is given for temperatures from 850° to 950° C.—P. V. M.

Sodium chloride; Melting and freezing point of ——. J. B. Ferguson. J. Phys. Chem., 1922, 26, 626—630.

THE melting point of sodium chloride is 803·4° C. and the freezing point 803·1° C.—J. F. S.

Hypochlorite solutions; Determination of available chlorine in ——. F. Dienert and F. Wandenbulcke. Ann. Falsif., 1922, 15, 338—339.

ONE c.c. of the hypochlorite solution is diluted with 1 l. of water, 2 g. of ammonium sulphate (to prevent formation of iodate) and a few crystals of potassium iodide are added, and the liberated iodine is titrated with arsenious acid solution, using starch as indicator. The results obtained agree with those yielded by Penot's and Gay-Lussac's methods. Poncius' method, in which the hypochlorite solution is titrated directly with alkaline potassium iodide solution, tends to yield high results owing to the fact that the iodate first formed reacts comparatively slowly with the alkaline iodide solution added subsequently.—W. P. S.

Magnesium perchlorate; Preparation and properties of —— *and its use as a drying agent.* H. H. Willard and G. F. Smith. J. Amer. Chem. Soc., 1922, 44, 2255—2259.

THE hexahydrate of magnesium perchlorate may be prepared by dissolving magnesia in perchloric acid, and evaporating the solution until fumes of perchloric acid are evolved and crystallisation commences at the surface. The solution is then cooled to ordinary temperature with the addition of sufficient water to keep the mass semi-fluid. The crystals are separated by centrifuging, redissolved in water, and crystallised. The hexahydrate melts at 145°—147° C., has sp. gr. 1·970 at 25° C., and is non-deliquescent. The trihydrate is prepared by keeping the hexahydrate over phosphoric oxide at 20°—25° C. for a month. The product has sp. gr. 2·044 at 25° C., and the same melting point as the hexahydrate. The anhydrous compound is obtained by heating either the trihydrate or the hexahydrate at 170° C., in a current of air for some time and then at 250° C. for a short time. Magnesium perchlorate decomposes at 400° C., without melting, forming a mixture of the oxide and chloride. When moist gas is passed over anhydrous magnesium perchlorate the moisture is removed as efficiently as by phosphorus pentoxide.
—J. F. S.

Hydrous oxides. IV. Hydrous stannic oxide. H. B. Weiser. J. Phys. Chem., 1922, 26, 654-686.

THE so-called stannic and metastannic acids are not acids but hydrated oxides of compositions which vary with the method of formation. There are no definite hydrates of stannic oxide and oxysalts, complex stannates, and metastannates are not definite compounds, but adsorption products, the composition of which is determined by the age of the oxide and the concentration of acid or alkali used in the preparation. Hydrated stannic oxide adsorbs colloidal gold, silver, and platinum, forming purple masses, the most common of which is purple of Cassius. These masses are colloidal in character and of varying composition. A mixture of the hydrated oxides of iron and tin in suitable proportions is soluble in dilute solutions of ammonia, the reason being, that hydrated stannic oxide is peptised by ammonia and the colloidal stannic oxide adsorbs ferric oxide. Stannic oxide does not precipitate in the usual way from a solution of tin in nitric acid which contains a suitable amount of iron. This is due to the fact that ferric nitrate peptises hydrated stannic oxide when the latter is either freshly precipitated or when it is aged. Stannic oxide jellies may be prepared by coagulating colloidal solutions of hydrated stannic oxide with small quantities of barium, strontium, calcium, and sodium chlorides or hydrochloric acid. —J. F. S.

Stannous oxide and stannous hydroxides; Preparation and reactions of ——. F. W. Bury and J. R. Partington. Trans. Chem. Soc., 1922, **121**, 1998—2004.

SIX specimens of stannous hydroxide (hydrated stannous oxide) were prepared from stannous chloride by the methods of previous investigators. Analysis showed the six samples to be essentially the same and support the formula, $3SnO,2H_2O$. No sample was entirely free from chlorine, although in most cases the amount was exceedingly small. Stannous hydroxide is stable up to 110° C.; it does not lose the whole of the water at 160° C., some of the water being probably constitutional; on standing under water it is slowly converted into stannous oxide. Several modifications of stannous oxide, differing in appearance, colour, and density have been described by Ditte (Ann. Chim. Phys., 1882, **27**, 145) and others, but the authors have found it impossible to confirm their statements in most cases.—J. B. F.

Nickel and cobalt hydroxides; Preparation of colloidal solutions of —— and some other compounds of these metals. O. F. Tower and M. C. Cooke. J. Phys. Chem., 1922, **26**, 728—735.

Two methods are described for preparing colloidal suspensions of nickel hydroxide, one by dialysing nickel tartrate in presence of an alkaline solution of potassium tartrate, and the other by precipitating and washing nickel hydroxide under special conditions. Only very weak suspensions of cobaltous hydroxide could be obtained by these methods. The characteristics of these colloidal suspensions are discussed. Colloidal solutions of nickel sulphide are readily formed in presence of an alkaline tartrate solution. (*Cf.* J. Chem. Soc., Jan., 1923.)—J. S. G. T.

Isomerism of metallic oxides. Part I. Lead monoxide. M. P. Applebey and R. D. Reid. Trans. Chem. Soc., 1922, **121**, 2129—2136.

IF pure lead hydroxide is dissolved in strong potassium hydroxide solution at a temperature near the boiling point, then on slowly cooling, the oxide is deposited in a well crystallised form. High alkali concentrations give rise to the red variety, moderate concentrations the yellow, and low concentrations yield a black or steel-grey variety of similar form to the yellow oxide. The red form crystallises in square plates, whereas the yellow gives needle-like rhombic crystals. The densities of the red and yellow varieties are 9·27 and 8·7 respectively. The solubilities of the two forms in *N*/1 sodium hydroxide were determined both gravimetrically and electrometrically; at 20° C., the solubility of the yellow form is about 1·8 times that of the red form. Evidence from solubility and from examination of crystalline structure shows that the yellow and red forms are polymorphic modifications. It is shown that the standard alkali electrode Hg/HgO in *N*/1 NaOH is easily reproduced and constant over long periods.—J. B. F.

Thorium oxide; Reduction of —— by metallic tungsten. Research Staff of the General Electric Co., Ltd., London (C. J. Smithells). Trans. Chem. Soc., 1922, **121**, 2236—2238.

WHEN a filament containing thoria is heated in a gas-filled lamp to a temperature of about 2700° K. the thoria is reduced to metallic thorium by the tungsten. As the heating is continued the thoria is converted into a grey, metallic, crystalline mass. These grey crystals are very stable towards acids and alkalis. On grinding the material and removing the unchanged thoria, the residue was not homogeneous, but contained transparent crystals varying in colour from yellow to blue, in addition to the grey metallic crystals. This mixture was not attacked by hydrofluoric and nitric acids, and on analysis gave Th=57% and W=26%. There is considerable evidence that the grey material is a thorium-tungsten bronze possibly of the form $Th(WO_3)_n$ where n may have a value from about 3 to 10. The coloured crystals are probably thoria containing small amounts of tungsten oxides in solution.—J. B. F.

Silica; Determination of —— in filtered sea water. R. C. Wells. J. Amer. Chem. Soc., 1922, **44**, 2187—2193.

THE most effective method of determining small quantities of dissolved silica in water consists in adding an aluminium salt, if such is not already present, and precipitating by ammonia in such quantity that the solution will give a pink colour with rosolic acid. The silica in the aluminium hydroxide precipitate is then estimated in the usual way. Silica cannot be estimated by the loss on evaporation with hydrofluoric acid in the presence of calcium sulphate. In rock analysis a single evaporation with hydrochloric acid is sufficient, provided silica is also determined in the ammonia precipitate. (*Cf.* J.C.S., Dec.)—J. F. S.

Silicates of strontium and barium. P. Eskola. Amer. J. Sci., 1922, **4**, 331—375.

THE attempt was made to explore the systems $SrO-SiO_2$, $BaO-SiO_2$, and to synthesise strontium and barium compounds analogous to diopside and anorthite by quenching mixtures of the oxides from various temperatures and studying the crystallographic and physical properties of the separated phases. In the $SrO-SiO_2$ system, the compounds formed are SrO; $2SrO,SiO_2$ (m.p. above range of electric furnace); SrO,SiO_2 (m.p. 1578°); and SiO_2. The eutectics $2SrO,SiO_2-SrO,SiO_2$ and SrO,SiO_2-SiO_2 melt at 1545° and 1358° respectively. In the similar barium system the main points are BaO, $2BaO,SiO_2$, eutectic $2BaO,SiO_2-BaO,SiO_2$ at 1557°, BaO,SiO_2 (m.p. 1604°), eutectic $BaO,SiO_2-2BaO,3SiO_2$ at 1437°, $2BaO,3SiO_2$ (m.p. 1450°), eutectic $2BaO,3SiO_2-BaO,2SiO_2$ none, the two forming a complete series of solid solutions, $BaO,2SiO_2$ (m.p. 1420°), eutectic $BaO,2SiO_2$-tridymite at 1374°, SiO_2. The dibarium trisilicate and the barium disilicate had a melting point diagram of Bakhuis Roozeboom's type I. without maximum or minimum, were isomorphous and of orthorhombic symmetry, and their refractive indices showed a continuous but not linear variation with composition. Attempts in both series to produce different modifications, *e.g.*, of SrO,SiO_2, which was isomorphous with and optically very similar to α-CaO,SiO_2, failed although both heating at varying temperatures for different lengths of time and crystallising from the corresponding vanadate were tried. The strontium and calcium metasilicates formed a continuous series of solid solutions, with a minimum at 1474°±3, corresponding to 44% CaO,SiO_2, 56% SrO,SiO_2. The crystals were pseudo-hexagonal and really monoclinic. The refractive indices showed a continuous variation with composition. Barium metasilicate, on the other hand, did not mix at all with calcium metasilicate, but gave a compound $2CaO,BaO,3SiO_2$ having no true melting point and breaking up on heating to α-CaO,SiO_2 and liquid. This compound was optically unlike all the other metasilicates. Points on the curve were the invariant point $CaO,SiO_2-2CaO,BaO,3SiO_2-$melt at 52% BaO,SiO_2 (1320°±4), and eutectic

$$2CaO,BaO,3SiO_2-BaO,SiO_2$$

at 73% BaO,SiO_2 (1267°), the liquidus of BaO,SiO_2 having a steep course toward the high melting point of BaO,SiO_2. Neither the strontium nor barium metasilicates gave with magnesium metasilicates compounds analogous to diopside, $CaO,MgO,2SiO_2$. This was regarded as a special case of the more general rule that in compounds in which the calcium is replaceable by magnesium or ferrous iron, it cannot be replaced by strontium or barium, while the isomorphous series including the latter may have isomorphous and miscible analogues among the sodium, potassium, or lead compounds. Both strontium and barium metasilicates with aluminium silicate gave felspars with very high melting points (much above 1700° C.). The crystals obtained were from melts at 1400° with three times the amount of the corresponding vanadate. The artificial strontium felspar was exactly like the calcium compound, anorthite, in optical properties, but the crystals were too poor to admit of investigation. The barium compound in optical properties resembled the natural celsian, no evidence being found of the existence of a nephelite analogue described by Ginsberg (Ann. Inst. Polyt. Pierre le Grand à Pétrograde, 1915, 23).—A. C.

Copper sulphate; Technical preparation of ——. T. Matsuno. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, **25**, 926—930.

Copper sulphate was prepared on a large scale from roasted cement copper containing: soluble copper (expressed as CuO) 59·06, insoluble copper (Cu_2O) 2·58, soluble iron (FeO) 11·05, insoluble iron (Fe_2O_3) 3·40, silicic acid 2·41, and oxygen etc. 21·50%. About 100 cub. ft. of warm water is poured into a dissolving tank (about 200 cub. ft. capacity), 8 lb. of sulphuric acid of 50° B. (sp. gr. 1·53) is added, and after agitation for 10 min., the calculated quantity of copper is introduced, the temperature of the bath being maintained at 60°—80° C. After 10 min., further quantities of the acid and copper are added, and the process is repeated until about 1500 kg. of copper has been added. The solution is then transferred to an evaporating bath by means of siphons and concentrated to 34·5° B. (sp. gr. 1·314), then transferred to a crystallising tank, in which many lead plates are suspended for supporting the crystals. The crystallisation is completed in about 1 week. The product is collected, crushed, washed with water and dried at about 50° C., the yield being about 1 ton. The extraction of copper is more than 92%, and the product contains only 0·05% Fe and no other impurities.—K. K.

Thiosulphate of bismuth and sodium; Double ——, *its preparation and use in estimations of potassium salts.* V. Cuisinier. Bull. Soc. Chim., 1922, **31**, 1064—1068.

Methods of preparation of this reagent as given by other authors are criticised and the following procedure recommended: Bismuth chloride solution is prepared by dissolving 10 g. of bismuth subnitrate in 10 c.c. of pure hydrochloric acid under the influence of heat. On cooling, the volume is made up to 100 c.c. with 95% alcohol and sufficient additional hydrochloric acid to maintain the clearness of the solution. To this is added an equal volume of sodium thiosulphate solution made by dissolving 20 g. of the crystalline salt in distilled water and making up to 100 c.c. After mixing, five times the volume of 95% alcohol is added and if the whole does not remain clear, any opacity is removed by the addition of hydrochloric acid, drop by drop, and shaking. After standing for 15 min. a crystalline precipitate of sodium bismuth thiosulphate is formed, which is washed with alcohol and dried in a vacuum over sulphuric acid. On exposure to air the crystals rapidly turn brown. In using this substance for estimations of potassium, the author finds that the results obtained are invariably too high and that the weight of the precipitate depends on the concentration of the reacting solutions. The iodine value of the precipitate is not proportional to the potassium in the solution under examination and the results appear to vary with the volume of alcohol used as precipitating agent.—H. J. E.

Calcium hydroxide; Colloidal ——. M. von Glasenapp. Kolloid-Zeits., 1922, **31**, 195—196.

Two varieties of colloidal calcium hydroxide have been obtained from a marly dolomite of the composition, CaO 22·75%, MgO, 15·50%, Al_2O_3 7·68%, Fe_2O_3 1·87%, SiO_2 15·27%, CO_2 34·83%, H_2O 1·81%. The dolomite was burnt at 720°—780° C. until the magnesium carbonate was entirely decomposed and the calcium carbonate half decomposed. After the burnt product had been kept for 12 hrs. in water the two colloidal varieties of calcium hydroxide were microscopically visible. The primary product separates first from solution as small drops which grow speedily and pass into the secondary product, which forms agglomerates of drops having the appearance of a network of cells. Both colloids are optically isotropic but strongly refracting; in reflected light the primary colloid is light blue and the secondary colloid bright orange in colour. The secondary colloid does not maintain the colloidal state very long but passes into crystalline calcium hydroxide.—J. F. S.

Fuller's earth; Adsorption and catalysis in ——. E. K. Rideal and W. Thomas. Trans. Chem. Soc., 1922, **121**, 2119—2123.

The specific surface, adsorption, and catalytic activities of three typical varieties of fuller's earth (Florida, Surrey, and Somerset) are widely different. Adsorption of Methylene Blue in aqueous solution is proportional to the specific surfaces of the three varieties. The catalytic decomposition of hydrogen peroxide is not dependent on the adsorptive power, but is probably determined by the iron content.—J. B. F.

Hydrogen peroxide; Catalysis of —— *by ferric salts.* J. Duclaux. Bull. Soc. Chim., 1922, **31**, 961—966.

The author has investigated the velocity of the reaction between hydrogen peroxide and ferric chloride in presence of hydrochloric acid at 25° C., measuring the undecomposed peroxide with permanganate. His experimental results confirm those of Bohnson (J. Phys. Chem., 1921, **15**, 18) and von Bertalan (J., 1920, 656 A). In addition, he finds that the hydrogen ion concentration must be sufficient to eliminate hydrolysis of the ferric salt, otherwise inconsistent results are obtained. The theoretical side of the reaction is discussed (*cf.* J.C.S., Jan., 1923) and the general conclusion drawn that the action takes place between ferric ions and the HO_2 ions derived from the peroxide which behaves as a weak acid.—H. J. E.

Diffusion of hydrogen and helium through glasses. Williams and Ferguson. *See* VIII.

Alkali carbonate and hydroxide. Bonnier. *See* XXIII.

Estimation of sulphates etc. Jellinek and Ens. *See* XXIII.

Boric acid. Deerns. *See* XXIII.

PATENTS.

Sulphuric acid; Process for the production of ——. T. Schmiedel and H. Klencke. E.P. 187,016, 12.7.21. Addn. to 149,648 (J., 1921, 693 A).

THE process described in the previous patent is modified by supplying the plant with nitrosylsulphuric acid of above 58° B. (sp. gr. 1·67), which may be maintained at an elevated temperature (about 50°—90° C.) if desired. The middle part of the plant may be sprayed with a solution of nitrosylsulphuric acid of lower strength than that used in the fore and rear parts of the plant, but above 54° B. (sp. gr. 1·598). Preferably the first units of the plant are supplied with nitrosylsulphuric acid of above 54° B., and in the following unit the nitrosylsulphuric acid is diluted with water to such extent (to below 50° B., *i.e.* sp. gr. 1·53) that its solvent power for nitrogen oxides is diminished, whereby large volumes of nitrous gases are suddenly evolved into the gas mixture and rapidly oxidise the remaining sulphur dioxide. The gas mixture is finally led through a chamber supplied with acid of above 54° B. for the absorption of the nitrogen compounds.—H. R. D.

Nitric acid; Process for recovering nitrous vapours in the form of aqueous ——. P. A. Guye, Assr. to L'Azote Français, Soc. Anon. U.S.P. 1,433,004, 24.10.22. Appl., 6.10.20.

FIBROUS material resistant to nitric acid is impregnated with water, and brought into contact with nitrous vapours diluted with an excess of nitrogen and oxygen.—H. R. D.

Magnesia; Manufacture of —— *from dolomite.* C. Clerc and A. Nihoul. E.P. 173,502, 20.12.21. Conv., 24.12.20.

DOLOMITE is calcined at such a high temperature (1000°—1200° C.) that the resulting magnesia can be hydrated only with difficulty whilst the lime is easily hydrated. The product is slaked with a quantity of water equal to about 20% of the lime present, sifted, and added gradually to, and mixed with, a solution containing magnesium chloride in excess, whereby the lime is converted into calcium chloride, and partially hydrated magnesia is obtained in a granular form which can be rapidly filtered and washed. The solution of magnesium chloride is made from the waste liquor of the ammonia-soda process by conversion of the calcium chloride in the liquor into magnesium chloride by reaction with the mixture of lime and magnesia in the presence of carbon dioxide.—H. R. D.

Sulphate of ammonia; Manufacture of [neutral] ——. W. C. Holmes and Co., Ltd., W. G. Adam, and C. Cooper. E.P. 187,035, 16.7.21.

AN improvement of the process described in E.P. 108,098 (J., 1917, 1007) consisting in mechanically conveying the crude damp and acid salt through a chamber through which is passed in the reverse direction a current of ammonia gas and heated air to effect the simultaneous neutralisation and drying of the salt. The apparatus comprises an inclined chamber of rectangular cross-section in which are located twin spiral conveyors partially overlapping, which convey the salt from the lower to the upper end of the chamber. The air is heated by passing it through a jacket surrounding the chamber and is then passed together with ammonia gas through the chamber.—H. R. D.

Ammonium sulphate; Continuous drying of pulverulent or granular materials, applicable to the manufacture of neutral ——. J. Marr, and The Coke Oven Construction Co., Ltd. E.P. 187,320, 16.7.21 and 26.4.22.

THE material is led continuously by pneumatic action and mechanical means through a rotary dryer, and exposed therein to a current of hot gases. The material is introduced into the feed conduit and conveyed to and from the dryer solely by pneumatic action, but in the dryer it is conveyed solely by mechanical means, for example by means of shelves. In the treatment of ammonium sulphate, the temperature of the gases should be such that the salt is not heated above 80° C. and ammonia is introduced into the feed conduit to neutralise any free acid and liberate any pyridine present.—H. R. D.

Potassium chloride; Method of recovering —— *from brine.* J. L. Silsbee. U.S.P. 1,432,796, 24.10.22. Appl., 12.4.20. Renewed 22.3.22.

A MIXTURE of salts containing chlorides of potassium and magnesium, separated from brine, is washed at approximately ordinary temperature with a solution of potassium chloride, whereby magnesium chloride is dissolved and part of the dissolved potassium chloride is separated. The washed material is separated, and the potassium chloride dissolved to form a hot saturated solution, which on cooling will deposit potassium chloride without precipitation of sodium chloride. The hot solution is separated from undissolved solids, cooled, and the potassium chloride which separates is removed from the mother liquor. —H. R. D.

Saltpetre manufacture; Process for ——. T. C. Meadows, M. Hauber, jun., and H. W. Charlton. U.S.P. 1,433,290, 24.10.22. Appl., 28.8.20.

GREENSAND, lime, caustic alkali, and sodium nitrate are digested at elevated temperatures and under superatmospheric pressure.—H. R. D.

Hydrogen; Process and apparatus for purifying ——. Deutsche Glühfadenfabrik R. Kurtz und P. Schwarzkopf G.m.b.H., Assees. of P. Schwarzkopf. E.P. 166,541, 13.7.21. Conv., 13.7.20.

HYDROGEN freed as far as possible from carbon monoxide and dioxide, oxygen, sulphur, and arsenic and phosphorus compounds by suitable successive treatments, is conducted over finely divided molybdenum or other similar metal of high melting point heated to incandescence (*e.g.*, 800°—850° C. for molybdenum powder), whereby the remaining impurities are removed. The gas after passing through the furnace is led by means of pipes over caustic soda to free it from any carbon dioxide formed, and is then dried. When the molybdenum becomes exhausted of its efficiency, it may be revivified by oxidation, dissolving, precipitation, and reduction.—H. R. D.

Nitrogen-carbonic acid mixture; Process and aparatus for the manufacture of pure —— *from combustion gases.* G. Scheib and M. Koch. E.P. 172,958, 13.12.21. Conv., 14.12.20.

COMBUSTION gases are passed over a contact substance consisting of a metal and its oxide, *e.g.*, copper and copper protoxide. A relatively large quantity of contact material is used and is kept in active condition by reducing the oxide formed by oxidation of the metal by means of reducing gases generated by passing an auxiliary current of combustion gases, separated from the main

current, over charcoal, benzol, petroleum, or the like, and then mixing this auxiliary current with the main current of combustion gases prior to entering the contact chamber. The apparatus comprises a furnace for generating the combustion gases, two conduits for the main current and auxiliary current of combustion gases, respectively, and a common channel into which these two conduits open and which leads to the tower containing the contact material. The conduit for the auxiliary current of combustion gases contains a support for the charcoal or the like used to generate reducing gases, and is connected with the combustion chamber by means of an adjustable flap. The process may be controlled automatically by regulating the supply of air for combustion according to the percentage of carbon dioxide in the combustion gases or by adjusting the position of the flap mentioned above according to the percentage of oxygen in a sample of gas taken from the middle of the mass of contact material.
—H. R. D.

Graphite; Purification of ——. M. Langheinrich. E.P. 187,080, 20.8.21.

Natural graphite is mixed with coal and heated by an electric current to a temperature of 2200° C. or higher, whereby the impurities (silica, alumina, pyrites, etc.) are reduced and sublimed. The volatilised impurities may be collected separately at different temperatures. The purified graphite retains its original flaky structure.—H. R. D.

Delivering measured quantities of acids. E.P. 172,011. *See* I.

VIII.—GLASS; CERAMICS.

Silica glass and other glasses; Diffusion of hydrogen and helium through ——. G. A. Williams and J. B. Ferguson. J. Amer. Chem. Soc., 1922, 44, 2160—2167.

Silica glass is permeable to hydrogen at high temperatures and pressures. The permeability is proportional to the gas pressure and is an exponential function of the temperature. It becomes appreciable at 300° C. Silica glass is similarly permeable to helium and the permeability is easily measured at 182° C. At 500° C. the permeability for helium is 22 times that for hydrogen. Neither pyrex glass nor Jena combustion tubing are permeable for hydrogen, but apparently hydrogen reacts with pyrex glass causing blackening. At 610° C. pyrex glass is permeable for helium.
—J. F. S.

Clays; Studies on ——. *I. Their chemical composition.* O. Boudouard and J. Lefranc. Bull. Soc. Chim., 1922, 31, 976—982.

A general discussion of the composition of clays taken from various sources. Analyses are quoted; the proportion of alkalis varies considerably in different samples of kaolin, and one specimen of halloysite is notable for its high calcium content. A stoichiometrical representation of the analytical results is given as a basis for comparison with the theoretical values for kaolin.—H. J. E.

Terracotta body; Effect of some fluxes on the absorption and transverse strength of a ——. E. C. Hill. J. Amer. Ceram. Soc., 1922, 5, 832—834.

A table is given of average results of shrinkage, absorption, and transverse strength tests on terracotta bodies of 2 clay: 1 porous grog, to which were added various amounts of fluxing materials, viz., felspar, Albany slip, powdered glass, white lead, cryolite, whiting and fluorspar, magnesium carbonate, and furnace slags. Insoluble materials, with considerable alkali content, such as felspars, powdered glass, and cryolite, appear to be the best fluxes. Depending on local economic conditions, most of the above fluxes, if free from discolouring impurities, can advantageously be used in place of vitrified grog.—J. B. P.

Enamelling of cast iron; Effect of sources of pig-iron on ——. M. E. Manson. J. Amer. Ceram. Soc., 1922, 5, 806—810.

An analytical investigation of enamelled cast iron made from two different sources of pig-iron showed that although blistering occurred continuously in one pig-iron, the only difference in the two irons was in combined carbon content. The silicon content of the unsatisfactory iron was then artificially reduced from 2·8% to 2·3%, and a metal with about 0·3% of combined carbon resulted, on which fairly successful enamelling was done. Whenever blistering occurred the combined carbon was found to have dropped to below 0·15%. However, from photomicrographs of blistered specimens, the direct effect of combined carbon on enamelling is doubted. These specimens showed characteristic dark blotches, which proved to be entirely surface phenomena. Tests did not show that enamelling lowered the initial combined carbon content, nor was evidence discovered that the blotches of the micrographs were developed during enamelling.
—J. B. P.

Heat-resisting alloys for enamel burning racks; Relative merits of ——. E. P. Poste. J. Amer. Ceram. Soc., 1922, 5, 811—816.

The results of oxidation and warpage tests, carried out at 1700°—1800° F. (about 910°—970° C.), on samples of the same size of basic open-hearth steel, cast steel, cast iron, calorised steel, "thermalloy," "misco," "nichrome," "rezistal," nickel, monel-metal, "calite," and "hardite," are given in comparative tables and graphs. Steels and cast iron are worst as regards warpage, while towards heat (*i.e.*, oxidation) "thermalloy" and "misco" showed fair, and the steels and cast irons poor, resistance.—J. B. P.

Silicates of barium and strontium. Eskola. *See* VII.

Patents.

Glass furnaces and the like; Recuperator for ——. W. McLaughlin, Assr. to C. E. Norton. U.S.P. 1,432,706, 17.10.22. Appl., 20.4.20.

The melting tank is provided with gas outlet flues along its walls, terminating in horizontal flues which converge into a chimney. Air inlet passages extending through the horizontal flues are spaced from the flue walls and are provided with burners near their inner ends. The inlet passages and the outlet flues are disposed in the same horizontal plane.—H. H.

Spinning nozzles from ceramic materials; Manufacture of ——. A. Kämpf, Assee. of G. Neumann. E.P. 166,533, 12.7.21. Conv., 12.7.20.

Fine metal wires of the thickness of the nozzle-openings are set parallel, in a mud of suitable ceramic material produced by the electro-osmotic process, in a cylindrical mould. The ceramic core is then dried, burnt (the process of hardening being regulated), and cut into discs of the desired thickness, the wires being removed by usual chemical methods.—J. B. P.

Waterproofing tile and the like. J. T. Pokorny, Assr. to A. T. Eddingston. U.S.P. 1,432,120, 17.10.22. Appl., 18.9.20.

Tiles are burnt in a high-domed furnace, into which coal-tar is then poured through hoppers which can be closed. Moisture is thus excluded, and the vaporised tar products are deposited on and absorbed by the tile.—J. B. P.

Molten glass; Method of and means for producing charges of ——. C. R. Lott. E.P. 187,661, 23.6.21.

Glass blowing; Method of and means for ——. V. Lorentz. E.P. 187,839, 21.10.21.

Glass making machines [*for producing pressed cups, etc.*]. E. A. Hailwood. E.P. 188,102, 20.8.21.

IX.—BUILDING MATERIALS.

Dolomite; Caustic calcination of —— *and its use in Sorel cements.* G. A. Bole and J. B. Shaw. J. Amer. Ceram. Soc., 1922, 5, 817—822.

In order to prevent the decomposition of calcium carbonate to the free lime so detrimental to an oxychloride cement, dolomites were calcined in special retorts having wrought iron or fireclay bodies, with a gas-tight chamber so constructed that the pressure of carbon dioxide inside the furnace could be kept constantly at 1 atm. With this furnace the material could be satisfactorily calcined at 700°—800° C., despite the fact (*cf.* Johnston, J., 1910, 1054) that calcium carbonate dissociates, under ordinary pressure, below 650° C. Data from tests showed that better cement is given and that calcination is generally quicker if burning can be done at 725°—750° C. Tests on floors and stuccos made from this calcined material showed satisfactory strength and good weathering resistance. There appeared to be no overburning, and only ores containing more than 4% of silica gave inferior cement.—J. B. P.

Patent.

Heat insulator. H. Mock. U.S.P. 1,433,088, 24.10.22. Appl., 23.5.21.

Insulating bricks are made with a core of powdered sulphur and an outer coating of asphalt or vulcanisable material.—J. B. P.

X.—METALS; METALLURGY, INCLUDING ELECTRO-METALLURGY.

Aluminium; Treatment of —— *before nickel-plating.* E. Tassilly. Bull. Soc. Chim., 1922, 31, 973—976.

The methods recommended for preparing the surface of aluminium for nickel-plating (Mazuir, J., 1921, 13 A; Canac and Tassilly, J., 1914, 142; Tassilly, J., 1914, 697) include immersion in a bath of aqueous hydrochloric acid to which a small amount of iron or manganese has been added. The author has investigated the part played by the metal in the solution, also the relative advantages of iron and manganese, and finds that in the case of aluminium containing iron as impurity no such addition to the acid is necessary. In the case of aluminium which is practically pure, the effect of pure hydrochloric acid is so slight that some such addition is necessary to obtain the effect required in the acid bath. In default of an analysis of the metal to be plated, the addition is advisable in order to obtain a suitable surface, though possibly unnecessary. As the action is, in its results, of a mechanical nature, there is no advantage obtained by substituting manganese for iron.—H. J. E.

Aluminium-arsenic; The system ——. Q. A. Mansuri. Trans. Chem. Soc., 1922, 121, 2272—2277.

Aluminium combines with arsenic at about 750° C., under low pressures, to form the compound, Al,As,. Yellow arsenic is first formed and then reacts with the aluminium. The compound is a brown amorphous powder and does not melt at temperatures up to 1600° C. It is stable at high temperatures but begins to decompose at lower temperatures, yellow arsenic being first formed. When exposed to moisture it is highly reactive, evolving arsine freely. On heating in air it is oxidised to alumina and arsenious oxide. The solid compound does not appear to dissolve in molten aluminium, but separates out almost completely at its freezing point. It forms a strong and hard envelope round the aluminium. Attempts were made to prepare alloys of higher arsenic content, but without success. The brown compound did not form a eutectic with arsenic nor was a compound containing a higher proportion of arsenic obtained; the excess of arsenic separated out again as free arsenic. —J. B. F.

Tungsten alloys; Analysis of high-percentage ——. K. Seel. Z. angew. Chem., 1922, 35, 643—644.

The serious loss of platinum involved in the customary fusions of tungsten alloys with sodium and potassium carbonates and nitrates in platinum crucibles may be avoided by fusing the finely divided alloy with sodium hydroxide and nitrate in silver crucibles. The fusion takes about 1 hr. and the crucibles are not seriously attacked. 0·5 g. of the finely divided alloy is fused with 6 g. of sodium hydroxide and 3 g. of sodium nitrate. The melt is dissolved in water and filtered, the iron oxide remaining on the filter being dissolved in hydrochloric acid containing a little potassium chlorate, filtered, and the two filtrates united. The iron is determined as Fe_2O_3 as usual. The aluminium and the greater part of the silica are removed from the filtrate with ammonia, filtered off, and the tungsten in the filtrate precipitated with mercurous nitrate after acidifying, boiling off the carbon dioxide, and concentrating to about 150 c.c. The tungstic acid obtained by ignition of the precipitate is strongly contaminated with alkali, which is removed by repeated extractions with 7% hydrochloric acid, and traces of silica are finally removed by treatment with hydrofluoric acid. In the case of alloys rich in iron, a residue containing iron and tungsten remains after the original fusion. This is fused with pyrosulphate and the tungsten precipitated with nitric acid, determined as tungstic acid, and added to the figure obtained above. The iron in the filtrate is determined in the usual way and added to the figure obtained above.—H. C. R.

Lead; Determination of —— *in lead amalgam.* M. G. Mellon. J. Amer. Chem. Soc., 1922, 44, 2167—2174.

Quantities of lead amounting to 0·4 g. in 30—50 g. of mercury may be rapidly determined with an accuracy of 0·05% as follows: the sample of amalgam is covered with water containing one drop of 10% acetic acid, treated with 10 c.c. of 2*N* copper nitrate, and stirred continuously for 30 mins. The solution is filtered from metallic copper, which has not dissolved in the mercury, acidified with one drop of 10% acetic acid, and the lead precipitated as chromate by the usual method.—J. F. S.

Metals; Properties of cold-worked ——. Z. Jeffries and R. S. Archer. Chem. and Met. Eng., 1922, 27, 882—889.

While the general effects of cold working are an increase in hardness and loss of plasticity, other specific properties are affected in somewhat different ways, the yield point being affected probably more than any other property belonging to the hardness group. The effects of cold working are directional in the sense that the mechanical properties are influenced to a greater extent in the direction of working. Important changes may take place on the surfaces of slip during and after deformation. Immediately after slip commences, the slip plane strength, *i.e.*, the resistance to motion along the slip, is less than the strength of the crystals along parallel planes, but as the slip continues a reversal of these conditions occurs, otherwise fracture would occur quickly. Retardation of the original slip takes place partly by the interference of adjacent grains and partly by the resistance on the slip plane itself, leaving in a worked metal slip planes in all stages of deformation. Slip causes rupture of the atomic bonds on the slip plane, and after motion has ceased a partial re-establishment of cohesion obtains by fragments of the ruptured crystals joining into larger crystalline units which is attended with varying degrees of disorganisation owing to differing orientation. This disorganised metal simulates amorphous metal in its mechanical properties. Atomic rearrangement on slip planes takes place at much lower temperatures than are usually associated with recrystallisation as is exemplified by the spontaneous ageing of iron at atmospheric temperature. The excess of slip plane strength over crystal strength at low temperatures is the fundamental cause of the general increase in elongation with decrease in temperature. Since strain-hardness is to be attributed chiefly to the slip interference created by the relative displacement of crystal fragments, this hardening will be greater, in general, the larger the number of planes on which slip takes place, and accordingly deformation produces hardness more rapidly as the temperature is lowered, as the initial grain size is smaller, and finally when spontaneous union of the crystal fragments takes place during deformation as in the blue heat range in iron. (*Cf.* J., 1922, 941 a.)—C. A. K.

See also pages (a) 972, *Oxidation of carbon by chromic acid* (Florentin). 980, *Reduction of thorium oxide by tungsten* (Smithells). 983, *Enamelling of cast iron* (Manson); *Heat-resisting alloys, for enamel burning racks* (Poste). 999, *Cobalt in alloy steels* (Willard and Hall). 1000, *Carbon in steel* (Bonnier).

Patents.

Unstainable steel and iron or alloys thereof; Manufacture of ——. L. Aitchison. E.P. 187,310, 14.7.21.

Articles are formed (*e.g.*, by casting) from metal having the composition of unstainable metal, but containing carbon in excess of the quantity desirable in the finished product. The article is then decarbonised superficially by heating in a current of hydrogen or in contact with a suitable decarbonising agent. Cooling may take place in contact with the reducing agent to prevent partial re-carbonisation from the interior of the metal.—C. A. K.

Iron; Art of making electrolytic ——. F. A. Eustis, C. R. Hayward, H. M. Schleicher, and D. Belcher, Assrs. to F. A. Eustis and C. P. Perin. U.S.P. 1,432,543—4, 17.10.22. Appl., (a) 7.7.21 and (b) 17.1.22.

(a) A solution of a ferric salt is reduced by means of hydrogen sulphide, and the reduced solution is used for leaching sulphide ore, whereby the iron therein is dissolved and hydrogen sulphide liberated and utilised in reducing further quantities of ferric solution. The leach liquor is electrolysed for iron. (b) A solution of a ferrous salt for use in the electrodeposition of iron is made by dissolving iron oxide in a dilute acid solution containing a ferrous salt. —A. R. P.

Magnetic sand or finely divided iron ore; Treatment of ——. A. Naito. E.P. 187,810, 29.9.21.

The sand or ore is mixed with powdered coal and heated to produce a coke containing iron ore, which is heaped in the open air, and either sulphur dioxide or chlorine gas passed through, or sea water or a solution of caustic alkali poured upon it. The product is exposed to the atmosphere till large lumps or masses are obtained, which are charged with a suitable flux into a smelting furnace. —T. H. Bu.

Metals [iron]; Process and apparatus for pickling ——. E. H. Hinckley. U.S.P. 1,434,011, 31.10.22. Appl., 20.5.18.

Iron is immersed in an aqueous solution of sulphuric acid of such concentration and temperature that the efficiency of ionisation and capacity for absorbing ferrous sulphate are at a maximum. —T. H. Bu.

(a) *Ferro-uranium; Process of making* ——. (b) *Electric furnace.* F. F. Mueller and R. W. Harris, Assrs. to Standard Chemical Co. U.S.P. (a) 1,433,403 and (b) 1,433,404, 24.10.22. Appl., 20.10.20.

(a) Uranium oxide is reduced with a carbonaceous reducing material in an electric furnace provided with a lining composed principally of non-carbonaceous material. The temperature in the furnace is raised sufficiently to eliminate most of the carbon in the bath; iron is added to the bath, and ferro-uranium of low carbon and silicon content recovered therefrom. (b) The furnace chamber consists of a shell lined with uranium oxide. A bottom electrode is partly embedded in the lining and an upper electrode enters the furnace chamber.—J. S. G. T.

Rust; Process and composition for preventing ——. C. W. Porter. U.S.P. 1,433,226, 24.10.22. Appl., 8.4.20.

An aqueous solution of a volatile aliphatic amine is used as a rust inhibitor. Iron, for example, is treated with an aliphatic amine and a metallic hydroxide in aqueous solution.—C. A. K.

Tinplate scrap; Treatment of ——. Victoria Iron Rolling Co. Proprietary, Ltd. E.P. 170,861, 29.10.21. Conv., 30.10.20.

Detinning operations are carried out by forming a galvanic cell, using the tinned scrap as anode, a copper container as cathode, and a solution of sodium hydroxide as electrolyte. Copper troughs containing copper oxide, which acts as a depolariser, are attached to the copper vat, a permeable material being used to retain the copper oxide in the trough.—C. A. K.

Ore concentrator tables. E. C. R. Marks. From E. I. du Pont de Nemours and Co. E.P. 187,296, 12.7.21.

The surface of an ore concentration table is covered with a fabric, both sides of which are coated with a cellulose ester, such as pyroxylin. The ester before use is mixed with a white pigment so as to allow the lines of demarcation of the ore pulp to be easily seen, and, for the same purpose, the fabric extends over the sides of the table.—A. R. P.

Lead; Process for the production of metallic —— *from lead sulphate.* F. E. Elmore, and The Chemical and Metallurgical Corp., Ltd. E.P. 187,313, 14.7.21.

Lead sulphate produced in chemical processes is reduced to metallic lead by mixing it with 4—8% of carbon, preferably about 5%, and heating the mixture to 800°—1000° C. in a vessel to which access of oxidising gases is prevented.—A. R. P.

Metal oxides; Process for the reduction of —— *by means of aluminium in the furnace.* P. C. Rushen. From Akt.-Ges. B. Felder-Clement. E.P. 187,375, 13.8.21.

A metallic oxide is heated with aluminium in a crucible, it being immaterial whether the aluminium is in powder or in compact form; the oxide and aluminium are not mixed but are placed side by side or one above the other; or the oxide may be placed in a tube or the like made of aluminium. The intensity of the reducing action is such that there is a complete separation of metal from the aluminium oxide produced, the resultant metal being free from aluminium compounds. The process is particularly applicable to the reduction of the oxides of tungsten, molybdenum, chromium, titanium, and similar metals of high melting point. —C. A. K.

Alloy. F. Milliken. U.S.P. 1,432,607, 17.10.22. Appl., 8.10.19.

The alloy consists of 60—70% Cu, 9—12% Ni, 19—24% Zn, 1—2½% Fe, and a trace of manganese.—A. R. P.

Alloy [suitable for exposure to hot conditions]. A. H. Coplan. U.S.P. 1,433,180, 24.10.22. Appl., 7.3.21.

An iron alloy, which is to be exposed to combustion conditions in use, contains Cr 1%, Ni 2%, Mn not less than 0·60%, C not less than 0·1%, and small quantities of sulphur and phosphorus.—C. A. K.

Alloy metal. A. S. Hatfield. U.S.P. 1,434,246, 31.10.22. Appl., 9.2.21.

An alloy containing principally cobalt, together with tin and molybdenum, the percentage of the latter being more than twice that of the tin. —T. H. Bu.

Metallurgical apparatus. [Zinc furnace.] A. Donaldson. U.S.P. 1,432,842, 24.10.22. Appl., 19.3.21.

The retort of a zinc smelting furnace is connected to an external portable fume condenser, in which the condensing area can be varied.—C. A. K.

Lead and silver; Recovery of —— from ores and metallurgical products. H. Hey. U.S.P. 1,432,858–9, 24.10.22. Appl., (a) 24.2.20 and (b) 16.9.20.

(a) Ores and metallurgical products containing silver and lead as chloride are leached with a hot brine solution, containing a chloridising agent, such as ferric chloride, in such a manner that any sulphide present does not react with the silver in solution. (b) Sulphide ores containing lead and silver which have, by a preferential chloridising roast, been converted into chlorides, are leached with a cold acid brine to extract the silver. The residue is then treated with a solution which extracts practically the whole of the remaining lead. —A. R. P.

Metals; Treatment of ——. F. and F. Palmer. U.S.P. 1,433,408, 24.10.22. Appl., 29.4.21.

Metals are treated with an aqueous solution of sodium sulphate, sodium chloride, and potassium ferrocyanide.—C. A. K.

Extraction of metals from their compounds; Method of ——. P. Freedman and E. Greetham. U.S.P. 1,433,541, 31.10.22. Appl., 10.4.22.

See E.P. 180,384 of 1921; J., 1922, 596 a.

Pickling metals. O. Vogel. U.S.P. 1,433,579, 31.10.22. Appl., 13.8.19.

See G.P. 309,264 of 1918; J., 1921, 853 a.

Coating wires and the like; Method of and apparatus for ——. Soc. Chim. des Usines du Rhône. E.P. 168,872, 11.8.21. Conv., 4.9.20.

XI.—ELECTRO-CHEMISTRY.

Tungsten [electric] furnace for experiments on dissociation and ionisation. K. T. Compton. J. Opt. Soc. Amer., 1922, **6**, 910—912.

Tungsten sheet is bent into the form of a cylindrical tube and clamped by end pieces, each consisting of a steel ring fitting in a split rectangular steel block. The blocks are mounted on water-cooled brass tubes serving as leads for the heating current. Short glass tubes surround the leads for purposes of insulation. Loops of fine tungsten wire, drawn tightly round the cylindrical tube, prevent bulging of the furnace. The central electrode consists of a straight length of 20-mil tungsten wire welded to heavier molybdenum leads. A furnace 60 mm. overall length and about 5 mm. diam., was raised to a white heat by 100 amps. at 6 volts, and reached its melting point when a current of about 200 amps. was employed.—J. S. G. T.

Electrolysis with drops of mercury as the electrode. J. Heyrovsky. Chem. Listy, 1922, **16**, 256—264.

To study the electrolysis of aqueous solutions of alkali and alkaline-earth salts, the author employed drops of mercury as the electrode, whereby it was possible to determine the exact course of the electrolysis. Electrolysis is produced when a certain e.m.f. is applied, the value of which is characteristic of each salt and which is a function of the logarithm of the concentration. The rapid increase of the current is explained by a diffusion of very dilute amalgams towards the interior of the drop of mercury. The author calculated the following potentials at which the cations deposit from *N*/1 solutions on a mercury cathode:—Lithium, −2·023; sodium, −1·860; potassium, −1·883; rubidium, −1·796; cæsium, −1·837. The affinity of the metals for mercury is given by the difference between the characteristic potentials of polarised drops and the normal electrolytic potentials of the pure alkali metals, the following values being found:—Lithium, 1·281; sodium, 1·138; potassium 1·325; rubidium, 1·409; cæsium (1·50).—W. T.

Ozoniser; New form of ——. H. Nemecek. Chem. Listy, 1922, **16**, 276.

Two stout copper wires serve as electrodes in a horizontal glass cylinder, the arrangement being such that the distance between the electrodes can be varied. The energy can be obtained by means of a Ruhmkorff's coil or an electric machine. —W. T.

Oxides of lead; Physical chemistry of the ——. VI. Anodic behaviour of lead and lead dioxide. S. Glasstone. Trans. Chem. Soc., 1922, **121**, 2091—2098.

Oxygen is evolved at a lead or lead dioxide anode at almost identical potentials, *e.g.*, 1·18 and 1·17 volts respectively, for a current density of 0·03 amp. per sq. cm. The appearance of a dark film, which completely covers the anode in the case of lead, corresponds with a sudden increase of anodic potential and the evolution of oxygen. The evolution of oxygen at the lead and lead dioxide anode appears to be due to the formation of an intermediate unstable higher oxide, present in extremely small amount in solid solution in the dioxide. The initial high e.m.f. of a lead accumulator obtained soon after charging is probably due to the presence of this unstable higher oxide.—J. B. F.

Platinum resistance coils. Roebuck. *See* XXIII.

Patents.

(A) *Arc shield.* (B) *Moulded insulation and method of making same.* W. H. Kempton, Assr. to Westinghouse Electric and Mfg. Co. U.S.P. (A) 1,431,961 and (B) 1,431,962, 17.10.22. Appl., (A) 25.7.18, (B) 8.1.19.

(A) A mixture of Portland cement, asbestos, and water is placed in a mould, a space being left which is subsequently filled with a mixture of carborundum, Portland cement, and asbestos. The whole is compressed so as to form a solid piece, which is then removed and submitted to curing, heating, and drying processes. (B) Shaped pieces are formed by moulding a mixture containing a filler, such as asbestos, a binder, such as Portland cement, and an oxidising agent (siccative). The pieces are cured and impregnated with an oxidisable oil, *e.g.* linseed oil, which is then oxidised by the oxidising agent.—J. S. G. T.

Electric furnace [heater]. E. F. Collins, Assr. to General Electric Co. U.S.P. 1,432,442, 17.10.22. Appl., 1.3.21.

A ribbon-shaped resistance for use as an electric furnace heater is constituted of a number of edgewise convolutions, forming a self-supporting unit, and spaced so as to permit heat diffusion. —J. S. G. T.

Electric furnace. T. S. Curtis, Assr. to Universal Optical Corp. U.S.P. 1,433,448, 24.10.22. Appl., 7.8.19.

Horizontal electrodes enter the furnace chamber through opposite walls at the same height and are supported so that their distance apart may be varied and their relative positions determined by means of a graduated scale.—J. S. G. T.

Storage battery [plate]. W. H. Wood. U.S.P 1,432,937, 24.10.22. Appl., 22.1.20.

The lead oxide paste employed is incorporated, prior to setting, with finely granulated material consisting essentially of cellulose, which is afterwards gradually removed by means of sulphuric acid.—J. S. G. T.

Battery separator. W. H. Wood and H. E. Smith. U.S.P. 1,432,938, 24.10.22. Appl., 9.2.20.

A battery separator consists of an insoluble supporting medium interspersed with threads consisting of a mixture of mammalian hair, *e.g.*, wool, which is insoluble in sulphuric acid, and a porous vegetable fibre, *e.g.*, cotton, soluble in sulphuric acid.—J. S. G. T.

Separator for storage batteries. W. H. Wood. U.S.P. 1,432,939, 24.10.22. Appl., 17.4.20.

A storage battery separator is made of rubber composition traversed by strands of mammalian hair from which the scaly exterior portions have been removed.—J. S. G. T.

Electric battery [electrodes; Material for use in the manufacture of ——]. F. M. Holmes, Assr. to W. L. Valentine and G. D. Rigsby. U.S.P. 1,433,136, 24.10.22. Appl., 19.6.22.

Bone meal is treated with sulphuric acid, and after removal of substantially all traces of uncombined sulphuric acid, the resulting product, consisting of calcium sulphate and phosphoric acid, is dried in a finely divided condition. In like manner the finely divided product of the reaction between lead carbonate and sulphuric acid, consisting of lead sulphate and hydrated lead oxide, is dried after removal of substantially all traces of uncombined acid. The two products are thoroughly mixed with silica flour and a finely divided absorbent earth filler, and acid added to the mass.—J. S. G. T.

Electric precipitator. U.S.P. 1,433,266. *See* I.

Electric furnace. U.S.P. 1,433,404. *See* X.

Chlorine for water purification. U.S.P. 1,430,785. *See* XIXb.

XII.—FATS; OILS; WAXES.

Copra drying; Use of sulphur fumes in ——. A. H. Wells and G. A. Perkins. Philippine J. Sci., 1922, 21, 49—55.

The main cause of colour and rancidity of coconut oil is the action of moulds on the copra during drying. Where steam drying is impracticable, sulphuring the copra is very satisfactory for the prevention of mould during air drying; 1 kg. of sulphur per charge of 3000 nuts is usually sufficient, and this is burnt in a pan on the floor of the sulphuring chamber, which may be about 4 ft. wide, 8 ft. long, 7 ft. high, the nuts being placed on trays piled one above the other on a trolley to facilitate removal. A preliminary sunning for an hour or so after opening the nuts is desirable, as the "meat" can then be separated more readily from the shells. The sulphured copra can be dried in two to three weeks in a shed without sunshine, if necessary, or more rapidly by sun-drying either on a floor or in light trays which can be stacked and covered up in case of rain. The direct protection against mould afforded by sulphur dioxide lasts about a month, but the copra is not susceptible to mould if once thoroughly dried and stored in a dry place. —G. F. M.

Illipé fat; Unsaponifiable matter (a highly unsaturated hydrocarbon and alcohols) in commercial ——. S. Kobayashi. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, 25, 1188—1196.

A highly unsaturated hydrocarbon and a few higher alcohols have been isolated from the unsaponifiable matter of commercial illipé fat imported from India. The fat had the following characters: sp. gr. 0·9021 at 40°/4° C., m.p. 39°—40° C., acid value 17·2, saponif. value 181·0, iodine value 54·8, unsaponifiable matter 8·55%. 100 g. was saponified and the unsaponifiable matter was extracted with ether. It was a light yellow solid with an aromatic odour and the following characters: m.p. 148°—154° C., iodine value 178·5, saponif. value after acetylation 83·7, ether-insoluble bromide about 71%, bromine content 67·30%. It gave a white precipitate of digitonide with an alcoholic solution of digitonin and the bromide became blackish brown at 150° C. and turned black at 165° C. without melting. The unsaponifiable matter was treated with hot 95% alcohol, and from the insoluble matter a highly unsaturated hydrocarbon was isolated by repeated recrystallisation from ether. This hydrocarbon, illipene, $C_{32}H_{56}$, has m.p. 64·5° C., iodine value 382·5, and gives 312·2% of ether-insoluble bromide (67·46% Br). It is optically inactive and boils above 315° C. at 2·5 mm. pressure. The higher alcohols in the unsaponifiable matter were freed from sterols by means of digitonin and when fractionated by repeated recrystallisation from acetone gave the following compounds: $C_{21}H_{38}O$, microscopical silky needles, m.p. 196°—197° C., iodine value 114·9 and saponif. value after acetylation 150·7; $C_{31}H_{56}O$, silver-white crystals, m.p. 186°—186·5° C., iodine value 100·2; $C_{27}H_{48}O$, silver-white grains, m.p. 159°—160° C., iodine value 82·3; $C_{21}H_{36}O$, light yellow needles, m.p. 125°—135° C., iodine value 100·2, saponif. value after acetylation 132·5. The solid fatty acid in the fat is mainly composed of stearic acid.—K. K.

Rape oil; Composition of the fatty acids of ——. Y. Toyama. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, **25**, 1044—1053. (*Cf.* J. Tokyo Chem. Soc., 1895, **16**, 187.)

Rape oil obtained from the seeds of *Brassica campestris*, L. (*B. chinensis*, L.) grown in the Shiga Prefecture had the following characters: sp. gr. 0·9147 at 15°/4° C., n^{20}=1·4734, acid value 1·6, Reichert-Wollny value 0·17, saponif. value 172·8, acetyl value 1·49, iodine value (Wijs) 102·8, and unsaponifiable matter 0·98%. The oil was saponified and the fatty acids separated and examined. Neither the lead-salt ether method nor the lead-salt alcohol method was suitable for separation of the saturated and unsaturated acids. The main constituent of the fatty acids of the oil was erucic acid, its quantity being about 65%. The quantity of saturated acids was less than 2%; palmitic acid was isolated and stearic, behenic, lignoceric, and arachidic acids were also probably present. After bromination of the liquid acids, freed from erucic acid, hexa- and tetra-bromostearic acids were isolated, and from the oxidation products by Hazura's method, sativic and isosativic acids were isolated, which proves the presence of linolenic and linolic acids in the oil. Methyl esters of the liquid acids, freed from erucic acid, when oxidised, yielded dihydroxystearic acid, indicating the presence of oleic acid. It was not found possible to separate the oleic acid by Reimer and Will's method (J., 1887, 732).—K. K.

Behenic and eracic acids; Derivatives of ——. Y. Toyama. Kôgyô-Kwagaku Zasshi (J. Chem. Ind., Japan), 1922, **25**, 1053—1055.

Erucic acid isolated from the fatty acids of rape oil crystallised from 90% alcohol in fine long needles, m.p. 33·5°—34° C. Behenic acid prepared by purifying hydrogenated erucic acid crystallised from 95% alcohol in thin scales with pearly lustre, m.p. 81°—82° C. A number of derivatives which may be of use for identifying the acids have been prepared. Methyl behenate, lustrous scales from 95% alcohol, has m.p. 54°—54·5° C., b.p. 224°—225° C. at 5 mm.; ethyl behenate, fine granules from 95% alcohol (irregular prismatic aggregates by microscopical examination), has m.p. 50°—50·5° C., b.p. 230°—231° C. at 5 mm.; behenic amide, fine needles from 95% alcohol, m.p. 111°—112° C.; behenic anilide, fine needles from 95% alcohol, m.p. 101°—102° C. Methyl erucate is a nearly colourless liquid, sp. gr. 0·8735 at 15° C., 0·8702 at 20° C., n^{15}=1·4577, n^{20}=1·4558, b.p. 221°—222° C. at 5 mm.; ethyl erucate, nearly colourless liquid, sp. gr. 0·8676 at 15° C., 0·8648 at 20° C., n^{15}=1·4562, n^{20}=1·4543, b.p. 229°—230° C. at 5 mm.; erucic amide, fine needles from 95% alcohol m.p. 82·5°—83° C.; erucic anilide, lustrous scales from 95% alcohol (short prismatic aggregates by microscopical examination), m.p. 65·5°—66° C.
—K. K.

Boring and cooling oils; Examination of water-soluble ——. K. Braun. Chem.-Zeit., 1922, **46**, 1016—1017.

The oil is weighed into a separating funnel, 100 c.c. of 60% alcohol added, the solution made alkaline and extracted with petroleum spirit (b.p. 30°—50° C.). The fatty oils and unsaponifiable matter are thus separated, and are weighed after drying at as low a temperature as possible. The weighed residue is saponified and again extracted with petroleum spirit. The residue gives the unsaponifiable matter and the difference the fatty oils. The alcohol is removed from the alcoholic soap solution after extraction with petroleum spirit and the residue dissolved in water, treated with excess of hydrochloric acid, and extracted with ether. The ethereal solution is washed with water saturated with ether until the washings are neutral, dried over anhydrous sodium sulphate, filtered, and the residue of fatty acids weighed after distilling off the ether. The free alkali cannot be determined by igniting the soap and titrating the ash with $N/10$ sulphuric acid and phenolphthalein owing to the presence of carbonates in the ash.—H. C. R.

Soap solutions; Constitution of ——. *Hexadecane sulphonic (cetylsulphonic acid and other sulphonates.* M. H. Norris. Trans. Chem. Soc., 1922, **121**, 2161—2168.

Hexadecanesulphonic acid is prepared by oxidation of hexadecylmercaptan with potassium permanganate. Manganese dioxide and a trace of oily dihexadecylsulphone are removed by filtration, and the lead salt of the acid is precipitated by lead acetate in hot slightly alkaline solution, washed with hot water and hot alcohol, and the acid liberated by treating a suspension of the lead salt in hot alcohol with hydrogen sulphide. Filtration and evaporation of the alcohol leaves a semi-solid mass, white at first, but turning brown. The acid is a hydrogen soap showing the typical behaviour of a colloidal electrolyte in conductivity, osmotic activity, and high temperature coefficient of solubility. It ranks among the highest soaps between sodium stearate and behenate. The length of the molecule is an important factor in producing a colloidal electrolyte. Sodium α-naphthalenesulphonate is less colloidal than the β-form, and ring compounds are far less colloidal than open-chain compounds with the same number of carbon atoms.—P. V. M.

Fat-liquor from Indian Oils. Das and Das. *See* XV.

Chaulmoogra esters etc. Perkins. *See* XX.

Drainage error in Bingham viscosimeter. Herschel. *See* XXIII.

Patents.

Cotton seeds; Method and means for cleaning —. F. O. Partington. E.P. 186,943, 30.11.21.

The fibres adhering to cotton seeds, used for the manufacture of oil and oil meal or cake, are removed by the following method. The seeds are passed through a beater, where dirt is partly removed, and then through a revolving gauze cage in which the remaining dirt is removed. Afterwards, the seeds are conveyed through a carbonising chamber in which they are immersed in sulphuric acid of 80° Tw. (sp. gr. 1·40) or caustic soda, and are then centrifuged, dried, and cleaned in another revolving gauze cage.—A. J. H.

Catalyst; Method of restoring the activity of a —. G. A. Richter and W. B. Van Arsdel, Assrs. to Brown Co. U.S.P. 1,431,982, 17.10.22. Appl., 14.9.21.

The oil is extracted from a nickel catalyst with a solvent and the catalyst is then subjected to the action of an agent capable of dissolving the oxide film on it. The catalyst is washed to remove this agent and is sealed against the access of air.
—H. C. R.

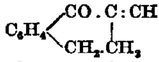
Emulsifying materials. E.P. 187,298–9. *See* XIX.

XIII.—PAINTS; PIGMENTS; VARNISHES; RESINS.

Resins; Relation between ability to form — *and chemical constitution. III. New method for producing synthetic resins.* W. Herzog and J. Kreidl. Z. angew. Chem., 1922, **35**, 641—643.

The preparation of a number of synthetic resins is described in which organic substances containing the group .CO.CH:CH., are heated to 200°—250° C.

in a stream of carbon dioxide for periods of 2—12 hrs. Resins may be obtained in this way from benzylideneacetone, $C_6H_5CH:CH.CO.CH_3$, anisylideneacetone, $CH_3O.C_6H_4.CH:CH.CO.CH_3$, vanillalacetone, $(HO)(CH_3)C_6H_3.CH:CH.CO.CH_3$, cinnamylideneacetone, $C_6H_5.CH:CH.CH:CH.CO.CH_3$, cinnamylideneacetophenone, $C_6H_5.CH:CH.CH:CH.CO.C_6H_5$, and from the condensation product of terephthalaldehyde and acetone, $CH_3.CO.CH:CH.C_6H_4.CH:CH.CO.CH_3$. Resins can also be obtained from substances containing the "resinophorous" group, CO.CH:CH., as part of a cyclic group, in which form it occurs in the arylidene compounds of α-ketotetrahydronaphthalene (α-tetralone),



$$C_6H_4\left\langle\begin{array}{l}CO.C:CH.R\\ \qquad\ \ |\\ CH_2.CH_2\end{array}\right.$$

Attempts are made to ascribe all polymerisations of organic substances to resins to the presence of this "resinophorous" group. Modifications of Raschig's formulæ for phenol-formaldehyde condensation products (Z. angew. Chem., 1912, 25, 1946) are proposed by which the formation of these products also is brought into line with this theory.—H. C. R.

Patents.

Printers' ink [from sulphite-cellulose waste lyes]; Production of ——. K. J. Smidt and R. Jaeger. E.P. 187,537, 13.2.22.

The waste lyes from the manufacture of sulphite-cellulose are treated with nitric acid and a small quantity of metallic copper or zinc as catalyst; the reaction [redacted] phuric acid in suitable quantity may be added before the reaction is complete. The black product is of syrupy consistency, and is ready for use. —D. F. T.

Varnish; Method of making ——. J. H. Young, Assr. to H. H. Robertson Co. U.S.P. 1,432,511, 17.10.22. Appl., 22.4.20.

Resin is heated uniformly in a closed vessel by a hot liquid circulating outside, which simultaneously serves to heat the oil to be mixed with the resin. The hot oil is introduced into the melted resin and the heating is continued; later the temperature of the circulating liquid is reduced so as to cool the mixture prior to the introduction of a liquid thinner. Rapid cooling is then effected by further reduction of the temperature of the liquid in the jacket.—D. F. T.

Inks, water colour paints, and like compositions. Plauson's (Parent Co.), Ltd. From H. Plauson. E.P. 187,732, 30.7.21.

See G.P. 355,117 of 1921; J., 1922, 826 A.

Rosin material for sizing. U.S.P. 1,433,124. *See* V.

XIV.—INDIA-RUBBER; GUTTA-PERCHA.

Rubber compounded with sulphur and litharge; Comparative tests with ——. H. P. Stevens. Bull. Rubber Growers' Assoc., 1922, 4, 520—522.

Comparative tests on the rate of vulcanisation of mixtures of rubber with sulphur, with or without the presence of litharge, the rubber having been prepared or packed under different conditions, showed that litharge obliterates irregularities in the rate of vulcanisation due to the use of varying proportions of sodium silicofluoride, but increases the differences arising from the effect of moisture and mould. The latter influence is probably related to the known connexion between the activity of litharge and the acetone-soluble constituents of rubber.—D. F. T.

[Rubber;] Experiments on tearability [of ——*].* B. B. Evans. Indiarubber J., 1922, 64, 815—819.

Mixtures of rubber and excess of sulphur were made containing also zinc oxide, refined china clay, or light magnesium carbonate, one set of batches including these ingredients in equal proportions by weight and another set in equal volume proportions. "Accelerated" mixings of the latter type were also prepared. From each mixing strips were formed and united by vulcanisation. Measurement was then made of the load necessary to effect the separation of the joined surfaces. The mixings containing zinc oxide showed greatest resistance to tearing, and the clay mixings least. The direction of the "grain" in the test pieces had no appreciable influence on the results. Under-vulcanisation increased the ease of separation or tearing. The effect of the organic accelerator was to make separation more difficult.—D. F. T.

Air [of rubber factories etc.]; New method for estimating volatile substances in ——. E. Fritzmann and K. Macjulevitsch. J. Russ. Phys.-Chem. Soc., 1920, 52, 212—226.

The method elaborated by the authors for determining the proportion of light petroleum vapour contained in the air of rubber factories etc., consists essentially in freezing out the light petroleum in two weighed U-tubes, each cooled by immersion in liquid air. In order to prevent choking of the tubes by the frozen petroleum, the tubes are packed with magnesium turnings. Before being passed through these tubes, the air is freed from dust, moisture, and carbon dioxide by passage through tubes containing, in order, soda-lime, calcium chloride, phosphoric anhydride, and cotton wool. —T. H. P.

Patents.

Rubber; Process for vulcanising —— and products obtained thereby. I. Ostromislensky, Assr. to New York Belting and Packing Co. U.S.P. 1,433,093, 24.10.22. Appl., 8.10.17.

Rubber or similar material is vulcanised by the action of an oxygen derivative of rubber added for the purpose.—D. F. T.

Rosin material for sizing. U.S.P. 1,433,124. *See* V.

XV.—LEATHER; BONE; HORN; GLUE.

Tanning materials and extracts; Qualitative analysis of different —— and the detection of adulterants in mixtures. M. Jamet. J. Soc. Leather Trades' Chem., 1922, 6, 336—350.

A summary of all the different methods used in the qualitative analysis of tanning materials, including the following tests:—bromine, ammonium sulphide, lead acetate-acetic acid, formaldehyde-hydrochloric acid, and coloration of Mulhouse (mordanted) strips. 1% iron alum solution gives characteristic colours or precipitates with the individual tannins. Nitrous acid is used to show the presence of ellagitannic acid. If 1% copper sulphate solution is added to a solution of the tannin a precipitate usually forms. When excess of ammonia is added the precipitate dissolves if gambier, hemlock, or pine bark tannins are present. Tannins derived from gallotannic acid and others containing protocatechuic acid give copper tannates which do not dissolve readily in ammonia. 10 c.c. of a strong solution of stannous chloride in hydrochloric acid is added to 2 c.c. of a 0·4% solution of the tannin in a porcelain crucible and allowed to stand for 10 mins. A pink colour is obtained with barks of

conifers and mimosas. A splinter of pinewood, 5 cm. × 1 cm. is soaked in a 5% tannin solution, left to dry, then damped with hydrochloric acid. The splinter becomes a deep reddish-violet with tannins containing phloroglucinol, *e.g.*, cutch and gambier. The pinewood shaving becomes feebly coloured after a few hours with tannins containing traces of phloroglucinol. Sodium sulphite crystals moistened with a solution of valonia acquire a vivid red colour. If a test-tube is rinsed out with a tannin solution, the drops allowed to collect at the bottom, and 1 c.c. of strong sulphuric acid poured down the side, characteristic colorations are obtained with different tannins. Lime water also gives characteristic colorations with tannin solutions. If 5 c.c. of a 10% solution of normal lead acetate is added to 5 c.c. of tannin solution, the mixture filtered, and excess of 10% solution of caustic soda added to a portion of the filtrate, quebracho and ulmo give a faint yellow colour, lentiscus and sumach a bright yellow, and wood pulp a dull yellow, whilst other tanning materials give no coloration. The colour obtained on chromed wood is characteristic, sumach, galls, and chestnut giving a green colour, cutch, mimosa, mangrove, and quebracho a dull brown, and myrobalans a yellow. The author reviews the usual quantitative tests with ethyl acetate, ammonium molybdate, etc.
—D. W.

Leather analysis; Report of a committee [of the Soc. of Leather Trades Chemists] on ——. M. Chambard. J. Soc. Leather Trades' Chem., 1922, **6**, 358—362. (*Cf.* J., 1921, 859 A.)

Samples of the same leather were analysed in three different laboratories, and the results showed wide variation in the hide substance, grease content, and mineral matter. Greater care is necessary in specifying the portion of the leather from which samples should be taken.—D. W.

Fat-liquor [for leather]; Manufacture of ready-made stable —— from Indian oils. B. M. and S. R. Das. J. Soc. Leather Trades' Chem., 1922, **6**, 328—335.

The authors have demonstrated the possibility of sulphonating Indian castor oil and sardine oil and blending the products with mineral oils, neutral oils, and soap so as to form an emulsifiable mixture suitable for fat-liquoring chrome leathers.—D. W.

Gelatin gels; Thermal expansion of ——. A Taffel. Trans. Chem. Soc., 1922, **121**, 1971—1984.

The coefficient of expansion and the specific volumes of gelatin gels for a given temperature are a linear function of the concentration of the gel. With increase of temperature, the gels expand regularly. One gram of gelatin is always associated with the same contraction in a gel at any one temperature, irrespective of the amount of water contained in the gel; this contraction, per 1 g. of gelatin, is 0·073 c.c., and 0·065 c.c. at 15° and 32° respectively. The contraction of a gel is not due to the filling up of the pores in the solid gelatin by water; only a fraction of the water in a gel is contracted, the weight per gram of gelatin undergoing contraction being the same for gels up to 25% concentration by weight. The temperature of maximum density of water is lowered by gelatin by an amount proportional to the concentration (determined up to 13% concentration). This is due to the thermal contraction of the gelatin content of the gel and the increase in the contraction on imbibition of the gel with falling temperature.—J. B. F.

Patents.

Artificial leather; Process for the manufacture of ——. C. Claessen. E.P. 171,360, 8.7.21. Conv., 6.11.20. Addn. to 155,778 (J., 1922, 459 A).

Artificial leather, which is waterproof, is made by coating material, prepared as described in the chief patent, with a mixture containing cellulose esters, resin or similar substances dissolved in an excess of a volatile solvent. A suitable mixture consists of 10 pts. of nitrocellulose, 15 pts. of alcohol, 55 pts. of acetone, 15 pts. of benzol, and 5 pts. of castor oil (*cf.* also E.P. 174,317 and 174,588; J., 1922, 627 A).
—A. J. H.

Skin; Prepared —— for diaphragms, sound plates and amplifiers of gramophones. J. W. Barstow. E.P. 187,049, 26.7.21.

A substitute for mica, wood, and metal used in the manufacture of diaphragms etc., consists of raw animal skin which is steeped in water until supple, then immersed for about 10 hrs. in a solution composed of 1 pt. of alum and 2 pts. of water or 1 pt. of formalin and 3 pts. of water, and afterwards dried under tension, sand-papered, and coated with French polish, or amyl acetate, copal gum, or varnish.—A. J. H.

XVI.—SOILS; FERTILISERS.

Already indexed from origin

Humus soils; Mechanical analysis of ——. G. W. Robinson. J. Agric. Sci., 1922, **12**, 287—291.

To destroy the organic matter, 10 g. of soil is mixed with 30 c.c of hydrogen peroxide (20 vol.) and heated for 30 mins. on a steam bath. After repeating the process with 25 c.c. of hydrogen peroxide a peaty soil is usually sufficiently oxidised to caus complete dispersion of the particles. The mechanical analysis of the treated soil is carried out a usual, and microscopical examination of the fractions shows them to consist of mineral particle only. The larger aggregates, cemented together b organic matter, are entirely destroyed. The cla fraction has a very different appearance from tha obtained by the ordinary process without oxidation, and the coagulum is much smaller.
—A. G. P.

Already indexed-Original.

Mechanical analysis of soils and other dispersion New method for the ——. G. W. Robinson. Agric. Sci., 1922, **12**, 306—321.

A 2—2·5% suspension of soil is prepared in a t cylinder, and samples are withdrawn with a pipet at measured depths and after measured periods settling. It is then possible to represent graph ally the relationship between percentage of s and settling velocity. It is suggested that t most suitable method of representing the mecha cal composition of soils is by means of a graphic relationship between the summation percentage a the logarithm of the settling velocity. By suita choice of times and depths of sampling, the meth is readily adapted to any of the existing syste of fractionation. A weak solution of sodium c bonate (0·025%) is recommended for the suspensi medium. Cylinders should be not less than 1¼ in diameter. Errors of a few millimetres in t depth of sampling have little significance. Cl agreement with the older methods of analysis obtained, and the time required for the fractio tion is very considerably shortened. The coar fractions are removed by sieves, and the fine sa by one sedimentation of 75 secs., as by the us method.—A. G. P.

Soil moisture determination; Electrical method of ——. T. Deighton. J. Agric. Sci., 1922, **12**, 207—230.

The moisture content of soils is calculated from a determination of the resistance between two carbon electrodes pressed into the soil. The most satisfactory experimental conditions—*e.g.*, size and nature of electrode, distance between electrodes, etc.—are indicated. A consideration of soil moisture-resistance curves showed that the resistance varied with the square of the moisture content when the latter was above 10% ; but below this figure irregularities occurred due to alteration in the physical condition of the clay colloids.—A. G. P.

Soil colloids; Absorption of water by ——. W. O. Robinson. J. Phys. Chem., 1922, **26**, 647—653.

Clay, loam, and silt soils and subsoils absorb a relatively constant quantity of water, which lies between 0·240 g. and 0·348 g., with a mean value 0·298 g. per g. of colloid present.—J. F. S.

Soils; Action of neutral salts on ——. [*Determination of soil acidity.*] J. van der Spek. Vers. Landbouwk. Onderz. Rijkslandbouwproefstat., 1922, 162—202. Chem. Zentr., 1922, **93**, IV., 1009—1010.

A number of acid and alkaline soils were treated with various neutral salt solutions and the resulting hydrogen-ion concentrations determined electrometrically. Great differences in the effects of different salts were observed. That these effects are the outcome of adsorption phenomena is indicated by the different action of salts with the same anion or cation, and by the fact that the course of the reactions leading to the equilibrium position follows an adsorption isotherm. On the other hand, the equivalent interchange of cations and the course of reactions leading to the formation of substances of increased or decreased dissociation in solution favour the view that chemical reactions only are involved. Reactions occur between free ions in solution and adsorbed ions. The different conceptions of the nature of chemical reactions in soils become simplified if it be assumed that adsorption of ions occurs on the surface of colloidal particles, and that adsorbed ions are not washed out by water but can still take part in reactions, and are interchangeable with ions bearing similar charges. In nature, acid solutions, particularly carbonic acid and humic acid, withdraw adsorbed basic ions from the soil leaving the free H-ions. The estimation of soil acidity by spotting out soil extracts on litmus paper is therefore inaccurate, since all the free H-ions are not extractable by water. The colorimetric estimation of soil acidity is best carried out with a salt-solution soil extract, although results are unreliable unless standard conditions of concentration and quantity of soil and of extracting solution are observed. Correct results can only be obtained by potentiometric methods.—A. G. P.

Fungicidal sprays. Horton and Salmon. *See* XIXB.

Patents.

Fertilisers; Process for the manufacture of ——. A. d'Ercole. E.P. 179,934, 9.5.22. Conv., 14.5.21.

Tricalcium phosphate (45 pts.) is treated with sulphuric acid of 48° B. (84 pts.) in a superphosphate mixer. When the reaction is nearly complete 17 pts. of calcium cyanamide (19% N) is stirred into the mixture, which is immediately transferred to a vat and allowed to react for about 20 mins. before removal.—A. G. P.

Fertilising material; Manufacture of material suitable for use as ——. E. L. Pease. E.P. 187,251, 15.4.21.

Basic material containing substances utilisable as fertilisers, *e.g.* potash-bearing clays, shales, rock phosphates, etc., are treated with acid (sulphuric, hydrochloric, phosphoric) to produce a semi-dry absorbent mass. This is used as a scrubbing material to remove ammonia from coal gas, producer gas, etc. The product may be used directly as a fertiliser, or may be heated in a retort to remove the bulk of the ammonia and the residue again used for gas purification, or it may be leached with water to remove soluble fertiliser salts. In the latter case sufficient ammonia must be present to precipitate the iron and aluminium.—A. G. P.

Fertiliser and process of making same. E. H. Sams. E.P. 187,423, 14.9.21.

Household refuse, sewage sludge, etc., is dried, ground, and screened to remove metal, glass, etc., and sprayed with ammonia liquor from gas works in the proportion of 1 gall. to 10 lb. of refuse. The whole material is re-ground and can be used directly on the land.—A. G. P.

XVII.—SUGARS ; STARCHES ; GUMS.

Cane-sugar juice; New method of purifying ——. D. J. W. Kreulen. Chem. Weekblad, 1922, **19**, 458—461.

In the treatment with lime after the ordinary sulphitation process, there is always a large zone in which lime is in excess, causing formation of dextrose and tending to affect the subsequent crystallisation. An apparatus is described by means of which the milk of lime can be forced into the vat by compressed air, which serves to divide it and to distribute it rapidly and uniformly through the liquor, which is by this means also kept well agitated.—S. I. L.

Sugars; Iodometric determination of ——. F. Auerbach and E. Bodländer. Z. angew. Chem., 1922, **35**, 631—632.

In the iodometric determination of the excess of cupric salt remaining when a reducing sugar is boiled with Fehling's solution, the quantity of thiosulphate solution required to titrate the liberated iodine is not a direct measure of the amount of sugar present. For instance, each 0·1 c.c. of $N/1$ thiosulphate solution is equivalent to 0·34 mg. of invert sugar when 10 c.c. of the solution is required for the titration, and to 0·41 mg. when 23 c.c. is used. The use of potassium thiocyanate in place of a portion of the potassium iodide, as recommended by Bruhns (J., 1920, 829 A), is untrustworthy. —W. P. S.

Carbohydrates; Oxidation of —— *with nitric acid.* P. Haas and B. Russell-Wells. Biochem. J., 1922, **16**, 572—573.

Sucrose, lactose, dextrose, lævulose, and the carbohydrates of *Chondrus crispus* (carrageen), on oxidation with nitric acid yield a substance similar to glycuronic acid, which reduces cold Fehling's solution.—S. S. Z.

Xylose; Methylation of ——. A. Carruthers and E. L. Hirst. Chem. Soc. Trans., 1922, **121**, 2299—2308.

Two series of methylations were carried out with the object of obtaining the two stereoisomeric forms of trimethylmethylxyloside. Methylation of xylose with methyl sulphate followed by treatment with methyl iodide and silver oxide gave crystalline trimethyl-β-methylxyloside. As obtained by distillation the product was a mixture of the α- and β-forms, from which the latter was obtained by crystallisation from light petroleum. It had the following constants: m.p. 46°—48° C., $n_D^{25}=1{\cdot}4350$, $[\alpha]_D=-67^\circ$ (in water). In acidified methyl alcoholic solution the equilibrium value of $[\alpha]_D$ was $+49{\cdot}5^\circ$. With the object of obtaining the trimethyl-α-methylxyloside the equilibrium mixture of α- and β-methylxylosides obtained by heating xylose with acidified methyl alcohol at 100° C. for 20 hrs., was separated as far as possible, and the α-form methylated by the silver oxide method. The product was a mobile syrup, b.p. 115°—118° C. at 12 mm., $n_D^{25}=1{\cdot}4410$, and it contained about 66% of the α-isomeride. The behaviour of both the α- and β-forms on hydrolysis was distinctly anomalous. The β-form only gave about a 50% yield of trimethylxylose, together with furfural derivatives and other decomposition products. Trimethylxylose crystallised from ether in large prisms, m.p. 87°—90° C. Mutarotation in aqueous solution was so rapid that the maximum value of $[\alpha]_D$ could not be obtained. In absolute alcohol $[\alpha]_D=+74^\circ$. From trimethyl-α-methylxyloside no trace of trimethylxylose could be obtained by hydrolysis, a viscous acidic syrup only being isolated. The rate of condensation of trimethylxylose with acidified methyl alcohol is very slow as compared with the hexoses. With 0·25% acid no change in rotation was observed after 60 hrs. at 15° C., but at 70° C. equilibrium was attained in 8 hrs.—G. F. M.

Fucose; Structure of ——. E. P. Clark. J. Biol. Chem., 1922, **54**, 65—73.

The method for the preparation of fucose from seaweed has been improved. On the basis of the relationship which exists between the configuration and rotation of lactones of sugar acids (Hudson, J., 1910, 366), it is concluded from the rotation of the methyl tetronolactone obtained from fucose that the configuration assigned to fucose by Mayer and Tollens (Ber., 1907, **40**, 2440) is correct.—E. S.

γ-Methylfructoside. R. C. Menzies. Chem. Soc. Trans., 1922, **121**, 2238—2247.

Dilute solutions of fructose (lævulose) in pure methyl alcohol are rapidly converted, in presence of 0·5% of hydrogen chloride, into solutions of methylfructosides, a change which is accompanied by a change of sign in the optical rotation. The change is the most rapid of its kind hitherto encountered in the sugar group, 5% and 2·5% solutions giving the maximum positive rotation in less than 30 mins. At this point the solution was neutralised with sodium methoxide, the solvent removed, and the resulting salt extracted with dry ethyl acetate, whereby an insoluble lævorotatory syrup ($[\alpha]_D=+27^\circ$) and a soluble hygroscopic syrup having $[\alpha]_D=+25{\cdot}2^\circ$ (in ethyl acetate) were separated. That the latter was γ-methylfructoside was evident from its similarity in behaviour to other substances of the γ-type, being completely hydrolysed by cold, 0·033% hydrochloric acid and decolorising *N*/500 permanganate in 30 mins., the same time as is required by γ-methylglucoside, whilst α-methylglucoside and β-methylfructoside require 30 hrs. under similar conditions. The complete methylation of γ-methylfructoside by the silver oxide method gives a tetramethyl derivative identical with that obtained from sucrose and inulin, and the ketose residue in all three substances is therefore identical.—G. F. M.

Inulin; Identification of —— by a mycological method. A. Castellani and F. E. Taylor. Biochem. J., 1922, **16**, 655—658.

Monilia macedoniensis, Castellani, ferments inulin with the production of gas. It also ferments dextrose, lævulose, galactose, and sucrose. Inulin can be identified by utilisation of the above mould in conjunction with other fungi.—S. S. Z.

Patent.

Sugar residues [e.g., those resulting from the polarisation of sugar products]; Process of recovering litharge from ——. A. S. Ramage, Assr. to The Sugar Research Synd., Ltd. U.S.P. 1,433,034, 24.10.22. Appl., 29.1.21.

Litharge is recovered from sugar residues containing lead carbonate and organic lead salts by subjecting the mixture in continuous flow to a gradually increasing temperature, and to the action of air flowing in the contrary direction, the oxygen content of the air being gradually diminished, so that the lead content is reduced first to metallic lead, which is gradually oxidised to litharge.—J. P. O.

XVIII.—FERMENTATION INDUSTRIES.

Saccharomyces cerevisiæ; Action of ultraviolet rays on ——. R. and R. de Fazi. Giorn. Chim. Ind. Appl., 1922, **4**, 463—464.

Tests on an industrial scale have shown that yeast previously exposed for 12 hrs. to the light from a quartz mercury vapour lamp ferments brewery wort more rapidly and develops less acidity than the same yeast not subjected to this treatment. (*Cf.* E.P. 143,121; J., 1920, 499 A.)—T. H. P.

Pentoses; Fermentation of —— by moulds. W. H. Peterson, E. B. Fred, and E. G. Schmidt. J. Biol. Chem., 1922, **54**, 19—34.

Out of 25 species of moulds investigated, 16 were found rapidly to ferment both xylose and arabinose; the destruction of the pentoses was, however, somewhat less rapid than that of dextrose. *Aspergillus niger* and other species of *Aspergillus* were especially active in fermenting the pentoses; *Penicillium glaucum* was also active, but with other *Penicillia* the fermentation proceeded slowly. In agreement with results obtained by others, it was found that over 90% of the carbon of the pentose consumed could be accounted for as carbon dioxide and mycelium. No volatile acid or alcohol was produced, but a small quantity of non-volatile acid appeared to be formed.—E. S.

Wines; Determination of free and combined volatile acids in ——. P. Malvezin. Ann. Falsif., 1922, **15**, 360—362.

The author maintains, in answer to criticism, that the ether-extraction method (J., 1909, 435) is reliable; the acidity of the ethereal solution varies with the concentration of the volatile acids, and is independent of the concentration of the fixed acids. Tartaric and lactic acids do not interfere under the conditions prescribed.—W. P. S.

Wines containing sulphurous acid; Action of —— on metals. P. Grelot. Ann. Falsif., 1922, **15**, 326—330.

Wines containing sulphurous acid or bisulphite act readily on certain metals. In the case of iron, zinc, tin, and aluminium, hydrogen sulphide is evolved and the wine becomes turbid owing to the liberation of sulphur in a finely-divided state. With lead, copper, and nickel the wine remains clear an there is no evolution of hydrogen sulphide, but th metals are blackened owing to the formation of layer of sulphide on their surface.—W. P. S.

Industrial alcohol. Cole. *See* IIA.

Identification of inulin. Castellani and Taylor *See* XVII.

Alkalinity of culture media. Noll. *See* XIXB.

Patents.

Fuel for internal combustion engines. E.P. 187,326. *See* IIa.

Alcohol fuels. E.P. 187,335. *See* IIa.

XIXa.—FOODS.

Wheat flour; Chemistry of strength of ——. H. E. Woodman. J. Agric. Sci., 1922, **12**, 231—243.

The possibility of the difference between strong and weak flours depending on differences in the proteins of the gluten were investigated. Proteins were considered identical if they exhibited identically the following three properties:—Optical behaviour when racemised by dilute alkali at 37° C. at three different dilutions; specific rotation in 70% alcohol; combining capacity for alkali as determined by titration in 80% alcoholic solution with $N/10$ sodium hydroxide, using phenolphthalein as indicator. The gliadins from weak and strong flours showed no differences, but the glutenins showed different behaviour during racemisation with alkali, indicating the possibility of two or more glutenins. The physical condition of the gluten, and consequently the shape of the loaf, also depends to a certain extent on the content of soluble salts in the flour. The proteins can be extracted with a cold 0·2% potassium hydroxide solution without alteration of their optical properties. The combining weight of gliadin is about 5000, and it is concluded that the molecule contains three or a multiple of three free carboxyl groups.—A. G. P.

Beef and mutton; Autolysis of ——. W. R. Fearon and D. L. Foster. Biochem. J., 1922, **16**, 564—571.

The processes of the post-mortem autolysis of beef and mutton are exactly parallel both at incubator temperature and at low temperatures. In the case of mutton both the initial soluble nitrogen and the soluble nitrogen when the equilibrium of the autolysis has been reached, are higher than in beef. This difference in the two kinds of muscle is probably due to the difference in structure and physical properties of the muscle and not to their chemical constitution. The above results do not throw any light on the different behaviour of beef and mutton after being frozen. After being frozen the course and degree of autolysis are greatly altered. The method of freezing and the rate of freezing are of great significance.—S. S. Z.

Goat milk; Non-protein nitrogen in ——. W. Taylor. Biochem. J., 1922, **16**, 611—612.

There was a found a correlation in a lactating goat between the output of nitrogen in the urine and the percentage of non-protein nitrogen in the milk. Both were determined by the amount of protein in the food.—S. S. Z.

Proteins; Heat coagulation of ——. W. W. Lepeschkin. Biochem. J., 1922, **16**, 678—701.

A study of the processes of denaturation and coagulation of protein. The author comes to the conclusion that denaturation is a weak hydrolysis of the protein and that coagulation is not simply a process of electrical discharge of protein particles by the ions but is also dependent on the chemical properties of the salts present.—S. S. Z.

Tryptophan-estimation in protein; Nitrogen-distribution in Bence-Jones' protein and colorimetric method for ——. E. Lüscher. Biochem. J., 1922, **16**, 556—563.

Bence Jones' protein differs from all other proteins analysed up to the present time, not only in its physical behaviour but also in its nitrogen distribution as determined by Van Slyke's method. The author proposes to use benzaldehyde instead of formaldehyde in Von Fürth's colorimetric method for the estimation of tryptophan (*cf.* J., 1921, 787 a).—S. S. Z.

Nitrogeneous metabolism of higher plants. III. Effect of low-temperature drying on the distribution of nitrogen in the leaves of the runner bean. A. C. Chibnall. Biochem. J., 1922, **16**, 599—607.

On drying the leaves of the runner bean at low temperature some of the protein is autolysed with the production of water-soluble nitrogen compounds which chiefly consist of ammonium salts, asparagine, and amino-acids. The residual protein is, however, not appreciably changed in character. The dried leaves contain enzymes which are activated by water. The presence of an asparaginase which is activated by the addition of water and which under specified conditions manifests marked synthetic activity, is indicated.—S. S. Z.

Nitrogenous metabolism of the higher plants. IV. Distribution of nitrogen in the dead leaves of the runner bean. A. C. Chibnall. Biochem. J., 1922, **16**, 608—610.

The nitrogen content of, and its distribution in, the dead leaves of the runner bean killed by a frost in the twenty-fourth week of its life are given.—S. S. Z.

Oat straw; Sugars and albuminoids of ——. S. H. Collins and B. Thomas. J. Agric. Sci., 1922, **12**, 280—286.

Oat straws, grown under various conditions, were examined for their sugar and protein content, with a view to correlating feeding value and conditions of growth. Good weather conditions at harvest are necessary to obtain high sugar content. The sugar gradually disappears after harvesting, particularly if the straw becomes damp. Exceptional care in storage is necessary to retain a high sugar content for six months. The protein content of the straw varied from 1·12 to 8·05% and was roughly proportional to the amount of nitrogen in the soil. Organic nitrogenous manures produced a greater variation in the protein content of oat straw than did artificial fertilisers. The amount of protein depended to a certain extent on the amount of grain produced. (*Cf.* J., 1920, 66 t, 82 t.)—A. G. P.

Vitamin A; Significance of —— *in the nutrition of fish.* K. H. Coward and J. C. Drummond. Biochem. J., 1922, **16**, 631—636.

During the development of the larval brown trout the high vitamin A content of the ova is utilised so that the supplies are almost exhausted. On giving food rich in vitamin A to the fish in their post-larval period they develop satisfactorily and are capable of storing the vitamin. On a diet containing adequate protein but deficient in the vitamin no such storage occurs and growth is subnormal.—S. S. Z.

Fruit; Changes which occur in the pectic constituents of stored ——. M. H. Carré. Biochem. J., 1922, **16**, 704—712.

The pectin content reaches a maximum during the process of ripening of apples and then gradually falls as the fruit becomes over-ripe. The date of picking of the fruit has no effect on the development of the pectin in either cold or ordinary storage. Protopectin—the precursor of soluble pectin—can be estimated by hydrolysing the residue with $N/20$ hydrochloric acid and then applying the calcium pectate method. Preliminary work suggests the existence of a definite relationship between the quantities of soluble pectin and protopectin constituents and that the production of soluble pectin is due to enzyme action. There is a possibility of the existence of a third soluble pectin.—S. S. Z.

Alanine. Jaitschnikov. *See* XX.

PATENTS.

Oleaginous emulsifying materials, and manufacture of edible substances. Manufacture of emulsions or emulsifying ingredients or materials. E. V. Schou. E.P. (A) 187,298 and (B) 187,299, 12.1.21.

(A) An oil-soluble gelatinised oil with pronounced viscous, tough, and elastic properties is produced from oils containing linolic or linolenic acid by heating or polymerisation, with or without previous or simultaneous oxidation. Fresh oil of a suitable kind is added to the gelatinised oil and the whole stirred at a temperature of 100°—120° C. until the gelatinised oil is completely dissolved, when the blend is cooled to atmospheric temperature. The substances distilling over during the preparation of the gelatinised oil may be recovered. The product is suitable as a substitute for butter and lard, or may be added to oils or fats to increase their viscosity. (B) A sticky and elastic oleaginous material, which may be prepared as described under (A), is used as the oleaginous portion of an emulsion, either alone or dissolved in or diluted with a quantity of untreated oil. An aqueous liquid, which may or may not contain a small proportion of solid matter of a viscous or sticky character, is vigorously stirred into the oleaginous portion, and an emulsion is produced which is soluble in oil and in which the oily portion constitutes the external phase and the watery portion the internal phase.—H. C. R.

Milk product and process of making it. P. G. Kinzer, Assr. to Carnation Milk Products Co. U.S.P. 1,432,699, 17.10.22. Appl., 6.3.18.

The cream is separated from fresh milk and churned to separate the butter. The skim milk from the first separation and the buttermilk from the second separation are combined with an edible vegetable fat to form a stable emulsion.—H. H.

Coffee substitutes; Manufacture of —— from cereals and the malt of cereals. K. Lendrich. U.S.P. 1,434,297, 31.10.22. Appl., 7.1.20.

See E.P. 131,304 and 153,971 of 1919; J., 1921, 58 A, 94 A.

XIXb.—WATER PURIFICATION; SANITATION.

Water; Statistical record of Toronto ——, 1912—21. N. J. Howard. Canadian Eng., 1922, 42, 468—476.

A review is given of the laboratory work in connexion with the filtration of the water supply of the City of Toronto, which is derived from Lake Ontario. The water is treated by slow sand and drifting sand filtration and by subsequent sterilisation. Aluminium sulphate was used also to remove the large bacterial pollution of the raw water. The number of bacteria was reduced 99% by slow sand filtration and 95% by drifting sand filtration. The numbers of *B. coli* in the raw water have much increased during late years, and now 12% of the water samples treated by slow sand filtration contain *B. coli* in 1 c.c. This is not regarded as a serious matter, because the water is afterwards treated with chlorine. The view is expressd that modern practice in America regards the purification of a water supply as more practical and economical than the purification of sewage before its discharge into a stream. Along with the increase in *B. coli*, the chlorine increased from 8 to 10 parts per million. The average amount of aluminium sulphate added increased from 1 grain to 1·3 grain per gal. during the last four years, more being required in summer than in winter. The slow sand filters were more efficient in summer, on account of their greater porosity in winter weather. The dose of chlorine required varied from 0·2 part per million in winter to 0·375 part in summer. No definite reason could be given for the occasional occurrences of taste in the water. The mortality from typhoid fever decreased from 12 to 3 per 100,000 during the period.—J. H. J.

Chlorination [of water] prior to filtration. N. J. Howard. J. American Water Works Assoc., 1922, 9, 606—611. [Reprint.]

During 1921 the Toronto water supply was treated with chlorine instead of with aluminium sulphate before filtration in drifting sand filters. This was done because of the large amount of aluminium sulphate required as a result of the rapid increase in the pollution of the raw water from Lake Ontario. The chlorine was applied at the rate of 0·15—0·3 part per million, any excess being absorbed by the sand filter. The purification effected in the summer was much better than with aluminium sulphate, but not so good in winter. The use of chlorine considerably increased the volume of water which it was possible to filter daily. An iodoform taste developed in the treated water rather more frequently than when aluminium sulphate alone was employed, but no connexion could be found between the addition of the chlorine and the development of the taste. The total cost of the chlorine treatment was much less than that of the aluminium sulphate method.—J. H. J.

Taste and odour [from water]; Modern practice in the removal of ——. N. J. Howard. J. Amer. Water Works Assoc., 1922, 9, 766—782. [Reprint.]

Taste in water arising from the presence of gases and iron in solution may be removed by aeration and filtration processes. Crenothrix may be removed by aeration and filtration or by filtration alone. Algæ may be removed by chlorine or more successfully by copper sulphate; they flourish best in water of high alkalinity, and experiments showed that a sufficient reduction of the alkalinity led to their death. The cause of taste following chlorination is not definitely established. There are two kinds of taste in waters treated with chlorine: a chlorine taste and an iodoform taste, which never occur together, but odour may occur at the same time, particularly when the water temperature is above 50° F. (10° C.). In water which contains chlorine in excess of the amount necessary for sterilisation both taste and odour exist. An application of 0·175—0·225 part of chlorine per million at a temperature of 35°—45° F. (2°—7° C.) does not usually lead to complaint of taste, but as the temperature rises more chlorine must be added to get the same sterilisation effect. Standard solutions of aniline dyes were made up to match the blue colour of starch iodide, and were used at Toronto Water Works as useful indicators as to the correctness of the amount of chlorine being added. The iodoform taste appears to be due to the presence of phenols and organic matter in the water before treatment, but in certain cases there appear to be other causes. Experiments with Lake Ontario water showed that in presence of small amounts of phenol, up to 0·017 part per million, an iodoform taste developed when 0·175 part of chlorine per million was added, and persisted up to a dose of 0·65 part, when the tasto disappeared. The reverse process of adding excess of phenol to water containing chlorine was not successful in removing the taste. Treatment by the excess lime method reduced but did not remove the iodoform taste.—J. H. J.

Alkalinity of water and culture media; Estimation of ——. H. Noll. Z. Hyg. u. Infkt. Krankh., 1922, **96**, 172—190. Chem. Zentr., 1922, **93**, IV., 1003—1004.

The estimation of alkalinity by direct and indirect titration, using methyl orange, gives good results. The indirect method after expelling carbon dioxide by boiling is more accurate, although the cause of the difference in the methods has not been ascertained. The limiting sensitiveness is about $N/1000$ solutions. In titrating ferruginous waters immediately after sampling, the carbonates of iron cause too high a figure for the alkalinity, and the estimation should be delayed until the iron has separated out. Humates and silicates are estimated as carbonates. In using phenolphthalein in the indirect method, the titre of the phenolphthalein should be determined and the same quantity of it used in each titration. Good alkalinity figures are obtained with ferruginous waters if the iron is wholly or partially precipitated. Humates do not affect the alkalinity when phenolphthalein is used; silicates are recorded as carbonates. Azolitmin gives similar results to phenolphthalein but the colour change is inferior. The alkalinity of culture media is best determined by spotting out on litmus paper. Phenolphthalein is only suitable for clear liquids. The difference between the neutral points of litmus and phenolphthalein is due to carbonates and not to phosphates. The estimation of phosphate in peptone extracts and nutrient media is most satisfactorily carried out by the molybdate method. The phosphate in nutrient media is partially removed by neutralisation and filtration.—A. G. P.

Fungicidal properties of certain spray fluids. E. Horton and E. S. Salmon. J. Agric. Sci., 1922, **12**, 269—279.

The fungicidal properties of a number of solutions towards the conidial stage of *Sphaerotheca Humuli* on young hop leaves, were determined. Disodium arsenate solution (0·096 % As_2O_5) was fungicidal but killed patches of leaf cells beneath the mildew patches; with a solution containing 0·02 % As_2O_5 the latter injury was not observed. Trisodium arsenate with 0·77 % As_2O_5 was fungicidal. Dicalcium arsenate containing above 0·024 % As_2O_5 and tricalcium arsenate containing above 0·02 % As_2O_5 were fungicidal. Calcium polysulphide (0·11 % of polysulphide sulphur) was fungicidal, but the following among its constituents were harmless: calcium sulphate, sulphite, thiosulphate, and hydroxyhydrosulphide.—A. G. P.

Patents.

Filtering apparatus [for water]. W. Paterson. E.P. 187,259, 26.4.21.

A manifold pipe system for the collection of filtered liquid and for the distribution of compressed air and wash water for cleansing the filter bed is superposed on a channel or tube, constituting the main collecting or distributing header, of which the upper surface is substantially flush with the bottom of the filter bed. The pipes are each connected with the header by a T-piece and are clamped in position. —H. H.

Chlorine gas [for water purification]; Method of producing ——. G. N. Blanchard. U.S.P. 1,430,785, 3.10.22. Appl., 21.7.20. Renewed 31.5.22.

A current from a transformer is conducted through cells containing salt water. The strength of the current is co-ordinated with the flow of water to be purified, so that the chlorine is produced in a fixed proportion to the flowing water.—J. H. J.

Sewage treatment. Dorr Co., Assees. of H. W. Morgan. E.P. 171,361, 26.7.21. Conv., 10.11.20.

See U.S.P. 1,392,197 of 1921; J., 1921, 868 A.

XX.—ORGANIC PRODUCTS; MEDICINAL SUBSTANCES; ESSENTIAL OILS.

Nicotine; Determination of —— *in tobacco and tobacco smoke.* M. Popp and J. Contzen. Chem.-Zeit., 1922, **46**, 1001—1002.

The nicotine was determined in eight kinds of cigar and pipe tobacco and in their smoke. The nicotine in the tobaccos was determined by Rasmussen's extraction method (J., 1915, 300) and by Mach's distillation method (Landw. Vers.-Stat., **45**, 40). The results obtained by the two methods agreed well with one another. To determine the nicotine in the smoke, weighed quantities of the tobacco were smoked in a holder or pipe and the smoke passed through five wash-bottles filled with 10 % hydrochloric acid, which after absorption was completed was made up to 1000 c.c. An aliquot part of this solution was made alkaline with sodium hydroxide and steam-distilled. The distillate was precipitated with silicotungstic acid. Other bases such as pyridine are also precipitated, but if acetic acid is present small quantities of pyridine are not precipitated. The total nicotine in the cigars and pipe tobaccos examined varied from 0·31 % to 2·21 %. The smoke from these tobaccos contained from 0·20 % to 1·05 % of nicotine.—H. C. R.

Alkaloids; Use of the newer indicators in titrations of ——. W. J. McGill. J. Amer. Chem. Soc., 1922, **44**, 2156—2160.

The indicators generally used in the titration of morphine, atropine, and quinine give results which are not nearly so accurate as should be obtained. In the case of morphine the average error using methyl red is 1·4 %, whereas bromophenol blue gives an average error of only 0·5 %, and in some cases this is as low as 0·1 %. The best indicator for quinine is bromocresol purple, whilst for cinchona residues, either cochineal, methyl red, or bromocresol purple may be used. Cochineal and methyl red give low results with morphine, atropine, and mydriatic alkaloid residues, whilst bromophenol blue gives satisfactory results in all these cases. Methyl red is the most satisfactory indicator for strychnine. —J. F. S.

Liquorice extract; Detection of extract of Atractylis gummifera in ——. U. Giuffrè. Giorn. Chim. Ind. Appl., 1922, **4**, 460—461.

Adulteration of liquorice extract with extract of *Atractylis gummifera*, which contains the poisonous glucoside, potassium atractylate, may be detected as follows. Fifty grms. of the extract is dissolved in a little water and the dense solution mixed with about 500 c.c. of alcohol, treated with animal charcoal, allowed to stand, filtered, and reduced by distillation to a small volume. After diluting with a little water, the liquid is made distinctly alkaline with sodium hydroxide, boiled for half an hour in a reflux apparatus, cooled, acidified with dilute sulphuric acid, and distilled to small volume in a current of steam. The presence in the distillate of valeric acid, one of the products of the alkaline hydrolysis of potassium atractylate, is indicated by the odour. The residue from the distilling flask is saturated with ammonium sulphate, boiled for 15 mins. with alcohol and animal charcoal, and filtered. Concentration of the filtrate and subsequent dilution with water result in the precipitation of another hydrolytic product, atractyligenin, which is purified by further treatment with alcohol and charcoal. The cold residue formed on evaporation of a drop of the filtered liquid on a watch-glass is treated with a few drops of concentrated sulphuric acid, which gives a yellowish coloration changing to carmine on addition of a little piperonaldehyde, vanillin, or other aromatic hydroxyaldehyde in aqueous solution.—T. H. P.

Carrageen (Chondrus crispus). III. Constitution of the cell wall. B. Russell-Wells. Biochem. J., 1922, 16, 578—586.

The chemistry of hot and cold extracts of carrageen was studied. Both extracts contain pentose radicles and calcium and ammonium ethereal sulphates. The ash also contains calcium, magnesium, sodium, potassium and traces of iron. Pectic radicles are not present in either extract. The cold extract contains a dialysable organic substance. On oxidation the cold and hot extracts yield mucic, oxalic, and tartaric acids; more mucic but less oxalic acid is obtained from the cold than from the hot extract. The extracted residue of carrageen contains cellulose. There are indications that *Ceramium rubrum* also contains ethereal sulphates.—S. S. Z.

System o- and p-toluenesulphamides. A. F. Dobrjanski. J. Russ. Phys.-Chem. Soc., 1920, 52, 139—144.

During the manufacture of saccharin treatment of the mixed *o*- and *p*-toluenesulphonic chlorides with ammonia yields a mixture of the corresponding sulphamides of which a portion, melting at 108° C., remains non-separable. This portion agrees in composition with the eutectic mixture of the two sulphamides, so that separation by fractional precipitation should be impossible. The acicular crystals, m.p. 120° C., described by Fahlberg, represent a mixture of the two isomerides in equal proportions, but the melting point curve shows no distectic point and gives no indication of the formation of a molecular compound; the crystals of the two components are readily distinguished in the mixture under the microscope.—T. H. P.

Alanine; Identification of —— by crystallo-chemical analysis. I. S. Jaitschnikov. J. Russ. Phys.-Chem. Soc., 1920, 52, 145—147.

Since optically-active alanine often yields opalescent solutions incapable of polarimetric investigation, the author has made crystallographic measurements which may be used to identify this substance. —T. H. P.

[*Chaulmoogra esters, etc.*] *Manufacture of certain drugs for the treatment of leprosy.* G. A. Perkins. Philippine J. Sci., 1922, 21, 1—16.

The use and method of administration of chaulmoogra and other oils and their derivatives in the treatment of leprosy is discussed. A new method for the preparation of the ethyl esters of the fatty acids of chaulmoogra oil is described. 10 kg. of crude oil is mixed with 13 l. of 95% ethyl alcohol and 750 c.c. of 93% sulphuric acid, and heated under a reflux condenser for 20 hours. The reaction product is washed with an equal volume of water and then with dilute soda till neutral. The separated oil is dried and distilled in small quantities in a continuous still under reduced pressure. The distillate is vigorously agitated with a current of steam for 2 hrs. to remove irritating volatile impurities, and then dried, filled into bottles, and sterilised. The yield amounts to 90—95% of the original weight of the oil taken. Hydrogen chloride can be used instead of sulphuric acid as a catalyst, but no advantage is apparently gained. The preparation of sodium "gynocardate" by neutralisation of a fraction of the fatty acids of chaulmoogra oil melting at 48° C., of sodium "morrhuate," a similar preparation made from cod-liver oil, and of the cod-liver oil esters is also described.—G. F. M.

ββ'-Dichlorodiethyl sulphide; Hydrolysis of ——. Synthesis of divinyl sulphide and the preparation of a non-vesicant isomeride of ββ'-dichlorodiethyl sulphide. S. H. Bates and S. A. Nickelson. Chem. Soc. Trans., 1922, 121, 2137—2139.

ββ'-Dichlorodiethyl sulphide when hydrolysed with 20% alcoholic potassium hydroxide gives about 26% of its weight of a light oil having a garlic-like odour and boiling at 85°—86° C. Although this b.p. does not agree with that given by Beilstein for divinyl sulphide there is no doubt that this is the substance actually formed, according to the equation

$$S(CH_2CH_2Cl)_2 + 2KOH \dashrightarrow 2KCl + 2H_2O + S(CH{:}CH_2)_2,$$

and the b.p. given in the literature is incorrect. The oil has sp. gr. at 15° C. 0·9174, and when freshly distilled the vapour density is practically normal, but when kept for 48 hrs. the substances polymerises to an opaque jelly. Treated with dry hydrogen chloride in the cold, 2 mols. are added on with formation of αα'-dichlorodiethyl sulphide, a colourless liquid with a pungent and objectionable odour, but devoid of vesicant properties. It boils at 58·5°—59·5° C. at 15 mm., but when distilled under atmospheric pressure, decomposes with liberation of hydrogen chloride. Like divinyl sulphide it reacts violently with nitric acid.—G. F. M.

Urea; Decomposition of —— by sodium hypobromite in alkaline solution, and improved procedure for the estimation of urea by this means. E. A. Werner. Trans. Chem. Soc., 1922, 121, 2318—2325.

An estimation of urea, based on the evolution of total nitrogen by hypobromite, including that fixed during the reaction as alkali cyanate, consists in the addition of the urea solution to a small excess of alkali hypobromite contained in a nitrometer. After 20 mins. the volume of gas evolved is recorded and the gas is then expelled from the nitrometer. Sulphuric acid (1 in 5 pts. of water) is added to the residual liquid until, after mixing, the permanent presence of free bromine is shown. Carbon dioxide is liberated which is not expelled. After 15 mins. 30% sodium hydroxide is added in excess, together with a small additional quantity of hypobromite. After complete absorption of the carbon dioxide, the volume of nitrogen produced is added to that recorded in the first stage. An error of about 0·5% on the total nitrogen, owing to the fixation of a trace of the nitrogen as nitrate, results. Suppression of the formation of cyanate by the generation of the hypobromite *in situ* results in a violent reaction, in which traces of carbon monoxide, increasing with the alkalinity of the reagent, appear in the evolved gas. Other conditions being equal, the addition of dextrose leads to the formation of carbon monoxide and markedly increases the proportion of nitrogen fixed as cyanate. This is also the case when the reaction is slowed down by the use of neutral hypobromite.—P. V. M.

Aqueous alcohol; Selective solvent action by the constituents of ——. R. Wright. Trans. Chem. Soc., 1922, 121, 2251—2256.

The effect of the three solutes, sucrose, benzyl alcohol, and glycerol on the partial vapour pressures of 38% aqueous alcohol has been investigated. Sucrose, soluble only in water, and glycerol, soluble both in water and alcohol, raise the vapour pressure of the alcohol and lower that of the water. Benzy alcohol, soluble only in alcohol, lowers the vapou pressure of each component of the solvent. Thu solids, soluble in one component only, lower th vapour pressure of that constituent of the solven in which they are soluble in the pure state. Thes conclusions are supported by freezing-point determinations which show, further, that glycerol, miscible with both components, has probably a greate attraction for water than for alcohol.—P. V. M.

Terpene present in the essential oil of Andropogon iwarancusa, Jones; Constitution of the ——. J. L. Simonsen. Trans. Chem. Soc., 1922, 121, 2292—2299.

The terpene, obtained by steam distillation of the grass, had the following constants: b.p. 165·5°—167° C. at 707 mm., sp. gr. at 30° C. 0·8552, n_D^{30} = 1·474, $[\alpha]_D^{30} = +62·2°$. On oxidation in neutral acetone solution with permanganate it gives a saturated liquid keto-acid, $C_{10}H_{16}O_3$, isomeric with pinonic acid. Since sodium hypobromite converts this acid into a dibasic acid, $C_9H_{14}O_4$, which on treatment with aqueous hydrobromic acid at 100° C. is further converted into homoterpenylic acid, and since the original terpene on saturation with hydrogen chloride at 0° C. yields a mixture of dipentene and sylvestrene derivatives, it is considered to be *d*-Δ^4-carene. Δ^3-Carene has already been identified in the oleo-resin of *Pinus longifolia* (J., 1920, 581 a), and as would be expected it has a normal molecular refractivity, whilst the terpene in question shows a considerable exaltation.—G. F. M.

Patents.

Dialkylaminoalkyl compounds; Process of preparing aliphatic ——. Farbw. vorm. Meister, Lucius, und Brüning. E.P. 169,185, 15.8.21. Conv., 17.9.20. Addn. to 167,781 (J., 1922, 877 a).

The condensation described in the main patent can be carried out by causing an alkali hydroxide to act on a mixture, in molecular proportions, of a halogenalkyldialkylamine and a substance of the general formula, R.CO.CHR'X, such as ethyl acetoacetate. Further, a purer product is obtained if the reaction mixture is mixed with benzene and extracted with ammonia, before drying and distilling. *Example.* 57—58 pts. of powdered potassium hydroxide is gradually added to a mixture of 136 pts. of chloroethyldiethylamine and 130 pts. of ethyl acetoacetate. After cooling the product is stirred with benzene, the benzene solution shaken with ammonia, dried, and fractionally distilled. The ethyl diethylaminoethyl acetoacetate thus obtained boils at 130°—132° C. at 10 mm.—G. F. M.

Colloidally soluble substances and suspensions or emulsions; Manufacture of ——. L. Lilienfeld. E.P. 173,230, 20.12.21. Conv., 21.12.20. Addn. to 156,725 (J., 1922, 686 a).

By heating a solution of a water-soluble alkyl or aralkyl derivative of a carbohydrate of the form, $n(C_6H_{10}O_5)$, containing another colloidal substance in solution, suspension, or emulsion, a precipitate is formed, which, after removing the impurities or by-products by washing with hot water, can be either re-dissolved in cold water or dried. This method gives a simple and effective means of preparing colloidal solutions, suspensions or emulsions of certain metals and non-metals, either through their salts or by reducing their oxides, or of metal compounds by the interaction of the respective components in an aqueous solution of a water-soluble alkyl derivative of a carbohydrate.—S. G. U.

Alcohols; Manufacture of ——. Badische Anilin- u. Soda-Fabrik. E.P. 175,238, 15.8.21. Conv., 10.2.21. Addn. to 158,906.

See U.S.P. 1,410,223 of 1922; J., 1922, 347 a. Copper catalysts are used which are prepared, at low reduction temperatures, from copper salts or compounds which have been formed at temperatures below that of red heat by methods other than precipitation.

Thymol; Manufacture of synthetic ——. M. Phillips; dedicated to the people of the United States. U.S.P. 1,432,298, 17.10.22. Appl., 25.2.22.

Cymidinesulphonic acid is diazotised, the diazo-compound being then reduced with sodium bisulphite to cymylhydrazine-3- or 5-sulphonic acid; by oxidation with copper sulphate or ferric chloride cymene-3-sulphonic acid is obtained, the sodium salt of which on fusion with sodium hydroxide or potassium hydroxide yields thymol.—D. F. T.

Chlorinated derivatives of hydrocarbons; Manufacture of ——. G. T. Koch, Assr. to Ohio Fuel Supply Co. U.S.P. 1,432,761, 24.10.22. Appl., 4.5.20.

Liquid paraffin hydrocarbons are treated with chlorine gas in the presence of finely-divided, activated carbon.—D. F. T.

Esters and materials containing esters; Process for the production of —— from olefines. S. B. Hunt. E.P. 173,786, 30.6.20.

See U.S.P. 1,365,052 of 1921; J., 1921, 162 a.

p-Cymol; Manufacture of ——. G. Stalmann. U.S.P. 1,433,666, 31.10.22. Appl., 4.9.19.

See E.P. 142,738 of 1919; J., 1920, 501 a.

Aromatic derivatives [alkylamides of sulphonic acids]; Manufacture of ——. W. Bader and D. A. Nightingale. U.S.P. 1,433,925, 31.10.22. Appl., 18.6.21.

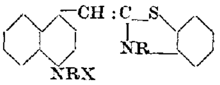
See E.P. 167,941 of 1920; J., 1921, 749 a.

Alcohol-ether mixtures. E.P. 187,051–2. *See* IIa.

XXI.—PHOTOGRAPHIC MATERIALS AND PROCESSES.

Cyanine Dyes. VI. Dyes containing a quinoline and a benzothiazole nucleus. Thioisocyanines. W. T. K. Braunholtz and W. H. Mills. Chem. Soc. Trans., 1922, 121, 2004—2008.

A series of photosensitising dyestuffs is described intermediate between the thiocyanines (J., 1922, 365 a) and the isocyanines in that they contain one quinoline and one benzothiazole nucleus. They are obtained by the action of alcoholic sodium hydroxide on a mixture of a quinoline alkyliodide and a 1-methylbenzothiazole alkyliodide. This method of preparation corresponds exactly with that of the isocyanines, with which substances they show a close relationship in properties, and their constitution is therefore considered to be represented by the formula



These compounds, to which the name thioisocyanines is given, form bright red iodides and their alcoholic solutions show a pair of overlapping absorption bands in the green and bluish-green at λ 5000—5100 and about λ 120—150 shorter. They are powerful photosensitisers for the green, giving an extra sensitisation to the gelatinobromide plate extending to about λ 5800. The detailed preparation of 2.1'-diethylthioisocyanine iodide from quinoline ethiodide and 1-methylbenzothiazole ethiodide, of 5-methyl-2.1'-diethylthioisocyanine iodide, of 5.6'.1'-trimethyl-2-ethylthioisosyanine iodide, and of several other derivatives is described.—G. F. M.

Patents.

Photographic film; Antistatic ——. A. F. Sulzer, Assr. to Eastman Kodak Co. U.S.P. 1,432,366–7, 17.10.22. Appl., 21.2.21.

A film support carries on one side a photographically sensitive layer and on the other a layer comprising (a) an ether of cellulose or (b) a cellulose ether and cellulose acetate.—W. C.

Photographic film. A. F. Sulzer, Assr. to Eastman Kodak Co. U.S.P. 1,432,368, 17.10.22. Appl., 21.2.21.

The film consists of a sensitive coating on an anti-static hygroscopic nitrocellulose support which carries, on the opposite side to the sensitive layer, a non-sweating insoluble antistatic coating.—W. C.

Photographic developer. W. Dieterle. U.S.P. 1,432,542, 17.10.22. Appl., 25.3.21.

A photographic developer consists of a sulpho-acid of a derivative of aminophenol dissolved in a solution of caustic alkali.—A. R. P.

[*Photographic*] *transparencies on glass, transfer images etc.* Farbenfabr. vorm. F. Bayer und Co., Assees. of A. von Biehler. G.P. 357,720, 8.2.21.

Sensitive transferable material prepared as described in G.P. 357,011 (J., 1922, 917 A), is rolled in the wet state with gelatin on to a plate of glass or other suitable material coated with hardened gelatin in the usual way, and after drying has commenced is separated from the support. The product possesses a protective film which renders it proof against damp and mechanical action.—W. C.

[*Photographic*] *transfer films.* Farbenfabr vorm. F. Bayer und Co., Assees. of A. von Biehler. G.P. 358,285, 16.12.20. Addn. to 357,011 (J., 1922, 917 A).

Softening materials, *e.g.*, triphenyl phosphate, triacetin, etc., are added to the substratum or to the film of cellulose compounds carried by it, and as an intermediate support is used a material having a definite structure, *e.g.*, stamped paper.—W. C.

XXII.—EXPLOSIVES; MATCHES.

Sporting cartridges; Use of petards of black powder in —— charged with smokeless powder. N. Bagajoli and G. De Florentiy. Giorn. Chim. Ind. Appl., 1922, 4, 457—458.

With the object of diminishing the pressures developed in sporting guns by cartridges of smokeless powder without lowering appreciably the velocity generated, it is suggested that very small petards, containing a few centigrams of fine grained black powder, be introduced into the cartridge case in immediate contact with the cap. The results of experiments made with various commercial powders show that, in some cases, the pressure may be reduced in this way by more than 220 kg. per sq. cm.—T. H. P.

Patents.

Explosive. T. L. Davies. U.S.P. 1,432,321, 17.10.22. Appl., 25.4.22.

An explosive composition including the tetranitrate, tetrabenzoate, and cinnamate of pentaerythritol as ingredients.—H. C. R.

Nitrocellulose powder grains; Coating for ——. T. L. Davis. U.S.P. 1,432,322, 17.10.22. Appl., 25.4.22.

The grains are coated with a heterocyclic nitrogen compound.—H. C. R.

Propellants; Process for making —— from ammonium nitrate and carbonaceous matter. Ver. Chem. Fabr. Mannheim. G.P. 334,546, 8.12.16.

Carbonaceous matter is used which forms homogeneous melts with ammonium nitrate. The melts are allowed to cool in thin sheets so as to obtain the propellant in a foliated form or as powder. The grinding of the charcoal and incorporation with ammonium nitrate under edge-runners are thus avoided and the manufacture of the propellant simplified.—H. C. R.

Propellants; Process for making —— from ammonium nitrate and carbonaceous matter. Rhenania, Ver. Chem. Fabr. A.-G. Zweigniederlassung Mannheim. G.P. 351,206, 13.6.17. Addn. to 334,546 (*cf. supra*).

The mixture of ammonium nitrate and carbonaceous matter is melted continuously in a vertical or inclined, steam-heated, jacketed vessel of small capacity, and is then cooled by means of a revolving chilled drum which dips into the homogeneous molten mass and from which the cooled propellant is removed in the form of thin leaves by means of a scraper. The decomposition of the mixture is thus avoided.—H. C. R.

XXIII.—ANALYSIS.

Platinum thermometers and resistance coils; Construction of ——. J. R. Roebuck. J. Opt. Soc. Amer., 1922, 6, 865—874.

In order to eliminate as completely as possible the zero shift in platinum thermometers, more especially such as are used at temperatures not exceeding 300° C., the platinum resistance wire is wound non-inductively in a helical groove cut in a cylinder of beeswax and resin, in which four radial arms of mica carried on a metal spool are embedded. Before winding, the wire is annealed at a dull red heat. After winding is completed the ends of the wire are joined to their respective leads by silver solder, and the cylinder of wax and resin removed by means of hot turpentine, which is then removed by a volatile solvent such as carbon tetrachloride. The cylindrical helix of wire is heated gradually within a hard glass tube and the annealing completed by passing a small current through the wire. Conduction along the leads is reduced by threading the wire through holes in short metal cylinders separated from each other by non-conductors. The leads are insulated from the cylinders by thin glass tubes. In the construction of resistance coils for use with the thermometer, manganin wire is wound non-inductively on a cylinder of paraffin wax, in which is embedded a brass cross, extending the length of the cylinder and each arm of which carries a strip of mica bent so as to form part of the cylindrical surface. The edges of the strips do not meet, so that the wire may spring in and out as required by temperature conditions. The coil is annealed by heating at 135° C. and is then mounted in a container with acid-free dry kerosene.—J. S. G. T.

Colorimeter. E. Moreau and A. Bonis. Ann. Falsif., 1922, 15, 357—360.

The apparatus consists of two similar graduated cylinders mounted side by side on a suitable stand; one of these contains the coloured solution under examination and the other the standard or comparison solution, which is admitted from a tapped funnel attached to a side tube at the bottom of the cylinder.—W. P. S.

Gases; New apparatus for washing ——. A. Ernesta. Chem. Listy, 1922, 16, 274—276.

The tube leading the gas to be purified into the washing vessel is surrounded by a long spiral; this increases the contact of the gas with the liquid and ensures efficient washing. The tube leading in the gas and the spiral are easily removed from the vessel.—W. T.

Filtration; Quantitative determination of the velocity of ——. A. Steiner. Kolloid-Zeits., 1922, 31, 204—209.

The velocity of filtration of suspensions and colloid solutions may be measured as follows: The top of a burette is widened so that it will take a cork through which the stem of a filter funnel passes, and a side tube is attached near to the top but just above the graduations. The side tube is connected through a manometer and a safety flask with a water pump. The volume of liquid collected in the burette is read at intervals and a filtration curve plotted. For comparative measurements the pressure of the filtration must be kept constant. The velocity of filtration may be used in the investigation of changes of hydration and of the effect of the addition of electrolytes.—J. F. S.

Cobalt; Separation of —— by means of phenylthiohydantoic acid. H. H. Willard and D. Hall. J. Amer. Chem. Soc., 1922, 44, 2219—2226.

COBALT may be quantitatively separated from arsenic, uranium, vanadium, titanium, tungsten, molybdenum, zinc, manganese, chromium, aluminium, magnesium, and calcium by precipitation with phenylthiohydantoic acid in slightly ammoniacal solution. In the presence of iron the precipitate is rarely free from this impurity, and usually contains 1—5 mg. regardless of the amount originally present. This does not, however, interfere with the volumetric estimation of cobalt. Nickel is always partially precipitated. The cobalt precipitate has not a definite composition and is probably mixed with some cobalt sulphide, thus making it necessary to convert the cobalt into some other more definite form. To separate cobalt from iron the procedure is as follows: a solution containing 1 g. of iron and 25 mg. of cobalt in 300 c.c. is treated with 8 g. of citric acid in a 500 c.c. Erlenmeyer flask, neutralised with ammonia (sp. gr. 0·90) and 5 c.c. excess added. The solution is heated to 35° C., 0·7—1·0 g. of phenylthiohydantoic acid dissolved in 30 c.c. of water or alcohol added, and the mixture shaken vigorously for several minutes. The cobalt is precipitated and after boiling for several minutes the precipitate may be filtered. Manganese may be separated in the same way as iron. The other metals including zinc are separated as above but a 10 c.c. excess of ammonia is used, and the solution boiled and stirred for some time to complete the precipitation. For the preparation of phenylthiohydantoic acid, $C_6H_5.N{:}C(NH_2).S.CH_2.COOH$, a mixture of 189 g. of monochloroacetic acid and 152 g. of ammonium thiocyanate is treated with 186 g. of aniline and 930 c.c. of methyl or ethyl alcohol, and the mixture is boiled for several hours under a reflux condenser. After allowing to settle, the clear liquid is separated and allowed to crystallise. The crystals are washed with water, dried, and recrystallised from alcohol and from water. The yield, including a second crop of crystals obtained after heating the mother liquor and insoluble matter for a further period under a reflux condenser, is 60—70%.—J. F. S.

Cobalt; Gravimetric determination of ——. H. H. Willard and D. Hall. J. Amer. Chem. Soc., 1922, 44, 2226—2231.

ALTHOUGH pure cobalt nitrate may be accurately ignited to the oxide, Co_3O_4, and the latter reduced by hydrogen to the metal, the oxide obtained by the ignition of the phenylthiohydantoic acid precipitate (*cf. supra*) contains a little sulphate. If the oxide obtained in this ignition is empirically assumed to be Co_2O_3 the results for cobalt are fairly good. The ignition of cobalt sulphate at 550° C. is the most accurate method for the determination of cobalt, but when this method is applied to the phenylthiohydantoic acid precipitate the results are usually slightly high and the sulphate is not completely soluble in water. The electrolytic estimation of cobalt is very satisfactory when the proper conditions and precautions are observed. Precipitation as cobalt ammonium phosphate followed by ignition to cobalt pyrophosphate is less accurate than the preceding methods.—J. F. S.

Cobalt; Volumetric determination of ——. [Determination of cobalt in alloy steels.] H. H. Willard and D. Hall. J. Amer. Chem. Soc., 1922, 44, 2237—2253.

VOLUMETRIC methods are the most reliable for the determination of cobalt. The most accurate method involves the oxidation of cobalt to cobaltic hydroxide in strongly alkaline solution by means of a perborate or hydrogen peroxide, followed by its reduction to a cobaltous salt. The reduction may be accomplished by the following methods: (1) addition of potassium iodide in acid solution, the iodine liberated being titrated with sodium thiosulphate; in this method iron must be absent; (2) adding the cobaltic hydroxide to an acid solution of ferrous sulphate, the excess of which is titrated with potassium permanganate; an empirical factor must be used in the calculation here; (3) addition of a strongly acid solution of stannous chloride, the excess of which is titrated with iodine, iodate, bromate, or bichromate solution; the last solution, titrated electrometrically, is especially recommended; if iron is present iodine will oxidise it quantitatively only in neutral solution; (4) addition of titanous sulphate, the excess of which is titrated with permanganate; since titanium hydroxide decomposes water with the liberation of hydrogen, the alkaline solution must be first almost completely neutralised. The presence of nickel does not interfere with these titrations, but the oxidation is incomplete if more than 7 mg. of iron is present. In the presence of a large excess of potassium bicarbonate, cobalt is oxidised by hydrogen peroxide to a green trivalent compound, which is reduced in the presence of pyrophosphate by ferrous sulphate, the excess of which is titrated with permanganate after acidifying with sulphuric acid. Iron and manganese in small amounts do not interfere with this method, but the principal source of error is in the removal of excess peroxide, without decomposing the cobalt compound. The methods described in this and preceding papers (*cf. supra*) were applied to the analysis of steels containing chromium, tungsten, vanadium, and cobalt. The procedure was as follows: A sample (0·7 g.) was treated with 40 c.c. of hydrochloric acid (sp. gr. 1·1) and the tungsten separated as a black powder, 1—2 c.c. of 85% phosphoric acid and 3 c.c. of nitric acid were added cautiously, and the solution kept hot until everything had dissolved. Seven grams of citric acid was added, and the solution neutralised with ammonia (sp. gr. 0·91) and an excess of 6 c.c. added. To the hot alkaline solution 1 g. of phenylthiohydantoic acid in 30 c.c. of hot water was added with constant stirring. The cobalt precipitated at once and the solution was boiled for a few minutes with vigorous stirring. The precipitate was filtered, washed, dried, ignited with potassium pyrosulphate, and dissolved in water. The cobalt was oxidised with perborate and reduced with standard stannous chloride, the excess of which was titrated with bichromate. Four independent determinations gave 3·77, 3·75, 3·74, and 3·75%, whilst the cobalt content found by the nitroso-β-naphthol method, after the removal of tungsten and iron, was 3·84%.—J. F. S.

Copper; Separation of —— by means of phenylthiohydantoic acid. H. H. Willard and D. Hall. J. Amer. Chem. Soc., 1922, 44, 2253—2254.

IN solutions slightly acidified with acetic acid, phenylthiohydantoic acid precipitates quantitatively copper, lead, mercury, cadmium, bismuth, and antimony, whilst arsenic, tin, and metals not precipitated by hydrogen sulphide are not precipitated. The copper precipitate when ignited to oxide contains sulphate, and ordinarily is too unstable to be weighed directly. The estimation of the copper in the precipitate is best carried out by fusing with potassium pyrosulphate, dissolving in water, and electrolysing the solution. The bismuth and antimony compounds are soluble in alcohol. Copper is separated from the metals of the iron and zinc groups by adding 7 g. of citric acid for each gram of metal precipitable by ammonia present, neutralising with ammonia and adding 5 g. of glacial acetic acid. The solution is made up to 300—400 c.c., heated to the boiling point, and treated with 0·5 g. of phenylthiohydantoic acid dissolved in a little hot water, then dilute ammonia is added until a yellow precipitate commences to form. The solution is boiled, and if the copper is entirely precipitated the precipitate rises to the top and leaves a clear solution below. If this does not happen, a little more ammonia is added, but the precipitate may then turn brown due to the formation of sulphide. The precipitate is filtered hot, washed with hot water, and treated as above. The method is excellent for small quantities of copper.—J. F. S.

Copper; Volumetric determination of —— by means of sodium nitroprusside. G. Loret. Ann. Falsif., 1922, **15**, 354—356.

The dilute nitric acid solution of the copper salt (containing not more than 0·1 g. of copper) is diluted to 100 c.c., neutralised with ammonia, then acidified slightly with nitric acid, treated with 10 c.c. of $N/10$ sodium nitroprusside solution (14·895 g. per l.), diluted to 200 c.c., and filtered; 100 c.c. of the filtrate is treated with 20 c.c. of $N/10$ silver nitrate solution, the mixture is filtered after a few mins., and 100 c.c. of this filtrate is titrated with $N/10$ thiocyanate solution, using iron alum as indicator. The number of c.c. of the thiocyanate solution used is multiplied by 12·6 to obtain the percentage of copper present. Silver, nickel, cobalt, and halogens must not be present in the copper solution.
—W. P. S.

Selenium; Determination of ——. L. Losana. Giorn. Ind. Appl., 1922, **4**, 464—466.

Selenium may be determined by the method given for estimating sulphur (J., 1922, 614 A, 691 A) if a somewhat larger excess of iron is used and air is excluded as completely as possible during the reduction. The decomposition of the selenide is effected with hydrochloric acid of at least 40—50% strength and best in a stream of hydrogen purified by permanganate, although carbon dioxide may be used. The substance taken should contain not more than 0·05 g. of selenium. Should both sulphur and selenium be present, the gases obtained on decomposing the mixed sulphide and selenide are passed in a slow current of hydrogen through the absorption tubes, the first containing zinc chloride solution acidified with just enough hydrochloric acid to prevent precipitation of zinc sulphide, and the second zinc acetate solution. Any hydrogen sulphide fixed by the first tube may be expelled by immersing this tube in a bath at 40°—50° C. and passing a rapid stream of gas through the apparatus. When the proportion of sulphur is small compared with that of selenium, a second small tube filled with zinc chloride should be placed between the other two tubes. The chloride and acetate solutions are treated separately with excess of iodine solution and titrated with thiosulphate. Penetration of selenium to the zinc acetate solution will be rendered evident by the precipitation of red selenium by the iodine solution.—T. H. P.

Volumetric methods; New ——. [*Determination of sulphate, lead, acids, and ammonia.*] K. Jellinek and H. Ens. Z. anorg. Chem., 1922, **124**, 185—202.

The known volumetric methods of determining sulphate are unsuitable on account of the filtrations involved. The authors have worked out the following method. Excess of barium nitrate is added to a sulphate solution, then excess of potassium chromate is added, and this excess determined by titrating in a barium solution until the disappearance of the yellow colour. The error by this method is 0·3%. The use of silver salt as an indicator is not possible because the solubilities of silver and barium chromates are very near. The following is given as a volumetric method of estimating lead; excess of chromate is added to a lead salt, a little silver nitrate is then added, and the excess of chromate is determined by titrating against a lead salt until the disappearance of the reddish-brown silver chromate. This latter method can also be employed for the indirect estimation of sulphate. Titration of metals against arsenates and arsenites gave no positive results. The authors suggest the use of a copper solution as an indicator in acidimetry, the alkali being added until the precipitated hydroxide makes its appearance.—W. T.

Alkali carbonates [*and hydroxide*]*; Estimation of —— in presence of phenolphthalein.* [*Determination of carbon in steel.*] M. Bonnier. Comptes rend., 1922, **175**, 765—767.

Errors in titrating alkali hydroxide in presence of alkali carbonates due to the instability of the bicarbonate, on the formation of which the end-point depends, may be eliminated by dilution of the hydroxide solution to $N/100$. Six drops of phenolphthalein indicator should be used and the acid added 1 c.c. at a time, the solution being stirred after each addition. When the colour begins to disappear, the acid should be added drop by drop. In estimations of carbon in steel by conversion into carbon dioxide which is absorbed by standard sodium hydroxide, this method is stated to give results which are accurate to 0·1 mg. In a steel containing 0·1% of carbon, for the analysis of which a sample of 1 g. of the metal is taken, this corresponds to an error of ±1 in the second decimal place.—H. J. E.

Magnesium; Volumetric estimation of —— in presence of potassium salts. A. Vürtheim. Chem. Weekblad, 1922, **19**, 461—462.

Precht's method (Z. anal. Chem., 1879, 18, 438) of addition of excess of alkali free from carbonate, filtration, and titration of the excess of alkali, gives satisfactory results. (*Cf.* J.C.S., Dec.)—S. I. L.

Iodimetry; Potassium bichromate as a standard in —— and the determination of chromates by the iodide method. W. C. Vosburgh. J. Amer. Chem. Soc., 1922, **44**, 2120—2130.

Titration of iodine with thiosulphate in dilute acid solutions gives results which are 0·1—0·3% higher and more concordant than the results of titration in a neutral solution. The presence of air affects the titration of iodine with thiosulphate when the acidity of the solution is equivalent to 0·3N hydrochloric acid or greater, causing too much thiosulphate to be required. An apparent excess of oxidising action of bichromate is caused by the titration of the iodine in a solution of too high an acid concentration. This can be corrected by the exclusion of air, but more easily by dilution to such a hydrogen ion concentration that the presence of air will not interfere. Chromates may be determined to within 0·1% by the iodide method under the proper conditions. Potassium bichromate as a standard for thiosulphate solutions agrees with pure iodine to within 0·1%, but gives a slightly lower value. Errors in the iodine standardisation leading to such a difference appear to be about as probable as errors in the bichromate standardisation. A standard solution of permanganate is not trustworthy as a standard for thiosulphate solutions.
—J. F. S.

tandardise a known amount of bichromate in /100 solution, the value found for the latter is bout 4 pts. per 1000 higher than the calculated alue; when the bichromate was 0·003*N* the amount f ferrous sulphate required was about 1% higher han the calculated quantity. The titration of the errous ion with a potassium bichromate solution ives results which agree with those obtained by the everse titration.—J. F. S.

oric acid; Estimation of ——. W. W. Deerns. Chem. Weekblad, 1922, **19**, 480—481.

HE citrate method proposed by Kolthoff (J., 1922, 63 A) for the estimation of boric acid in presence of hosphoric acid is criticised. (*Cf.* J.C.S., Dec.) —S. I. L.

hlorine; Rapid estimation of —— in organic compounds. E. Votocek. Chem. Listy, 1922, **16**, 248—249.

HE author combines the method of Marcusson and Dröscher (J., 1911, 510) with his own method of titrating chlorides with a mercuric salt, using sodium nitroprusside as indicated (*cf.* J., 1918, 444 A). Combustion of the substance in an atmosphere of oxygen in the presence of sodium hydroxide solution is effected in a funnel-shaped vessel of several litres capacity fitted with a stopcock. Since sufficient hydrogen is present in the molecule to convert all the chlorine into hydrogen chloride, the products of combustion are absorbed by water and titrated directly with mercuric nitrate. The estimation takes about 1½ hrs. —W. T.

Chromic oxide; Function of —— in oxidation by means of mixtures of sulphuric and chromic acids. L. J. Simon. Comptes rend., 1922, **175**, 768—770. (*Cf.* J., 1922, 614 A, 646 A.)

IN oxidations by this method it is important that the details as to amounts of reagents to be used should be noted. The organic substance is heated to 100° C. for 4 min. with a mixture of 12—15 c.c. of concentrated sulphuric acid and 4 g. of chromic anhydride; the latter may be replaced by 12 g. of silver chromate. The reagent itself may be similarly heated without loss of oxygen, but, on adding chromium alum, oxygen is evolved, the quantity depending on the amount of alum added. The latter may be replaced by the equivalent quantity of chromic oxide with similar results. In the presence of a sufficient quantity of chromic oxide, chromic anhydride is completely decomposed by sulphuric acid at 100° C.; the quantity added is limited in practice by the fact that the material becomes pasty. The increase in oxidising activity shown in presence of chromic salts may be utilised in oxidising substances such as homologues of acetic acid which are otherwise only partly decomposed. —H. J. E.

Molecular weight of substances in alcoholic solution; Determination of —— from the elevation of the flash-point. R. Wright. Trans. Chem. Soc., 1922, **121**, 2247—2250.

AN apparatus for the determination of the molecular weight of substances in alcoholic solution by elevation of the flash-point consists of a tinned connexion of the silica jet, the rate of [illegible] the bath being about 1° C. in 15 mins. For that determination a fixed constant quantity of liquid is placed in the vessel, which is heated for about 2 mins., the flame removed, and a series of short gusts of air admitted through the spiral by regulation of a clip until constant temperature is reached. The flame is held close to the silica jet while air is being passed through, the heating and aerating being continued alternately until, at the flash-point, the flame strikes back into the vessel with a slight explosion. The products of combustion are swept out by air, the bath cooled 1° C., and the process repeated with smaller temperature intervals between the tests. Of at least four flash-points thus obtained the lowest is taken as the correct value, an accuracy of 0·05° C. being reached. Constancy of temperature before the application of the flash test, sufficient aeration at each application of the flame to the jet, immediate removal of the products of combustion, and dryness of the jet are essential. The flash-point of pure alcohol in this apparatus is 17·4° C., and the flash-point constant 7·7, from which data and the observed flash-points of solutions of known composition the molecular weight can be determined as in the boiling-point method, the results for the substances examined being comparable in accuracy with those obtained by the latter process. The method is, however, tedious, and requires high concentrations of solute, viz., from 2 to 8%.—P. V. M.

Bingham viscosimeter; Drainage error in the ——. W. H. Herschel. J. Opt. Soc. Amer., 1922, **6**, 873—898.

DRAINAGE error in viscosimeters arises owing to the variation with viscosity of the volume of liquid discharged from the bulb of the viscosimeter. Indications of the existence of drainage error in the case of the Bingham viscosimeter are obtained by comparison of results afforded by that instrument with those given by viscosimeters of the Saybolt and Redwood types. Graphs permitting the drainage error in any test may be determined, or indicating a time of flow such that the drainage error is negligible, are given. It is concluded that drainage error in the case of a Bingham viscosimeter having a bulb of volume 4 c.c. is negligible for comparatively light oils only when a sufficiently long time is taken for the discharge, and may be avoided by having the trap on the opposite limb from the bulb which measures the volume discharged. An appendix is devoted to a comparison of viscosities as determined by the Scott viscosimeter and by Basseches's plummet method. In the latter method a cylindrical plummet with a conical base is suspended from one arm of the beam of a balance and is immersed to the junction of the cone and cylinder in the liquid under test. The times taken for the pointer of the balance to traverse a definite number of scale divisions when one or other of two definite weights is placed in turn in the balance pan are determined. The instrument is calibrated by means of a liquid of known viscosity. Results obtained are in fair agreement with one another, but differ considerably from values of viscosity determined by the falling ball method. (*Cf.* J., 1922, 964 A.) —J. S. G. T.

electrolysing the solution. The bismuth and antimony compounds are soluble in alcohol. Copper is separated from the metals of the iron and zinc groups by adding 7 g. of citric acid for each gram of metal precipitable by ammonia present, neutralising with ammonia and adding 5 g. of glacial acetic acid. The solution is made up to 300—400 c.c., heated to the boiling point, and treated with 0·5 g. of phenylthiohydantoic acid dissolved in a little hot water, then dilute ammonia is added until a yellow precipitate commences to form. The solution is boiled, and if the copper is entirely precipitated the precipitate rises to the top and leaves a clea[illegible] and precipitate rises [illegible] (Jamet). tion below, [illegible]ter analysis (Chambard); *Humus soils* ammonia [illegible] *Soils* (Robinson). 991, *Soil moisture* tur[illegible]ighton); *Soil acidity* (Van der Spek); *Iodometric* [illegible]*mination of sugars* (Auerbach and Bodländer). 992, *Inulin* (Castellani and Taylor); *Volatile acids in wines* (M[illegible]). 993, *Tryptophan in proteins* (Lüscher). 995, *Alkalinity of water and culture media* (Noll); *Nicotine in tobacco* (Popp and Contzen); *Alkaloids* (McGill); *Liquorice extract* (Giuffre). 996, *Alanine* (Jaitschnikov); *Urea* (Werner).

Patent List.

The dates given in this list are, in the case of Applications for Patents, those of application, and in the case of Complete Specifications accepted, those of the Official Journals in which the acceptance is announced. Complete Specifications thus advertised as accepted are open to inspection at the Patent Office immediately, and to opposition within two months of the date given: they are on sale at 1s. each at the Patent Office, Sale Branch, Quality Court, Chancery Lane, London, W.C. 2, 15 days after the date given.

I.—GENERAL; PLANT; MACHINERY.

Applications.

Caldwell. Production of vapour from distillable liquids or solids. 32,428. Nov. 27.

Cashman. Furnaces. 32,734. Nov. 30.

Gill. 33,341. *See* II.

Goldschmidt A.-G., Lüty, and Schertel. Production of finely-divided solid substances. 33,365. Dec. 6. (Ger., 8.12.21.)

Heller. Production of extracts from organic raw substances. 33,198. Dec. 5. (Switz., 5.12.21.)

Holmes. Pulverising-machine. 33,380. Dec. 7.

Kennedy. Crushers. 32,517. Nov. 28.

Kernohan, Lochhead, and Trink. Furnaces. 33,472. Dec. 7. (U.S., 8.12.21.)

Lewis. Production of catalytic agents. 32,977. Dec. 2.

Lloyd, Meldrums, Ltd., and Simon-Carves, Ltd. Apparatus for effecting intimate contact of gases and liquids. 33,532. Dec. 8.

Lumière. Capillary process for exchange of liquids in chemical processes, dyeing, etc. 33,331. Dec. 6. (Fr., 7.12.21.)

Pickford. Recovery of volatile liquids, solvents, etc. 32,700. Nov. 30.

Russell. 33,252. *See* XVII.

Soc. Gén d'Evaporation Proc. Prache et Bouillon. Apparatus for separating solids from liquids. 33,362 and 33,4[illegible]. Dec. 6 and 7. (Fr., 20.12.21 and 24.1.22.)

Complete Specifications Accepted.

22,062 (1921). Wake. Rotary apparatus for drying, calcining ores, low-temperature distillation, etc. (189,193.) Dec. 6.

23,035 (1921). Bellis Heat Treating Co. Crucibles. (168,887.) Dec. 13.

32,360 (1[illegible]). Allis-Chalmers Manufacturing Co. Crushers. ([illegible]739.) Dec. 13.

33,282 (1[illegible]) [illegible] 10,575 (192[illegible]). Blyth. Apparatus for separat[illegible] gas from [illegible]ial suspended therein. [illegible] Dec. 13.

a su[illegible]ution, then excess of potassium chromate is added, and this excess determined by [illegible] in a barium solution until the disappearance of the yellow colour. The error by this method is 0·3%. The use of silver salt as an indicator is not possible because the solubilities of silver and barium chromates are very near. The following is given as a volumetric method of estimating lead; excess of chromate is added to the lead salt, a little silver nitrate is then [illegible] Deutsche Werke A[illegible] chromate is deter[illegible] Dec. 6.

[illegible] (1922). Dickson and Mann, and Thornto Apparatus for wet separation of granular material (189,407.) Dec. 6.

25,050 (1922). Klug. Apparatus for separati suspended particles from gases. (188,310.) Dec.

II.—FUEL; GAS; MINERAL OILS AN WAXES; DESTRUCTIVE DISTILLATION; HEATING; LIGHTING.

Applications.

Asiatic Petroleum Co., and Marshall. 32,961. *See* XII.

Atkinson. Combustion of fuel. 33,039. Dec. 4

Calder and Lennox. Treatment of oil-gas residuals. 32,414. Nov. 27.

Caldwell. 32,428. *See* I.

Coley. Gas manufacture. 33,432. Dec. 7.

Coppée et Cie. Coal-washing apparatus. 33,704 Dec. 9. (Belg., 9.12.21.)

Dobson, and Sugden and Co. Regenerativ furnaces for gas production etc. 32,926. Dec. 2.

Dubois, Du Boistesselin, Hertenbein, Tabb, an Varnier. Agglomeration of powdered fuel et 33,335. Dec. 6. (Fr., 12.5.22.)

Gill. Furnaces, gas-producers, etc. 33,341. Dec.

Heyl. Oil shale. 33,572. Dec. 8.

Heyl. Desulphurising oils. 33,573. Dec. 8.

Hirchberg. Treatment of hydrocarbon oi 33,074. Dec. 4.

Hutchins. Retorts for distilling carbonaceo materials etc. 32,525. Nov. 28.

Jörgensen and others. 33,113. *See* IX.

Koppers Co. Purification of gases. 32,3 Nov. 27. (U.S., 8.12.21.)

Liljenroth. Production of gas. 32,612. Nov. (Sweden, 3.12.21.)

Loy. Pulverising-apparatus for solid fuel. 32,4 Nov. 27. (Fr., 6.12.21.)

Lymn. Utilising coking fuel in gas-produce 33,563. Dec. 8.

Moore. 32,887. *See* VII.

Reynard, Tapping, and Thornley. Distillation coal. 32,989 and 33,579. Dec. 2 and 8.

Soc. de Recherches et de Perfect. Industri Purifying ground combustible. 33,607. Dec. (Fr., 28.1.22.)

Complete Specifications Accepted.

14,605 and 14,725 (1921). Helps. Manufac of gas. (189,475.) Dec. 13.

20,590 (1921). Redfern (Stuart). Gas-produc (189,491.) Dec. 13.

20,596 (1921). Terrell, and Monarch Man Ltd. Light-giving bodies for incandescent light (189,492.) Dec. 13.

22,062 (1921). Wake. *See* I.

22,271 (1921). Marks (Hoover Co.). Conve of high boiling point hydrocarbon oils into low ing point oils. (189,200.) Dec. 6.

22,507–8 (1921). Broadbridge, Edser, and ley. Production of coal briquettes. (189,22 Dec. 6.

22,524 (1921). Broadbridge, Edser, and Bea Production of coke. (189,506.) Dec. 13.

22,830 (1921). Bradley. Fuel. (189,515.) De

22,[illegible] (1921). Straus. Fractionation of p eum. ([illegible]) Dec. 6.

[illegible]7,761 (1921), 941, 2729, and [illegible] Distillation of shales, coal,

SOCIETY OF CHEMICAL INDUSTRY.

FORTY-FIRST ANNUAL MEETING IN GLASGOW.

The annual meeting held in Glasgow from July 4 to 11, 1922, resembled that held in the same city exactly twelve years previously in that on both occasions a distinguished chemist from North America occupied the presidential chair; Prof. Ira Remsen enjoyed that honour in 1910 and Prof. R. F. Ruttan in 1922. Since the former year, however, the thoughts of home chemists have been widened by an ever-growing recognition of the importance of the Anglo-Saxon condominium, and it is not too much to say that the extremely cordial welcome accorded to Dr. Ruttan was not only an expression of good will and appreciation of his high personal qualities and attainments, but an acknowledgment of the fact that he represents one of the earliest and greatest of the nations constituting the British Commonwealth. The ovation which was given Dr. Ruttan when he was entertained by the London Section at Oddenino's Restaurant on June 26, and which was repeated at the dinner and meeting in the Hotel Cecil on June 28, reached a fitting climax when he took the chair at the Annual General Meeting held in the fine hall of the Institution of Engineers and Shipbuilders on July 4 in Glasgow.

In addition to Dr. Ruttan, Dr. Ellwood Hendrick, of New York, the envoy of the American Section, received a very cordial welcome, and the entire proceedings were graced by the presence of a number of foreign guests, among whom were noted Col. W. R. Lang, of the University of Toronto, Mr. F. E. Cornell, Montreal, Prof. L. F. Goodwin, of Queen's University, Kingston, Mr. A. Lucas, irector of the Government Laboratory, Cairo, Messrs. H. Wigglesworth and J. V. N. Dorr, New York, Mr. A. E. Gibbs, Philadelphia, Mr, H. A. Galt, Ohio, Messrs. W. J. Craig and A. G. Byard, rom Spain, and Mr. J. H. Marshall, from Switzerland. The attendance of home members was thoroughly representative, and the crowded meetings afforded evidence, if such were needed, that the Society has lost none of its popularity and influence among chemists or their half-brothers, the hemical engineers, and among those who walk in heir wake.

Particularly noteworthy features of the meeting were the President's address, the inaugural Messel Memorial Lecture, and the Conference of e Chemical Engineering Group. The numerous ocial functions and other diversions proved xceedingly popular and the whole programme, oth in its conception and execution, reflected e very greatest credit upon the Committee the Glasgow and West of Scotland Section, s chairman, Mr. J. H. Young, technical chemist the Cassel Cyanide Co., Ltd., and its hon. cretary, Dr. J. A. Cranston, lecturer in ysical chemistry in the Royal Technical ollege, Glasgow. It is difficult to bestow too uch praise upon all those who were responsible r or who helped in the organisation of the meet- g, but to each and all the President and Council, eaking in the name of the entire membership, ish to convey their very great appreciation and ncere thanks, and to assure them that "Glasgow, 22" will long remain in their memories as one the very best meetings that the Society has er held. In this connexion especial mention must made of the generous hospitality, which was offered with true Scottish geniality to members and guests, including the ladies, by the Rt. Hon. the Lord Provost of Glasgow, Mr. Thomas Paxton, LL.D., who in several speeches showed that he fully appreciated the value and potentialities of chemical science and industry; the Corporation of Glasgow; the Governors and Staff of the Royal Technical College; the directors of Nobel Industries, Ltd.; the Clyde Navigation Trustees; the Council of the Institution of Engineers and Shipbuilders, for the use of its fine building; David Perry, Esq., a former Lord Provost; the directors of Provincial Cinematograph Theatres, Ltd.; and a number of private individuals whose generosity contributed materially to the great success of the meeting. Nor must we forget to mention the very useful Handbook, edited by Dr. Cranston for the Local Executive Committee, which contained not only the detailed programme and all the necessary information concerning the city and neighbourhood, but a valuable account of the chemical and allied industries of Glasgow and the West of Scotland from the pen of Mr. W. H. Coleman.

Annual General Meeting.

As the full report of the proceedings of the annual general meeting appears, by traditional right, in the Transactions (this issue pp. 209—219), a short summary will suffice in this place.

The civic welcome extended by the Lord Provost and the President's reply were models of terse and apt expression; the Report of the Council was taken as read and adopted unanimously on the motion of Mr. Young, seconded by Mr. Grant Hooper; and the Hon. Treasurer's report, which disclosed a very favourable financial position but a prospect of diminished revenue, owing to the prolonged industrial depression, was also well received. The congratulations to Mr. E. V. Evans were voiced by Dr. S. Miall and Mr. F. H. Carr. The nominations of the Council for the election of president and vice-presidents were approved unanimously, and the ballot for the election of members of Council resulted in the filling of the four vacancies by Mr. J. H. Young, Dr. A. Holt, of Liverpool, Mr. W. A. Williams, of Edinburgh, and Prof. W. R. Hodgkinson, of London.

Presidential Address.

Dr. Ruttan prefaced his address with an expression of thanks for the honour conferred upon the Canadian Sections by his election to the presidency, and laid stress on the good results which had followed the holding of last year's annual meeting in Canada. After a short reference to the international organisation of science, he approached the main topic of his address, the organisation and development of scientific and industrial research. Beginning with the establishment of the parent nation's Advisory Council in 1915, he traced the various movements which had developed in Australia, South Africa, New Zealand, India, and Canada. The remainder of the address was devoted to a discussion of the fundamental problems connected with this branch of national activity, such as the nature and permanency of State-aid, the functions of central institutions, and the respective spheres of action of research associations and universities. In Dr. Ruttan's view, research in both pure and applied science should become one of the accepted responsibilities of the State, and the necessary financial support should be given with the same degree of certainty, permanency, and freedom from politics that is accorded other enterprises of a vital national character. On the motion of Dr. E. F. Armstrong, president-elect, a very hearty vote of thanks was accorded to Dr. Ruttan for his valuable address (*cf.* pp. 211—218 T of this issue), which will undoubtedly be widely read by all interested in this important subject.

After the meeting luncheon was served to over 300 members and guests in the Grosvenor Restaurant by invitation of the Glasgow Section. Mr. J. H. Young presided and made an excellent speech of welcome, to which Dr. Ruttan replied. Similar but more informal luncheons were held on the two following days, at one of which Sir David Macalister, Principal of Glasgow University, was the chief speaker.

In the afternoon of the first day members and guests attended a garden party at The Knowe, Pollokshields, by invitation of David Perry, Esq., the attractions including a band, Highland dances, bagpipes and other purely Scottish delights. The same evening the Lord Provost and magistrates of Glasgow entertained the Society at a reception in the palatial Municipal Buildings. After introductory speeches by the Lord Provost, Dr. Ruttan and Mr. J. H. Young, the guests separated, according to age and inclination, into two groups, one engaging in the dances in the Banqueting Hall and the other listening to a concert of really excellent vocal music, given by the Glasgow Select Choir, and conducted by Mr. Herbert G. Cross.

MESSEL MEMORIAL LECTURE.

On the morning of July 5, Prof. Henry E. Armstrong delivered the inaugural lecture devoted to the memory of the late Dr. Rudolph Messel. The President, having explained the nature of the bequest to the Society, presented to the lecturer the memorial medal, which has been designed by the well-known artist, Mr. E. Gillick. Sir William Pope referred to Dr. Messel as a pioneer in technical chemistry, and to Prof. Armstrong as a pioneer in technical education who had done probably more than any other to improve the quality of science teaching in this country.

The lecture, entitled "Rhapsodies culled from the Thionic Epos, including a discussion of the conditions determinative of Chemical Interchange," proved of absorbing interest; it covered, directly and incidentally, a wide range of topics, and was composed in that incisive, perspicuous and literary style of which the author is a master. Iconoclastic and constructive, retrospective and prospective, satirical and appreciative, the lecturer carried his large audience with him and well achieved the *aliquid certi* he had in view, namely, to lay a foundation and set an example. To equal a predecessor, it has been said, one must have twice his worth; succeeding Messel lecturers will need far more. As the lecture is long and will shortly be printed in the *Transactions*, it is not proposed to desecrate it by presenting it here in abstract form; it must suffice to state that it consisted mainly of a record of the life, work and character of the Society's generous benefactor and the lecturer's intimate friend, and critical but constructive dissertations on chemical action, catalysis, and sulphuric acid. That those who were not present may glean some crumbs which fell from the rostrum, we append a few of the shorter "rhapsodies" as samples of the rest, and assure them that had they heard the applause with which the vote of thanks, proposed by Prof. G. G. Henderson, was received, they would share with the writer the view that only one opinion was possible concerning the success of the First Messel Memorial Lecture.

Messel was the first to give platinum full industrial use; this was his great achievement. . . . A man of astounding vigour and full of feeling, he burnt the candle at both ends and all over its surface.

Platinum may well become the bond of union between the sexes. . . . Gold has led woman to minister to man in the past; why not platinum in the future, especially as our gold is now reduced to paper which cannot be worn with effect as jewellery?

To save the world from a Russian fate, science must be made as constructively effective in commanding human nature as it has been hitherto in hurrying the nations to their ultimate destruction.

The chemist alone, through his thionic influence, has made the Northcliffe press possible, the destruction of forests certain.

The pages of our chemical journals are full of careless writing—of careless writing due to careless thinking.

Everything seems to be now a sort-of-a-kind-of what it used to be; canned goods have captured the world and impudent advertisement counteracts conscience.

We must never forget that the laboratory worker is an artist and that, as a rule, practice comes first; so-called theory is usually brought to the aid of practice, in justification of its acts.

All single things dealt with by the chemist are chemicals. A chemical can only be defined as a material which can take part in a chemical change; combustion undeniably involves chemical change; oxygen is a chemical. Who manufactured oxygen? We can only say—It is!

Don't let us think of Lavoisier merely as a man who heated mercury in air and lost his head; think of him as the pioneer who not only sought to put system into the souls of chemists but also tipped their tongues with harmony.

Every text-book lies in telling the student that hydrogen and oxygen interact to form water.

There is nothing dogmatic in the assertion that all chemical change is an electrochemical, *i.e.*, an electrolytic, process.

Altars have been set up everywhere for the worship of a narrow doctrine mislabelled Physical Chemistry; the chief ikon has been St. Arrhenius, a divinity of Scandinavian origin; Teutonic priests, the Ostwalds . . .

A horrible pedantic jargon has been piled up around ethylic aceto-acetate and other compounds which can lead a double life, beginning with the word "tautomerism": an unnecessary invention.

Hydrogen-ion-concentration is pure gibberish, a chord that cannot be struck upon "the lyre of language clear."

Following the lecture, Mr. W. J. U. Woolcock took the chair and Dr. J. W. McDavid read a paper on "A Rapid and Accurate Method for the Calibration of Storage Tanks." The principle of the method is that water flowing through a tube or orifice under a constant head gives a constant rate of flow. By calibrating the instrument with a particular nozzle, the rate of flow can be determined accurately, so that by observing the time taken to fill a tank to a given level, the volume up to that level can be readily calculated. The apparatus weighs only 26 lb.

Dr. R. A. Joyner followed with a paper on "The Viscosity of Cellulose in Cuprammonium

Hydroxide." The author, using a modification of the method devised by Gibson, Spencer, and M'Call (J.C.S., 1920, 117, 484) has found that the viscosity of the cellulose solution diminishes as the copper content increases up to a certain limit, the concentration of the cellulose and ammonia being kept constant; that the viscosity falls as the concentration of ammonia increases, when the concentration of the cellulose and copper remain constant; but that the viscosity rises as the concentration of cellulose increases, the concentration of copper and ammonia being kept constant. The action of sodium hydroxide on the viscosity of cellulose was studied at different temperatures with varying concentrations, and on the assumption of the presence of two celluloses of widely different viscosity, the reaction appeared to obey the monomolecular law. No degradation products of cellulose were formed when the viscosity was lowered by the addition of N/30 and N/100 sodium chloride solutions at 100° C. A simple relationship was found for the action of air on cellulose dissolved in cuprammonium hydroxide; and the viscosity of the solution was reduced very quickly and without formation of oxycellulose by adding sodium hypochlorite in alkaline solution.

After lunch, members were privileged either to inspect the Dalmarnock Power Station, which supplied last year 151,688,636 B.O.T. units to private consumers, or the Provan Chemical Works, which is one of four plants owned by the Glasgow Corporation for working up by-products of gas manufacture. The Provan Works is the largest and has been completely reorganised during the last two years under the direction of Mr. W. A. Walmsley, with the result that the City is now reaping a handsome profit from the distillation of tar and ammonia. A description of the works is given in Mr. Walmsley's paper read before the Chemical Engineering Group (*cf. i.*).

ANNUAL DINNER.

The annual dinner was held in the Grosvenor Restaurant on July 5, Dr. Ruttan presiding over a very large company, which filled the large dining hall to its capacity. Among the guests were the Rt. Hon. the Lord Provost and Mrs. Paxton, Sir John Reid, Sir John S. Samuel, Dr. Ellwood Hendrick, and Dr. H. F. Stockdale.

After the loyal toasts had been honoured, Dr. E. F. Armstrong, in proposing "The Society," said it had been stated in the Press, and particularly in *The Times*, that we had no technical ability in this country. In rising to propose the toast of the Society of Chemical Industry, he felt bound to refute with all the energy at his command the suggestion that we have not in this country technical ability and aptitude both to invent and to carry out commercial operations. He declared that we have in Great Britain aptitude and ability to carry out any process under the sun; that we do not want to import, introduce, smuggle or convey under any Act of Parliament, under any definition, with or without duty, any kind of foreign chemist, foreign idea or foreign brains into this country. The trouble of chemists was that they did not advertise themselves, and if they would only adopt some of the usual methods of advertisement things would be very much better. The thing that had struck him in Glasgow was the very fine building belonging to the Institution of Engineers and Shipbuilders, and he hoped they would all leave Glasgow with a vow that they would leave no stone unturned until the chemical societies of this country had such a building. He coupled with the toast the name of their President, Dr. Ruttan, whose virtues had been sounded sufficiently already.

Dr. Ruttan, responding to the toast, spoke of the manner in which the Council had carried on the work during the year while he had been in Canada, and especially thanked Sir William Pope, who had acted as Chairman of Council during that period. The affairs of the Society were in a very flourishing condition, as were those of the five sections in Canada, where a General Council had been formed to keep these Sections in closer touch with each other. The result of the work of that General Council was that a meeting had recently been held in Ottawa at which some 100 members from all parts of Canada had attended. It was very important in the interests of the parent Society that this should be done. He read a letter of greeting from this General Council sent from this first meeting, and added that the relationship between the Sections in Canada and the parent Society were very much those of the Overseas Dominions to the Mother Country, bound by bonds of affection but without a constitution, which made them loyal supporters of the parent Society in the one case and the Mother Country in the other. He expressed his complete agreement with what Dr. Armstrong had said regarding advertisement and bringing the claims of chemistry more prominently before the notice of the public, as only in that way would they be able to influence the legislature by bringing forward a strong body of public opinion. Time would not permit him to discuss many matters he would like to, but there was one point he would bring up. The suggestion he wished to make before leaving the chair was that renewed efforts should be made to emancipate the chemists of the universities of the Empire from the domination of German reference books. This had every prospect of success at the previous meeting of the International Union of Pure and Applied Chemistry, but for some reason we in the Empire had not taken a very active part in that very important undertaking. The question had been asked, especially in America, Why duplicate these books of reference? The German books, although leaving much to be desired, were cheap and readily available. There were several reasons for this course of action. The domination by Germany of the reference shelves in the scientific libraries of the world had been an important factor in attracting graduate students to German universities and thus inoculating to a certain extent the universities of the Empire with the German method. Many examples had been quoted, especially in chemistry, where the characteristic chauvinism of the German editors had been so strong as not only to lessen their appreciation of the work of other nations, but also their accuracy in recording achievements of the "Ausländer." That we should be in possession of English summaries of the chemical literature of the last seven years at the earliest possible date was a matter of which the importance was fully appreciated, and no more opportune time to break with the tradition of viewing chemistry "through German eyes" was likely to arise. The longer we waited the more difficult would be the task. Even if the German compendia were impartial there would still remain the objection that, to younger chemists, at any rate, the habit of consulting German works of reference—in default of others—leads by mass suggestion to an appreciation of German effort in chemistry which was by no means warranted by the facts. Moreover, the German compendia were not impartial. The almost exclusive use of German compendia and monographs throughout the whole civilised world had given that country a world-wide influence and prestige out of all proportion to the value of its contributions to knowledge. He hoped that in future students in the Overseas Dominions and the Mother Country would be encouraged to complete their studies in one or the other, and that the courses might be sufficiently attractive to draw students from England to complete their studies at the universities in the colonies. It must be known throughout the Empire that British chemistry was better than German chemistry. It must be known throughout the Empire that there were greater opportunities for gaining knowledge of chemistry in England than there were in Germany. That being the case, he felt sure that it would be possible to establish within the Empire reciprocity between the various universities which would enable us to maintain the prestige of English chemistry and to increase very largely the number of men who were advancing in the higher branches of the science.

Sir William Pope, proposing "The City of Glasgow," spoke of the splendid hospitality which the Society had received at the hands of the Corporation and of all those connected with the meeting in Glasgow.

The Lord Provost, replying, said the Corporation of Glasgow was always willing to welcome societies such as this whose work so closely affected the health of large cities; none more so than the work of chemists. Glasgow had a very dense population, and they wanted all the assistance they could get from the chemical societies and scientific research men to help them in their endeavour to make the city more healthy.

Mr. W. J. U. Woolcock proposed "The Honorary Secretary of the Glasgow Section," and referred to the smooth manner in which all the arrangements for the meeting had worked.

Dr. J. A. Cranston acknowledged the toast and said that everybody connected with the task had done their share and that without that help the work could not have been done.

Mr. E. V. Evans proposed "The Glasgow Section." Mr. J. H. Young, responding, said that the members of the Section in Glasgow felt that they would like to see a definite step forward as the result of this meeting. They could not expect to add many new members at the present time owing to the trade depression, but a great deal of good would be done if joint meetings with the sections of other societies could be arranged. For instance, the Glasgow Section of the Society of Chemical Industry might arrange to hold joint meetings with the Institute of Chemistry; and the same applied to Edinburgh, and the meetings might be held alternately in Glasgow and Edinburgh. This idea of joint meetings might be pushed a great deal further than it had been hitherto and should be applied to such places as Liverpool and Manchester, and elsewhere in the case of towns in close proximity. The plan might be adopted in South Wales also, and in that way much good work remained to be done.

Prof. G. G. Henderson, who proposed the toast of "The Visitors," coupled with it the name of Dr. Ellwood Hendrick, and also suggested that telegrams of greeting should be sent from the meeting to the chemists of Canada and the United States.

Dr. Elwood Hendrick, in reply said:—

From across the deep waters I bring you greetings and the assurance of all good will and fraternity. I shall ask you to take this statement for granted and the message as delivered, because in addition to the felicitations of ceremony and the message from our hearts, I bring also a problem and seek its solution.

In what follows I shall speak only of conditions in the United States. Whether these obtain in similar or in less measure here or elsewhere in British possessions you will know far better than I. The problem has to do with the great gulf that lies between the profession of chemistry and its business. As corporations grow in magnitude, this gulf threatens to become even wider; and since Mr. Young touched upon the subject yesterday I venture the belief that you are not total strangers to it.

We study long and ardently to attain proficiency in science and in its practice. On the other hand, no study, no proficiency, no competency, and sometimes not even character, is demanded of him who would engage in the business of chemistry. So long as he can offer or borrow money he is welcome. This is because the need of chemical development is so urgent for the welfare of every industrial nation that we do not dare place hindrances in the way of it. The situation follows, however, that the business rules the profession; rules it in its own field. This is not true of all chemical enterprises by any means, but it occurs so frequently that gross ignorance directs chemical practice, that I venture to make this general statement: in the United States the weakness of chemical industry is not in the works, or in equipment, or in labour, or in engineering skill, or in the chemists themselves; it rests in the boards of directors of chemical establishments.

Corporations have the unfortunate habit of what we call window-dressing, in which men who have achieved success in any walk of life are thought to assure it also in chemical industry. Thus, a successful banker, stockbroker, lumber merchant, mine owner, and what-not are invited to join the board in the belief that the public will follow the mistaken idea that astuteness will conquer in spite of ignorance.

In no other great profession than ours does this situation exist. Imagine if you will a sick man sending for a physician and demanding that he punch a time clock coming and going, that he be paid according to the time spent in reaching his diagnosis; and that he prescribe treatment wholly according to the patient's whim and desire; or of a client insisting that his counsellor at law shall construe the law according to his wish and not as it is written.

The control of chemistry by business has reached such a pass that I have known a speculator in the industry to destroy the entire research organisation of a great establishment engaged in the most difficult and involved scientific processes, and to consult an excavation engineer for enlightenment as to how the works should be operated.

The future of the industrial nations rests with their chemists. According as they are more or less men of wisdom and understanding, and above all things men of character, industry will flourish or fade away. We cannot ask for all of these standards from the man who represents the investment of capital alone.

Now the last thing we want to do is to restrict the rights of property, or to destroy initiative. But chemical industry is a professional institution, and it cannot flourish if it is ignorantly directed. Chemical vision and understanding are required of it if it is to prosper. And the looting of corporations by cutting off necessary expenditures for research and technological development, the use of such funds for dividends, or to make a brave showing for the market manipulation of shares, is so great an offence against the general welfare that no self-respecting chemist should countenance it or endure participation in it.

Before anyone is admitted to the practice of medicine, it is required of him that he make a solemn oath to devote himself to human welfare. A solemn oath of allegiance to the principles of right is required of everyone who would practise at law. At present, chemists pass examinations—and look for a job. This does not accord with the great obligations of our profession. Therefore, as a possible means to secure a better status for the profession of chemistry in its own affairs, I venture to suggest that an Oath of Science be drawn and administered to everyone who would engage in chemical practice. He should bind himself on honour to seek diligently the truth by the right co-ordination of all facts, which alone leads to the truth, to abstain from all knavery under any and all conditions, and to address himself to the welfare of humanity, striving throughout his days to seek the light of greater understanding and to bring about a larger, a better, and more abundant life for all mankind.

Two sources of enjoyment were provided for the morning of July 6. A large party accepted the invitation of the Clyde Navigation Trustees and made a tour of Clyde Harbour on board a boat specially placed at its disposal; and the other spent an enjoyable morning in the Picture House, Sauchiehall Street, where, among more frivolous pictures, they saw a film depicting the manufacture of rubber goods, kindly lent by the North British Rubber Co., Ltd., and a second, lent by Messrs. Chance and Hunt, Ltd., showing the mining of sulphur by the Texas Gulf Sulphur Co., U.S.A. A third film, relating to the manufacture of newsprint in Quebec, was unfortunately not available.

CHEMICAL ENGINEERING GROUP.

Among those to whom congratulations are due is the Committee of the Chemical Engineering Group for organising what proved to be the most successful conference which the Group has yet held. The subject discussed was Evaporation and Distillation and under this heading the following papers were read:—(1) "Observations on the Design of Ammoniacal-Liquor Stills," by Mr. P. Parrish; (2) "Tar Distillation," by Mr. W. A. Walmsley; (3) "The General Problem of Evaporation," by Prof. J. W. Hinchley; and (4) "The Historical Development of the Distillation of Glycerin," by Mr. T. H. Gray. Mr. W. H. Coleman presided at the first session and Mr. J. Arthur Reavell, chairman of the Group, at the second. The discussions which followed the reading of the papers were bright and very useful to the technical men concerned; and the attendance throughout was extremely good. Abstracts of the papers are appended:—

Ammoniacal-Liquor Stills.

The present continuous columnar still for the distillation of gas liquor owes its origin to Savalle (1875), who was apparently intimately acquainted with the design and operation of the apparatus invented by A. Coffey in 1831 for producing in one operation a more concentrated spirit from alcoholic mashes. It is estimated that the quantity of gas liquor produced and distilled in the United Kingdom is approximately 1250 million gallons of 1·73 per cent. ammonia per year. The view is expressed that little advance has been made in the design of ammoniacal-liquor stills, largely because designers and manufacturers have concentrated their efforts on a circumscribed phase, viz., facility in removing the elements to admit of cleaning, and have to a large extent ignored, or overlooked, the question of operating costs and thermal efficiency, which are the major considerations.

The arrangements of gas-liquor stills are divided into three categories and the distinctive features of each are described and discussed. It is suggested that solutions of ammonia of such strengths as are typical of normal gas-liquor behave generally according to Henry's law. Gas laws, however, whilst allowing of a ready interpretation of the conditions obtaining in the still, do not afford all the fundamentals necessary to design, and the view is expressed that it is only by patient observation of details, such as can be obtained from practical working conditions, that an advance in the design of the elements constituting gas-liquor stills can be made possible.

Two diagrams dealing with the thermal aspect of gas-liquor stills, as affecting the manufacture of sulphate of ammonia, are furnished, and these give information on a phase of the subject concerning which singularly few data have hitherto been available.

The conditions governing the water balance of a saturator are then dealt with. This subject is of interest owing to the introduction of washing processes for the production of neutral sulphate of ammonia.

Several graphs, plotted from experimental data, are given to show:—(a) Liquor and gas concentrations at two rates of feed with identical steam consumption; (b) efficiency of a gas-liquor still from the standpoint of steam consumption; (c) relationship between the composition of the liquor being distilled and the distillate leaving the still; and (d) intrinsic capacity of a still for dealing with gas liquor of varying concentrations.

The essential parts of a unit of plant for continuous distillation are described, and the following points, among others, are considered:—(a) Gas-liquor storage tanks; (b) preheaters and coolers; (c) Devil-liquor storage tank; (d) constituent parts of gas-liquor stills; (e) liming chambers; and (f) seal pots. Many interesting observations of considerable practical utility are made, including some relating to the starting and working of gas-liquor stills which should appeal to those who are responsible for their control and supervision.

Finally, an indication is given of the direction in which still design and arrangement are likely to advance. It is suggested that the present arrangement of plant does not allow of maximum conservation of the available heat, and that modification in this respect is essential. Designers must concentrate their efforts on the evolution of the elements of a still which admit of optimum bubbling of an attenuated character, together with maximum impact of the respective bubbles so formed. Time contact between liquor and vapour must also be ensured to promote rapid distillation. Optimum bubbling is a function of a definite vapour velocity which differs in each compartment of the still. Instead of the perforations or serrations of the elements being uniform in size, as at present, they must be varied to suit the varying volumes obtaining.

In the ensuing discussion Mr. Cooper expressed the opinion that a saving of more than 15 per cent. in the steam consumption of a still was not possible, and Dr. E. W. Smith discussed the effect of using an ammonia catch in reducing the cost of producing ammonium sulphate. Two forms of hoods were described by Mr. Ramsay Sibbald, who said he had used them to replace the serrated hood, which is sensitive to slope of the column. Professor Goodwin pointed out that depth of liquor on the trays had a certain bearing on the efficiency, and that the presence of oil would greatly influence the ultimate contact between the steam and gas. Mr. Byard urged the use of superheated steam, and described its uses in a Continental works. Mr. Coleman, the chairman, in thanking Mr. Parrish for his paper, observed that this was the first paper in which the application of scientific principles to the design of ammonia-liquor stills had been fully studied. He also described the Mallet type of dissociator. Mr. Parrish gave a detailed reply.

Tar Distillation.

Of the types of tar produced in gas-works' practice, that derived from coal carbonised in horizontal retorts is essentially a high-temperature tar, whilst tar produced in vertical retorts may be regarded as a mixture of low-temperature and high-temperature tars. Low-temperature tars are essentially paraffinoid and high-temperature tars benzenoid in character. The tar acids extracted from the oils obtained by distilling "horizontal" tar are mainly phenols and phenol homologues; those derived from "vertical" tar contain polyhydric phenols showing great affinity for oxygen.

The distillation of tar may be roughly divided into two parts:—(1) The primary or crude distillation, which consists in evaporating from the tar a certain amount of its volatile matter, condensing this volatile matter and separating it into fractions, leaving behind in the still a residue of pitch of good merchantable quality; and (2) refining operations, under which are included all subsequent operations, such as the extraction and refining of tar acids, benzols, naphthas, etc.

The paper describes, with the aid of drawings, the lay-out of the Glasgow Corporation's Provan Chemical Works, and types of plant erected there for distilling tar and refining tar products. These works were designed with a view to obtaining a straight flow line through them, the waste materials travelling to one end and the finished materials to the other. The causticising portion of the carbolic-extraction plant is of interest in that the system is continuous. It comprises two Dorr reaction agitators and two Dorr thickeners, with Harding conical ball-mill, in which the lime is ground and slaked, and an Oliver continuous rotary filter for filtering the waste calcium carbonate sludge. There is also a Scott's evaporator for concentrating the caustic soda. The stripping of naphthas from light oils is carried out in two Wilton oil-topping plants, each of 10,000 gallons capacity per day. Three types of column are described in the paper, viz., the column packed with Lessing rings, the bubbler type of column, and the Kubierschky spraying column.

The paper also describes an experiment on the continuous distillation of vertical-retort tar, carried out in two Wilton dehydration coils, with a final steaming still. The tar in the first coil was maintained at 170° C. and at a pressure of about 30 lb. per sq. in. On releasing to atmospheric pressure, naphthas and water passed off as vapours to the condenser, and the residual tar was then pumped through the second coil, where the temperature and pressure were maintained at 360° C. and 24 lb. per sq. in., respectively. On reducing to atmospheric pressure, mixed carbolic and heavy oils passed away as vapours to the condenser, and the residual tar was steamed with superheated steam in the final superheating still. The experiments showed that tar could be distilled continuously with production of a good medium soft pitch of 120° F. twistpoint, even without the final steaming-still.

In the ordinary method of distillation, the tar yielded approximately 57 per cent. of oils and 43 per cent. of pitch. Under the conditions of the experiment, the yields were 73 per cent. of oils and 27 per cent. of pitch. The increased quantity of oils and the reduced quantity of pitch show that considerable cracking had taken place. The experiment, however, is not complete, as the oils produced have not yet been fully investigated.

Questions were asked by Messrs. Nichols and Mavis regarding details in connexion with the works, and in the discussion which followed Mr. Maclaurin made a strong plea for the adoption of a better nomenclature of high- and low-temperature tars, suggesting that these should be divided into five grades, namely, high-temperature tars, semi-high-temperature tars, medium-temperature tars, semi-low-temperature tars, and low-temperature tars. Mr. Parrish believed the time of contact between the flue gases and the stills in the new plant was too short and advocated the spiral instead of the vertical form of flues. He also expressed a wish that Mr. Walmsley would carry out tests on the different types of columns which had been installed at the works. The Wilton still was discussed by Messrs. Cooper and Potter, the last-named speaker giving a series of interesting figures illustrating the running of this type of plant. Mr. Coleman mentioned a series of experiments which he had carried out on pre-heaters, and suggested that a study of chimney losses would assist in economising in fuel.

The General Problem of Evaporation.

Evaporation in the technical sense is synonymous with vaporisation, which may take place under two distinct conditions, viz., at or below the boiling-point of the liquid evaporated. The study of the latter condition has occupied the attention of physicists, meteorologists, physiologists and others to an extraordinary extent for many years, but rarely has the work had any chemical-engineering aspect. Fifty years ago Stephan concluded that the rate of evaporation was proportional to the linear dimensions of the surface, and assumed that in still air it was strictly proportional to the difference between the vapour pressure of the liquid and the vapour pressure in the air; these conclusions, however, are of little use to the chemical engineer.

From a large number of experiments performed under laboratory and factory conditions, the rate of evaporation from a water surface is given by the formula

$$W = 26{\cdot}2\left(1 + \frac{v}{1{\cdot}17}\right)\left(\frac{p_e - p_a}{P}\right)^{1{\cdot}2}$$

where W is the weight of water evaporated in kg. per sq. metre per hour; v is the velocity of the current of air in metres per second; p^e is the vapour pressure of the liquid in mm. of mercury; p^1 is the vapour pressure of the water vapour in air in the same units; and P is the barometric pressure. It is obvious that the formula should give satisfactory results with any solution, if the depression of the vapour pressure of the solution due to the presence of the salt be taken into account. As from a theoretical point of view the rate of evaporation in a still atmosphere should be proportional to the vapour-pressure differences, some explanation of the index is desirable. The explanation seems to be that absolutely still air is impossible under the conditions, for moist air is lighter than dry air, so that convection must be a normal accompaniment of evaporation. Again, when there is a difference of temperature between the liquid and the atmosphere, the convection effect is still more marked.

The above formula may be applied to drying operations as well as to evaporation from crystallising tanks and similar plant. Evaporation at the boiling-point brings forward a completely different set of conditions.

The rate of heat transmission in evaporating plant depends on the temperature drop and the temperature level; the velocities of the liquid and steam over the heating surfaces; the viscosity and density of the liquid; the resistance of the heating surfaces and any deposited scale; and the resistivity of the material of which the heating surfaces are made. There is little doubt that the rate of heat transmission is nearly proportional to the temperature-drop, but since mechanical disturbance takes place in some relation to temperature-drop and temperature-level and is limited by the design of the plant, no mathematical equation can be deduced except for a particular design. For any particular type of plant or at any particular temperature-level there is one temperature-drop at which the heat transmission will be a maximum.

All manufacturers know the value of "circulation" and the problem is approached by them in several ways. Mechanical circulation has been adopted with highly beneficial results; it is always found that an improvement in heat transmission results, if the circulation be improved by increasing the area of "down-comers," by altering the hydrostatic head, or by other means.

The presence of solid matter in the liquid to be evaporated is often beneficial in limiting the amount of scale-formation, but in nearly all cases the problem of scale-formation is a problem for the chemist as well as for the chemical engineer.

It will be realised that owing to the high latent heat of steam the cost of evaporating water is very high unless steps be taken to recover the heat dissipated in the steam. By using this steam in a second apparatus working at a lower temperature and pressure, and so on, one obtains the well-known system of "multiple evaporation."

Another method of recovering the latent heat of the evaporated steam has been brought to some practical success recently. By compressing the evaporated steam its temperature may be raised so that it can be used again as heating steam in the evaporator. This is equivalent to making the heating surface of the apparatus the condenser for the evaporated steam. Siemens tried this plan in 1868, but on account of the low efficiency of compressors in his day the experiment was a failure. A "heat pump" enables one to obtain by a single evaporating apparatus the same efficiency as is obtained with a triple- or quadruple-effect evaporator.

All those who contributed to the discussion, viz., Prof. Goodwin and Messrs. Parrish, Pooley, Malpass, and Alliott, considered that the paper offered considerable food for thought. The question of frothing was raised and several interesting suggestions were made regarding its prevention and elimination. Several speakers were of the opinion that the heat pump had to be viewed from a commercial as well as a scientific standpoint, and that it was not a sound economical proposition.

History of Glycerin Distillation.

Starting with a reference to Scheele's "sweet principle of fats" (1779), obtained by digesting lead oxide with olive oil, the author alluded briefly to Cap's process (1830—40), and also to that of Tilghmann (1850), who passed an emulsion of fat and steam through iron or copper pipes at 600° F. G. F. Wilson, of Price's Candle Co., made the first notable advance, in 1854, by actually distilling candle-works' "sweet liquor," using pre-heated copper stills of 10—30 cwt. capacity and air condensers. Although this process was economically wasteful, owing to the high temperature used, it persisted until the introduction of modern steam-heated vacuum stills.

After referring briefly to the patents of G. F. Wilson (1854), Wilson and Payne (1855) and E. T. Hughes (1859), the author described the process of F. J. O'Farrell (1881) as the next important advance. This inventor patented the use of vacuum and pump for distilling crude soap-lye in steam at 200° C. The extension of the use of glycerin for blasting and in the arts led to considerable activity in the design of apparatus and patents were issued to Clark (1881), G. Payne (1882), O'Farrell (1883), A. M. Clark (1884), and A. G. Brookes (1885); but the next notable advance was made by the Belgian Van Ruymbeke (1893), who patented the master idea of using a high-pressure steam coil for heating the still, thus dispensing completely with direct fire heat. This, together with the use of expanded re-heated steam for the actual distillation, obviated to a great extent the decomposition of the glycerin.

Scott's patent (No. 15,159 of 1899) constituted the next step forward, and the author described in detail a modification of the original plant which he had used, together with some results obtained in large-scale working. The plant patented by W. E. Garrigues in 1905 (No. 24,100) was next described and characterised as somewhat complicated, but economical in consumption of heat energy. Even more intricate and more economical was the plant of F. J. Wood, of which the main idea was to work from one to six stills with one jet of steam (E.P. No. 21,658 of 1907, and No. 24,920 of 1913).

The latest development in glycerin-distillation is contained in the patent of the Société Française des Glycerines (No. 125,574 of 1919). The plant is designed to work without the use of free steam. Crude glycerin at 180° C. is passed in an atomised state by means of suitable jets from one vessel to another vessel or still of higher vacuum. Steam coils maintain the temperature at about 180° C., and condensers and pump are used as required.

During the discussion, in which Prof. J. W. Hinchley and Messrs. Pooley, Parrish, and Hayhurst took part, several important points, such as purity of yield, entrainment of impurities, points where losses occur, use of oil as heating medium, etc., were raised. In replying Mr. Gray stated that as his records had been destroyed by fire, it was impossible to give actual figures.

Conversazione at the Royal Technical College.

The social functions of the annual meeting were fittingly terminated on Friday evening, July 7, by a conversazione held in the Royal Technical College by invitation of the Glasgow Section. Prof. Thomas Gray briefly welcomed the guests in the Hall, and in speaking of the prominent share taken by the Section in the doings of the Society reminded them that two former Presidents, Sir George Beilby and Prof. G. G. Henderson, were members of that Section. Notwithstanding the attractions of the dance, which commenced forthwith, a large proportion of the visitors made the tour of the building under the guidance of Student-Associates. There were two parties—one proceeded upwards to the fourth floor to attend the first experimental chemistry lecture and inspect the chemical laboratories, and then to descend to other parts of the building, whilst the other visited the mechanical engineering laboratory in the basement to witness machinery in motion, and then worked upwards so as to arrive at the fourth floor in time for the second experimental lecture.

There were exhibits in the following Departments: — Mechanical Engineering, Electrical Engineering, Library, Natural Philosophy, Pharmacy and Materia Medica, Botany and Bacteriology, Mining, Architecture and Building Construction, Metallurgy, Geology, Textile Manufacture, Chemistry and Technical Chemistry. The latter part of the evening was devoted to dancing and social intercourse.

Excursions.

No visit to Glasgow would be complete without a trip to the historic Loch Lomond, and so on Friday, July 7, a special train conveyed a very large party of members and ladies to Balloch, where they embarked on a steamer which took them to the head of Loch Lomond and back to Tarbet. Lunch and tea were served on board, and a stay was made at Tarbet to give the party an opportunity to walk over to Loch Long.

The Saturday was spent by 100 fortunate members at the Ardeer Works of Nobel Industries, Ltd.; the special train left Glasgow at 9 a.m. and returned at 5 p.m. The visit was both enjoyable and instructive, and we hope to give an adequate account of it in a future issue.

On Monday, July 10, there was an excursion to the Trossachs. The party went by train to Aberfoyle, and thence by coach to the Trossachs Hotel, where lunch was served. A walk of about one mile brought the party to Loch Katrine pier, where members embarked for Stronachlacher. At this place coaches were taken to Inversnaid on Loch Lomond, and the return journey was made by boat to Balloch, and by special train to Glasgow. The last day was spent in Edinburgh, where the Castle, the "Royal Mile" and other historic places were visited in the forenoon. Lunch was taken in the Caledonian Station Hotel, and in the afternoon the new chemical laboratories of the University were inspected by kind permission of Sir James Walker, and a visit was made to the Forth Bridge.

THE TRAINING OF THE CHEMICAL ENGINEER.

On June 28, Dr. R. F. Ruttan was welcomed to this country at a dinner given by the Committees of the Chemical Engineering Group and the Chemical Industry Club in the Prince's Room of the Hotel Cecil, London, and subsequently a meeting of the two organisations was held to hear his address on the training of the chemical engineer. Mr. J. Arthur Reavell presided over a very large attendance. As Dr. Ruttan's address will be printed in a later issue of this *Journal* it will suffice in this place merely to indicate the nature of its contents.

In a country like Canada, where ultimate success depended entirely upon the utilisation of vast natural resources, the type of man in greatest request was he who could adapt to prevailing conditions methods, principles and processes already known and well-tried elsewhere; such a man was the chemical engineer and one of the pressing problems was to provide an adequate supply of chemical engineers to meet both the present and the future demand. The chemist and the engineer had been called respectively the physician and the surgeon of industry, each playing his allotted task in promoting industrial science, but the claims of the general practitioner must not be overlooked; the chemical engineer must be able both to diagnose with the deftness of the physician and remedy with the assurance of the surgeon.

Attempts made in certain American and British universities to train the chemical engineer by providing the student with plant and demonstrating to him processes on a semi-large scale had not been successful, and in his opinion the best means was that initiated at the Massachusetts Institute of Technology, which consisted, briefly, in a 4-years' thorough grounding in the fundamental sciences, supplemented by a year's practical training in one or more specially selected and equipped stations. Such stations were situated near to large industrial centres and were provided with plant covering a wide field of technical operations; and each unit was directed by a fully qualified lecturer experienced in works' practice and provided with a technical library, together with a wealth of information available in the form of experience gained by specialists in working the various plants engaged in the industry.

Dr. E. F. Armstrong said that the scheme outlined by Dr. Ruttan was extremely interesting, but he had been taught from boyhood to doubt everything until he was convinced, and then to remain sceptical. The great difficulty lay in teaching the student two great subjects—chemistry and engineering—concurrently. Five years' training would be insufficient to produce a man who would be fit to enter a works. The type of man most wanted in chemical industry was one who, above all else, had a good knowledge of chemistry, whose knowledge was absolutely up-to-date, and who knew how to search the latest literature for matter he did not know. Provided the aspirant had been well grounded in chemistry and physics, those in the factory could teach him all that was necessary to make him an efficient works' chemist, particularly if he had a mechanical turn of mind.

Prof. F. G. Donnan said that the most important *desideratum* in chemical engineering was complete mastery over the all-important subject of physics. Industrial chemistry was almost entirely physics. As a professor he was inclined to agree with Dr. Armstrong that the universities were unable to turn out fully-qualified chemical engineers. It was impossible to erect full-sized plant in our universities, and useless to demonstrate with miniature plant.

Sir Robert Robertson thought that the American plan would be successful. At the beginning of the war there was a great dearth of men able to work and design plant, and although few were called upon to design, experience had shown how rapidly those who were well-trained in pure physics and chemistry were able to take control. One defect in the scheme was the omission of training in costing. Dr. Ellwood Hendrick expressed the opinion that the most important factor leading to success in chemical engineering was the possession of inborn curiosity and personal inclination, and he described how at the Pratt Institute, Brooklyn, U.S.A., under Dr. Allen Rogers, ordinary industrial workers had been successfully trained on lines which took advantage of those innate qualities to convert them into competent works' chemists. He hoped and anticipated that applied psychology would be called in to aid in the selection of the right type of man. Mr. J. McKillop suggested that no scheme of education was complete unless it included training that would qualify the chemical engineer to occupy the highest position in the works, viz., that of managing director; and after Dr. Schack-Sommer had given his views, Dr. Ruttan expressed agreement with Prof. Donnan's opinion that physics should be studied far more than it had been in the past; organic chemistry should be made more quantitative, and some of the time now devoted to making preparations should be given to the study of theoretical chemistry, and especially physical chemistry, a sound knowledge of which was of supreme importance to the chemical engineer.

THE CHEMICAL INDUSTRY CLUB.

A few weeks ago a meeting was held at the Chemical Industry Club which may have important results.

The Club has been established in its present premises for nearly three years and has grown steadily, not only in numbers, but also in its position relative to the general development of the profession and industry of chemistry in this country. The strong desire for greater unity among the manifold interests of chemistry, which has shown itself in so many ways since the commencement of the war, is as keen as ever, notwithstanding the difficult period through which all have been passing. This desirable end is not easy to attain. In addition to the social side, there are other, and perhaps more important, sides upon which it is desired to bring chemists and those interested in chemistry more closely into touch, and whilst this is recognised, it is being more and more strongly felt that the Chemical Industry Club can provide at any rate a common meeting place where the other questions can be freely discussed and from which, perhaps, they can be developed. It has naturally taken time for this feeling to grow, but that it has grown is now generally recognised.

Some time ago the Federal Council for Pure and Applied Chemistry recognised the Club as an important factor in the general organisation of chemistry by inviting one of its number to represent it officially upon the Council. It is well-known that the Federal Council represents all the different chemical interests, and is the only body of its kind in the country. Its object is unification of purpose and development. At one of its recent meetings it approved by resolution the general idea of developing the Club in the interests of the profession and, at the invitation of the Club, appointed seven of its members to attend a meeting with seven representatives of the Club to discuss the best means of extending its usefulness. It is this meeting which is referred to above.

The seven members of the Federal Council who were appointed were Sir William Pope, the chairman, Prof. H. E. Armstrong, Dr. F. E. Armstrong, Dr. Stephen Miall, Mr. W. J. U. Woolcock, Mr. E. V. Evans, and Prof. J. S. Phillip. The members of the Club, who were appointed by the Executive Committee, were Mr. A. G. Craig, the chairman, Dr. W. R. Ormandy, Dr. F. B. Dehn, Dr. A. Rule, Mr. T. Miller-Jones, Mr. W. Cullen, and Mr. H. E. Coley. These fourteen gentlemen, with the single exception of Mr. Woolcock, who was unfortunately prevented from being present by a previous appointment, dined together at the Club and after dinner discussed the subject in detail.

It is inadvisable to enter into the details of that discussion, which was very frank, for to do so would be to depart from the recognised principle laid down for all Club meetings, viz., not to give publicity to the views expressed. The Club has always endeavoured to promote frank expression of opinion, which is essential to its success. Consequently, what was said at this very interesting gathering, and a good deal was said, will be regarded merely as a necessary but confidential preliminary to the results obtained.

However, some facts and figures were given in order to enable those present to form their opinions, and these are of general interest. It was stated that the number of members standing on the books of the Club at that moment was 727. Of these 456 were town members, 244 country members, and 27 foreign members. Although such a membership was regarded as indicating very great progress, it was felt that there were many more who might and should join, and that the total did not represent all the support the profession and industry generally could give to the Club. It is, perhaps, understandable that in the early days of the Club some should have doubted its usefulness and were therefore not disposed to support it, but that feeling is practically eliminated, and now that the Club is receiving support from so many leaders of the profession, there is no reason why it should not increase very materially both its membership and its usefulness.

Financially the Club has been a success. It has paid its way without asking for a single donation or calling upon its guarantors for one penny. It has succeeded in accumulating sufficient funds to enable it to undertake necessary improvements, slowly, it is true, but surely. But it needs a little more support to enable it to provide some facilities which are perhaps not absolutely necessary but are certainly very desirable. At the present rate of subscription, which is very low (£3 3s. for town members, £2 2s. for country members, and £1 1s. for foreign members), each member contributes an average of about £2 14s. to the Club's income. The premises are sufficiently spacious to accommodate 1000 members, and an increase to this figure is one of the immediate objects in view.

Such a gain in membership would increase the income by about £700, and with this sum much could be done to increase the general efficiency of the Club. At the same time it must be remembered that the present facilities are not by any means limited to those seen and enjoyed in the Club premises proper at No. 2, Whitehall Court. The members have the use of another dining room across the corridor, an excellent lounge and drawing room, and bedroom accommodation.

It was made clear at the meeting referred to that the present Club could serve as the nucleus of a much more elaborate and imposing organisation, and so fulfil the dreams of many. But such growth would have to be steady and sure. The ambition was approved, but those who could claim the longest experience and the greatest influence in the profession advised, and rightly advised, a continuation of the steady work which was now proceeding, and promised the weight of their influence in the effort. They thought that if the present policy of keeping the Club as chemically select as possible were continued, an increasing number of professional men would apply for membership.

And so, as the result of a very pleasant evening, it was decided to hold regular meetings of the representatives present, with the object of gradually building up the Club on sound lines in the interest of the profession and industry of chemistry generally. The fourteen members named above have undertaken, with the consent of the two organisations—the Federal Council and the Club—to work individually and collectively to make the Club better known and greatly to increase its influence in uniting the separate chemical interests of the country into a concrete and powerful whole.

STELLAR CHEMISTRY.

H. DINGLE.

The science of chemistry owes its origin and early development to the inspiration of one great idea. With a passion almost religious in its fervour, men consecrated their time, their thought, their energy—their whole lives, in short—to the search for the Philosopher's Stone. Universal transmutation was the goal of their ambition. We do not think much to-day of the Philosopher's Stone. We look upon it as chimerical, unworthy of the serious attention of scientific workers. Transmutation we know takes place; we have direct evidence of it; but the Philosopher's Stone—that is too much for our credulity.

And yet, if we take the trouble to examine the grounds on which we reject it, we shall find our justification not a very easy thing to establish after all. Shall we say the idea is too fantastic, somewhat too reminiscent of the Arabian Nights? It ill becomes us, in these days, to deny existence to the marvellous. Are not the Arabian Nights themselves made to look commonplace? Pioneers of aeronautics have given us a carpet as magical as any conceived by the Eastern mind. Centuries ago a Greek Aladdin rubbed a rod of amber, and the genius of the rod now lights our cities, warms our homes, carries us to the ends of the earth, and executes our enemies. No; it is not on these grounds that we can reject the Philosopher's Stone. Nor can we take refuge in the fundamental diversity of the chemical elements. That doctrine, from which the 19th century drew such nourishment, is barren for the 20th: the atom is no longer the ultimate particle of matter. We are forced, then, to the contention that there is no evidence for the existence of a Philosopher's Stone, that it diverges from the whole trend of modern thought, and that it is therefore intrinsically improbable. But can even this position be maintained? If we consider stellar spectra in relation to temperature, we find that the hotter the star the simpler the spectrum, until at the highest temperature we obtain practically nothing but the lines of hydrogen or helium. Is it, then, not reasonable to argue that in temperature we have the true Philosopher's Stone, converting all things—not, indeed, to gold, but to the infinitely more precious substance, hydrogen? Whatever may be said on this point—and we shall return to it later—there is no doubt that if a modern chemist devoted his attention to the production of extremely high temperatures, with a view to the transmutation of every element into hydrogen, he would be regarded, not as a fanatic, but as one engaged on a problem of the utmost importance and pertinence. It would be strange indeed if chemistry, after abandoning the idea that retarded its progress for so long, were led by the onward march of progress back to that idea again.

Stellar chemistry has, indeed, a wonderful tale to tell. It was in 1859 that the researches of Kirchhoff and Bunsen, on the absorption of light by luminous gases and vapours, showed for the first time how the solar spectrum was to be interpreted. With that discovery a new era was opened in the annals of science, no less fundamental and infinitely farther reaching, both in space and in time, than the simultaneous announcement by Darwin of the doctrine of biological evolution. Everyone now knows how the twin sciences of astrochemistry and astrophysics arose. The spectra of terrestrial sources of light were, broadly speaking, of two kinds, depending on the physical state of the luminous body. A glowing solid or liquid gave rise to a bright continuous spectrum. An incandescent vapour produced a spectrum consisting of bright lines or bands on a dark background. The fact that the latter type of spectrum was characteristic of the chemical nature of its source suggested a means of analysis far more convenient than the standard reaction methods, and one which could be applied to substances at any distance from the experimenter so long as they were in the gaseous form and sent out sufficient light. The stars—and, in particular, the sun—were at temperatures incompatible with any condition but a gaseous one, and it would seem, therefore, that their composition could be determined. But there was a serious difficulty, in that the solar spectrum was of a kind quite unlike that of a luminous body on the earth. It consisted of a continuous spectrum, crossed by a large number of *dark* lines and bands. What was to be made of this? Kirchhoff and Bunsen solved the problem by showing that the dark lines were produced by absorption, and not by emission, of light. They found that if a glowing gas were placed in the path of a beam of light from a hotter source, giving a continuous spectrum, the gas would absorb from the beam just those "wave lengths," or spectrum lines, which by itself it would emit. The resulting spectrum would have a continuous background, crossed by dark lines in positions corresponding to the emission lines of the interposed gas, and would therefore serve the same purpose, so far as chemical analysis was concerned, as the emission spectrum of the gas.

The meaning of the solar spectrum was at once made clear. The sun consisted of a central mass giving a continuous spectrum, and an outer envelope of cooler vapours, whose chemical composition could be ascertained by comparing the dark lines of the solar spectrum with the emission lines of various substances produced terrestrially. It was not long before the spectra of other stars were obtained, and found, in the great majority of cases, to be absorption spectra of similar type, though not always showing the dark lines in the same positions. It appeared, therefore, that the constitution of the sun was typical of that of most of the members of our stellar system. Confirmation of this constitution was obtained by placing the slit of the spectroscope tangentially to the sun, so that only the light of the outer portions was analysed. The spectrum obtained showed bright lines, most of which were identical in position with some of the dark lines in the ordinary solar spectrum.

Thus, almost at a bound, chemistry became a cosmical science. We are accustomed to this today, and it is perhaps a little difficult for us to realise what must have been the emotions of those before whose eyes the larger field was spread for the first time. Dynamics—which for so long had been the sole guide to cosmogony—now shared the honour with chemistry. Indeed, chemistry took precedence, for whereas dynamics was practically confined to the solar system, chemistry could extend its labours into the whole of the visible universe. By far the most striking fact of stellar chemistry is the discovery that the universe throughout consists of practically the same elements as those with which we are familiar on the earth. The lines in stellar and nebular spectra which have not yet been identified are extremely few, and there is strong probability that their number will be still further reduced. Not only is this true of our own stellar system, but the spiral nebulæ, which are believed by many astronomers to be distinct universes, also show lines which we can match in terrestrial laboratories. When we consider the enormous extent of space covered by modern observations, and the extreme diversity of the physical conditions existing in the different bodies examined, we cannot but realise that there must be some deep significance in this remarkable fact. Does it mean that the whole of the physical universe arose from a common origin? Or is it that Nature is restricted in her operations, so that she cannot produce material existences of a different type from those of which the earth is composed? At present we cannot decide between these alternatives.

It is not surprising that, in their early enthusiasm at the tremendous possibilities opened up by spectrum analysis, chemists should have entertained hopes which have not as yet, at any rate, been realised. Sober reflection shows us that the power of the spectroscope is limited in more than one direction. The spectrum tells us nothing, for example, of the chemical composition of the greater bulk of the sun and stars; namely, the inner portions, which give rise to the continuous background of the spectra. We can only analyse the thin outer envelopes or atmospheres of these bodies. Nor can we even be sure that our information there is complete. The hypothetical element, coronium, for instance, is represented in the solar spectrum only by bright lines produced from the sun's corona during an eclipse. It gives no absorption lines, and if we had no moon to shut out the body of the sun's light, we might even now be ignorant of its existence. Who can say what substances present in the stars may be hidden from us in the same way? Again, we know now that there is a very large amount of dark matter in the universe. With regard to this, and to the composition of millions of faint stars which our large telescopes reveal to us, the spectroscope is silent. Once it was hoped that a means might be found of analysing a substance through light reflected from its surface, and that in this way the planets could be brought to yield up the secret of their composition. But here also our hopes have met with disappointment, except in so far as absorption by planetary atmospheres has lifted the veil a very little. Even our nearest neighbour, the moon, is a complete stranger to us. The fact is that the spectroscope, after bestowing its early affection on chemistry, has transferred its favours to physics. The later developments of spectroscopy have thrown no end of light on the physical characteristics and order of development of the stars. So intimate is our present knowledge of the processes taking place in a luminous body that it is probable that, even had the heavenly bodies yielded only unfamiliar spectrum lines corresponding to no known elements, we should still, in time, have been able to analyse the spectra and form ideas as to the evolution of the physical universe.

So far as chemistry is concerned, however, it is possible that the recent progress of astrophysics may throw some light on the order of the evolution of the elements. The study of a large number of stellar spectra has shown that the spectra can be arranged in a continuous sequence, in which the transition throughout, from one end to the other, is perfectly gradual. The spectra of more than 99 per cent. of the stars examined are included in this sequence, and the few outstanding ones, though of great interest from a physical point of view, can be ignored for our present purpose. The temperatures of the stars whose spectra are thus classified are also found to be in regular order. Thus, denoting arbitrarily-made divisions of the succession by the letters B, A, F, G, K, M, we find that, from the B to the M stars, the temperature falls continuously. The characteristics of the various classes of spectra are as follows. In the very hottest stars —of which comparatively few exist, and which precede the sequence we have mentioned—we obtain bright lines of hydrogen and helium, together with evidence of an unknown substance. In the B stars hydrogen and helium are still predominant, but faint lines of other elements appear also. These are somewhat strengthened in the A stars, though the hydrogen lines still form by far the most conspicuous feature. The hydrogen lines are considerably less predominant in the F stars, and the metallic lines are much stronger. The G stars, *e.g.*, the sun, show the metals as conspicuously as they do hydrogen. The same tendency is continued in the K group, whilst in the M stars bands of compounds —particularly titanium oxide—make their appearance. We have thus a regular progression, with decreasing temperature, from a marked predominance of the lightest elements to a more or less uniform distribution of a variety of substances.

It is inevitably suggested by these facts that in the stars elements are being made or broken up. There is strong reason to believe that each star passes through the spectral sequence twice—first from M to B, and then back to M again. If, then, we are to take the spectra at their surface value, it would seem that in the upward stage the elements are being broken up into lighter ones, and that recombination takes place as the star descends the scale of temperature again. If this is so, a large amount of energy must be released during the building-up process, and we could account very satisfactorily for the maintenance of the heat of some of the stars, such as the sun, in spite of the enormous amount of energy they radiate continuously into space. The hypothesis has obvious attractions. But we must remember that the spectrum is not an infallible guide to the complete composition of its source. The fact that the spectrum of a star consists mainly of hydrogen does not necessarily mean that the star itself is so constituted. In this connexion a suggestion recently advanced by Dr. Saha, of Calcutta, is of very great interest.

The atom, as is well known, is now believed to consist of a central core of positive electricity, surrounded by an equivalent negative charge in the form of electrons, whose number varies from element to element. The core practically determines the atomic weight, whilst the chemical and spectral properties of the atom are due to the outer electrons. At high temperatures there is a tendency for an atom to become *ionised*, *i.e.*, to lose one of its electrons, by the vigour of its collisions with neighbouring atoms. When it does this its spectrum is considerably modified and the substance becomes, in fact, for spectroscopic purposes, a new element. At a still higher temperature another electron may become detached, and then virtually a third new element is produced, and so on. Now the successive spectra, due to the neutral, singly-ionised, doubly-ionised, etc. atoms, tend to lie farther and farther in the ultra-violet region as the amount of ionisation is increased. But, owing to the absorption of the shorter waves by the earth's atmosphere, we are unable to obtain solar and stellar spectra beyond a short distance in the ultra-violet. Consequently, the spectrum of a star which appears to us to contain practically nothing but hydrogen, may actually contain lines, in the far ultra-violet, due to a large number of ionised substances of which we can obtain no knowledge. Hydrogen, however, is not affected in this way to anything like the same extent as the heavier elements, for, since it contains only one electron, it would, if it lost that, cease to be an element at all and would have no chemical or spectral properties. At very high temperatures, therefore, the visible spectrum of a mixture of substances would appear to be dominated by hydrogen. On this view the spectral evidence of the absence of a substance from a star is not to be accepted as final.

We are dealing here with problems of very great difficulty. The time has not yet come when decisive answers can be given to them. Nevertheless, the rate of progress during the last few years has been so rapid that it would be unwise to conclude too hastily that they are beyond solution. Chemistry has, at any rate, a new direction for its activities, and it is not improbable that in the stars it will find the answer to questions which, in the laboratories of earth, could hardly have arisen.

THE RECOVERY OF PRECIOUS METALS FROM PHOTOGRAPHIC AND OTHER TRADE-WASTE SOLUTIONS.

E. GARDNER.

Comparatively large quantities of silver, gold, and platinum are used in photography, glass-silvering and chemical gilding, electroplating and other industries, but relatively very small amounts are recovered from spent solutions owing to ignorance of simple and cheap methods of recovery. In the first three trades mentioned above, over 2 million ounces of silver nitrate, worth £200,000, is consumed yearly in Great Britain; of this amount more than three-quarters is used in photography and most of the silver content is lost irretrievably.

Photography.—The spent solutions produced by the photographer comprise toning-baths, fixing-baths, and various washing waters. Taking an average print on self-toning paper, about 85 per cent. of the silver originally present goes into the preliminary wash-water and fixing baths, 5—8 per cent., remains on the print, and the remainder passes away in the final washing.

Of the methods of recovery recommended in text-books on photography, precipitation of silver from fixing-baths and wash waters by means of "liver of sulphur" does not produce a precipitate that settles well, and contamination with polysulphide, or any sulphides, is to be avoided where photographic materials are used. Precipitation of gold from toning-baths by ferrous sulphate is not satisfactory for cold and very dilute solutions, especially when thiocyanates are present; and there are much better reducing agents than ferrous oxalate for precipitating platinum.

The method recommended by the writer is to collect all solutions in a wooden vessel and to precipitate with clean scrap iron. Reduction is complete within 24 hours, heating is unnecessary, and the precipitate settles very satisfactorily. Two wooden casks should be used for continuous photographic work, one being used for charging and precipitating while the precipitate is settling in the other. The clear liquid is siphoned off.

At the yearly clean-up the precipitate is passed with water through a coarse sieve (6 holes to the linear inch) to separate undissolved iron, drained on a calico filter, washed with hot water, placed with the cloth in an enamel dish, and dried at a gentle heat. The precipitate should not be dried completely otherwise it may ignite spontaneously. It consists of impure metallic silver and possibly gold and platinum, and is technically termed "foots," an Anglo-Saxon word meaning the dregs or lees settling from a liquor. The operation of obtaining the precipitate may be called "footing."

The precious metals on paper cuttings, spoiled prints, etc. may be recovered by incinerating the material, if necessary after moistening with a solution of alkali nitrate, and adding it to the footing cask. Great care is required in burning celluloid films. Spoiled plates should be fixed, but negatives are not worth stripping. Batches of spoiled emulsion should be liquefied in warm water and treated with scrap iron in a separate cask, as they are very rich in silver. It is recommended that the collected precipitates be sent direct to a refinery; it is useless to send dilute solutions to a refinery as the freight on these will leave no margin of profit.

Glass-Silvering and Chemical Gilding.—In this, the next largest of the industries using gold and silver compounds, the bulk of the metal is retained on the article manufactured and the solutions used are to a large extent self-precipitating. All spent solutions and ashes are put into the foots barrel, as described above, and preferably with the addition of a little sodium chloride. The ashes will include those of sawdust, which is, or ought to be placed wherever solutions containing precious metals may drop or be spilt, as well as those of old polishing cloths, aprons and leathers. It should be noted that sawdust saturated with silver nitrate is very inflammable when dry. Handwash is collected in a separate vessel in which it is not necessary to use iron for precipitation, and settling can be facilitated by adding a very little lime. At the clean-up the rate of filtration can be accelerated by mixing some coarse sawdust with the precipitate. The whole is then dried, burned, and the ashes collected. Gold and silver stains on the hands can be readily removed with a very dilute solution of potassium cyanide, to which a few drops of hydrogen-peroxide solution have been added, and these washings can be put in the foots barrel. Finally, the foots barrel, after it has been in use for several years, should be burned and the ashes collected.

Gilding and Electroplating.—The electroplater has as a rule some knowledge of chemical manipulation and facilities for heating batches of liquor. For the recovery of precious metals from cyanide baths, many text-books recommend the addition of sufficient acid to decompose half the cyanide, and so precipitate the insoluble gold or silver cyanide. This method is to be condemned as very dangerous owing to the evolution of hydrogen cyanide. It is true that the recovery is fairly complete with silver, but the clear acid liquor has to be treated subsequently with scrap iron in the case of gold. Another method recommended is to evaporate the bath to dryness and to fuse the residue in a crucible; this is impracticable in many workshops. A more convenient method is to heat these solutions with zinc dust with frequent stirring, when a complete although slow precipitation is obtained. A very rough test to ascertain if precipitation is complete is to acidify a sample of liquid with hydrochloric acid; absence of precipitate indicates complete precipitation of the precious metals.

All neutral or slightly acid silver solutions, other than cyanide, should be acidified and precipitated as chloride. Desilverising acid or "stripping" solution must, if necessary, be diluted before precipitation, and the filtrate obtained must be neutralised or further diluted before passing to the drain. The precipitated chlorides may be drained and sent to the refiner, or reduced to metallic silver with scrap iron.

Solutions from platinum-plating, which often contain much phosphate, can be precipitated with zinc dust, but complete reduction is difficult. In some workshops electrolytic reduction, using an insoluble anode, is carried out and found satisfactory.

Filtration of Precipitates.—A few instructions on the making of square calico filters for these precipitates may be of use.

A square wooden frame is made of such size that its corners will just rest on the edge of the deep circular vessel into which it is proposed to filter. The frame may be, for example, 14 in. square and 3 in. deep and made of batten 1 in. thick, thus leaving an inner opening of 12 in. square.

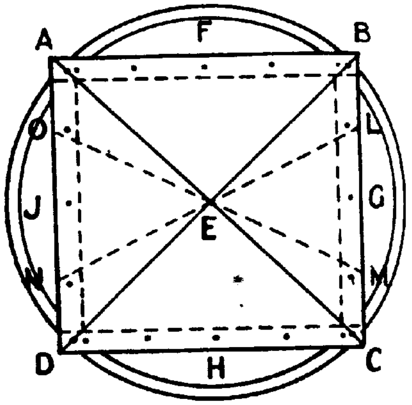


FIG. 1.

Top view of filter. Scale ⅛.

From a piece of new, closely woven calico, washed to remove dressing and dried, cut an exact square of 24 in. side, mark the middle of each side and the middle of each upper edge of the frame, which may be conveniently standing on the circular vessel (Fig. 1). Taking the middle of each cloth-edge in turn, and doubling ½ in. underneath to strengthen it, fasten it temporarily by means of copper tacks to the middle-points, F, G, H, J, of the upper edges of the frame, leaving the slack of the cloth hanging inside.

On the side AB, draw the cloth-edge tight from its central tack, double ½ in. underneath as before, and fasten it with a tack almost at the corner B; repeat this with the other half of the same edge towards corner A. Turn the frame round and deal similarly with side CD. These two sides are now finished and are represented in the diagram of the unfolded cloth taken from the frame by the same letters (Fig. 2).

Taking side BC, hold the cloth-edge in one hand at a point B_1 (Fig. 2), 6·5 in. from the central tack, double ½ in. underneath as before, slightly raise it from the frame, and with the other hand fold neatly along the line EP. Bring the point B_1 exactly down to the corner B of the frame and fasten it there with a tack; treat the similar points C_1, D_1, and A_1 in the same way.

The cloth ought now to form a perfectly regular inverted pyramid inside the frame, and if not, some slight adjustment must be made. Each side will consist of one layer of cloth, but underneath the smaller triangles EBL, EMC, EDN, and EOA, in Fig. 1 there will be two extra layers. Drive the tacks home, add a few extra ones, and trim off the four ears of cloth which project beyond the frame (the triangles AA_1T, BB_1P, CC_1R, and DD_1S in Fig 2).

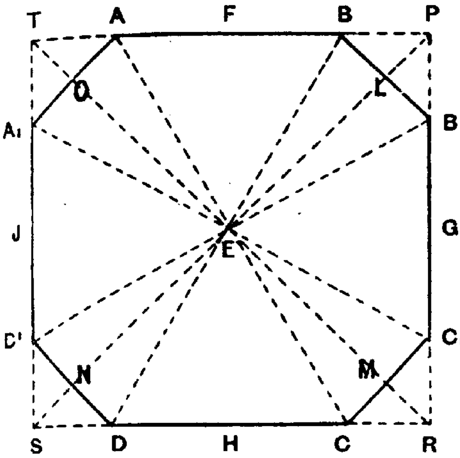


Fig. 2.

Filter cloth removed from frame, showing folds. Scale ⅛.

The filter is now ready for use. Some boiling water is first passed through. Then a little precipitate is put in to form a filter bed, and as soon as the filtrate runs clear the filtration is proceeded with, care being taken that the filter does not run dry before all the precipitate is placed on the cloth. Finally, remove the soluble salts by washing a few times with hot water.

In packing precipitates before sending them to a refinery, care should be taken not to use metal boxes. A precipitate like moist silver chloride rapidly attacks iron or zinc, and foots powders often retain sufficient acid to corrode a metallic container. Well-made wooden boxes or jars of glass or earthenware should be used.

SAFEGUARDING OF INDUSTRIES ACT.

BORIC ACID.

On May 27, 30 and 31, Mr. Cyril Atkinson heard the complaint of the Chemical Merchants' and Users' National Vigilance Committee, represented by Mr. K. Swan and Mr. R. L. Parry, that boric acid had been improperly included in the list of articles dutiable under Part I. of the Act. The opponents, represented by Sir Arthur Colefax and the Hon. S. Cripps, were Howards and Sons, Ltd., H. Coghill and Son, Ltd. (Newcastle, Staffs.), G. H. Poole and Sons (Bootle), and Joseph Townsend, Ltd. (Glasgow). Mr. Whitehead represented the Board of Trade.

Mr. Swan, for the complainants, said that the boric acid imported into this country, mostly of 99·5 per cent. purity, came from the Larderello district of Tuscany, but the importation had ceased since the passing of the Act. The point at issue was whether this acid was a fine chemical or not; he held that it was not. Boric acid was used mainly for the following technical purposes:—(1) For preserving butter and other foodstuffs; (2) in pharmacy; (3) in toilet preparations; (4) for glazing and enamelling pottery; (5) in the glass industry; (6) in metallurgy; (7) for leather manufacture; (8) in the soap industry; (9) for paper-making; (10) in the manufacture of candles; (11) for making borax; (12) as a ball-room floor polish. It was not normally, if at all, used as an analytical reagent; it had not been treated by the trade as a fine chemical, and was not manufactured by fine-chemical manufacturers. It was not generally dealt in or handled by dealers in fine chemicals, but was almost always sold by the producers or their agents direct to the consumer. It was obtained mainly from Tuscany, but also from natural borax by the simple processes of acidification and crystallisation.

Evidence was then given by representatives of four firms of chemical dealers, who stated that in their opinion boric acid was a heavy chemical; and various references in trade journals were adduced in support of this view. It was, however, elicited that in this country dealings in boric acid for the home trade were very rare and for relatively very small quantities.

Signor U. Funajoli, managing director and head of the electrical department of the Società Boracifera di Larderello, Florence, described the occurrence and extraction of boric acid from the natural springs and *soffioni* in Tuscany, and emphasised the simplicity of the process that was utilised in producing acid of 99·5 per cent. purity. He stated that during the war his firm exported about 80—90 tons a month to the United Kingdom, and that this trade existed before the war. About 10 per cent. of the boric acid exported consisted of 82 per cent. material, which was labelled "crude" and made by mixing the 99·5 per cent. acid with the lowest grade material of 55 per cent. purity. All the output was sold to Borax Consolidated, Ltd., and unless chemically pure boric acid was asked for no tests were made for the presence of lead and arsenic; if these were present they were eliminated by further crystallisation. His company's works were under the Government Mining Department and were not regarded as chemical works. Counsel for opponents elicited that since the Act was passed boric acid had been sent into this country invoiced as sassolite, a mineral containing about 80 per cent. of boric acid. Practically all the material exported from Italy was produced by his company. Before the war more crude acid than refined was exported; during the war the proportion of refined rose considerably, this product bringing in the greater profit; but recently increased labour costs had militated against the production of the refined material.

Mr. E. J. Parry agreed with the previous evidence, excepting the statement that arsenic and lead could be removed by crystallisation. The uses of boric acid in this country were distributed approximately as follows:—preservatives 60 per cent.; medicine and pharmacy 30 per cent.; other uses 10 per cent. Witness quoted a number of printed references to the classification of boric acid as a heavy chemical, and stated that in this Society's *Journal* abstracts concerning it were placed in Section VII., in which heavy chemicals were for the most part treated.

Sir A. Colefax said that his case was that boric acid was a fine chemical. No attempt had been made to describe how the Italian material was purified. As carried out in this country the manufacture was extremely difficult inasmuch as lead and arsenic had to be eliminated. As Mr. Parry had admitted, the B.P. quality was not sufficiently pure for preservative purposes. Imports from Italy were about 40 per cent. of the total importation, but only a fraction of the quantity manufactured here.

Mr. Alfred Howard, director of Howards and Sons, Ltd., said that his firm had been manufacturing boric acid for more than 40 years and that over 90 per cent. of the production, which was all of B.P. quality, was sold to wholesale druggists; the raw material used—boracite or colemanite—was purchased from Borax Consolidated, Ltd. Even if not of B.P. standard, he regarded boric acid as a fine chemical because it required much careful preparation. Similar evidence was given by Mr. H. Poole, whose firm manufactures boric acid for use as a food preservative. Mr. T. E. Lescher, director of Evans Sons, Lescher and Webb, Ltd., said that his company dealt in, but did not manufacture, boric acid—chemically pure, pure B.P., and commercially pure. The last-named was generally of B.P. quality, but the purity was not guaranteed. He regarded boric acid as a fine chemical because it was mainly used for medicinal and preservative purposes, and it had to be extremely pure. If such a chemical were used mainly for industrial purposes he would regard it as a heavy chemical, but he would still consider boric acid a fine chemical even if 50 per cent. of the production were used in industry.

Mr. B. D. Jones, secretary of Burton, Baker and Co., said that his firm used annually 300 tons of boric acid for food preservation, all of which was purchased from Borax Consolidated, Ltd., and Mr. F. Dickens, of Darton, Gibbs and Co., antiseptic surgical dressing manufacturers, stated that his company used 50 tons per annum. Mr. P. A. W. Self submitted results of analyses of commercial boric acid showing the high degree of purity of this grade, nearly all of which is apparently up to B.P. quality. On this account he held boric acid to be a fine chemical. If pharmaceutical chemicals and antiseptics were excluded from the list of fine chemicals, practically only analytical reagents would be left in it. Mr. F. A. Hocking, pharmacist to the London Hospital, stated that that Medical School consumed 2¼ tons of boric acid yearly; and Mr. Edmund White, managing director of Hopkin and Williams, Ltd., expressed the view that boric acid was a typical fine chemical.

Mr. H. F. Johnson, sales manager to Borax Consolidated, Ltd., said that his company controlled many boric-acid manufacturing plants, partly through subsidiary companies and partly by working arrangements. About one-fifth of all the boric acid imported into this country came from Italy, which provided about 11 per cent. of the world's consumption. Of the boric acid consumed in the United Kingdom, 36·22 per cent. was used in medicine and surgery, 34 per cent. for food preservatives, and 6·78 per cent. for boric lint; but of borax, 82 per cent. was used for industrial purposes (pottery 25%, enamelling 14%, dyes 1%, glass 1·78%, metal industries 3·6%, paint and varnish 1·79%, and starch 10%). His firm controlled 85 per cent. of the sales of boric acid in this country, and all of it was up to the old B.P. standard. Much more of the acid manufactured here was used for pharmaceutical than for industrial purposes. A letter from the witness to the Larderello Co., written in October last, was then produced, in which he stated that the principal use was for industrial purposes, and that its importation should be free. The report of the directors of his company for 1921 was quoted to the effect that the medicinal uses of boric acid were ancillary to its industrial uses, and it was stated that the company had lodged a complaint with the Board of Trade asking that boric acid be removed from the list as it was in no sense a fine chemical. The witness explained that at that time he was importing boric acid, and that the complaint had been dispatched without proper consultation with his technical colleague, who had afterwards objected. Subsequently pressure was brought to bear by the manufacturers in this country, and the complaint was withdrawn. The industrial uses of boric acid in this country were—pottery 3·7, enamelling 0·42, glass 3·65, and tannery 4·84 per cent. respectively of the total consumption. Of borax and boric acid combined about 60 per cent. was used for industrial purposes.

The process of manufacture in this country was then described *in camera* by Mr. H. Derring, works manager and chief chemist to Joseph Townsend and Co., Ltd., of Port Dunder, Glasgow. Dr. H. Bassett, professor of chemistry in University College, Reading, supported the view that the process conducted in this country was a fine-chemical process because its conduct involved continuous, skilled chemical supervision. In his view boric acid was a fine chemical because of the complexity of the process of manufacture; because the bulk of it was used for purposes which demanded very great purity, and most of these purposes were real chemical purposes, its uses in pharmacy and as an antiseptic being based on its chemical activity. His views on the general question of what is a fine chemical had been arrived at since the Act was passed, and he had followed with much interest the reports of the discussions which had been held by Sections of the Society of Chemical Industry. He did not think that references to trade catalogues threw much light upon the subject.

In his final speech Sir A. Colefax said that the complaint concerned only a fraction (one-fifth in 1920) of the boric acid consumed in this country. The object of the Act was to safeguard *home* industries, and over 80 per cent. of the consumption was made here by a process which differed entirely from the Italian process, and which required continual skilled chemical supervision, *i.e.*, supervision which was not confined to analytical tests, but which involved the application of the results of such tests. Whereas all the boric acid made here was of B.P. quality, the Italian product was not tested for lead and arsenic. The witness who had spoken about the Italian process had not described it but had only given some very inadequate details. The nature of the process used and the degree of purity of the product were very important considerations.

Mr. Swan objected that the Board of Trade had not called any witnesses to support the contentions advanced in its counter-statement. On the question of skilled supervision he said that it appeared from the opponents' statements that by increasing the number of chemists employed in a works and introducing new complications into the process any chemical could be brought within the category of fine chemicals. He held that there was practically a complete parallel between this case and that concerning tartaric and citric acids (*cf.* J., 1922, 115 R). The use of boric acid for preserving food was regarded by the trade as a commercial use, and the substance had always been regarded by it as a heavy chemical. The evidence on that point remained uncontradicted, and there, he thought, the case should end.

The referee's decision, signed on June 20, ran as follows:—

I have said in previous cases that *primâ facie* a substance is not dutiable on importation into this country and that it becomes dutiable under the Act in question only if there is no reasonable doubt about its being covered by the words in the schedule.

The complainants base their case against the inclusion of boracic acid in the list of dutiable substances upon trade usage. They contend that there has been such a general classification or acceptance of boracic acid as a heavy chemical as to make further consideration unnecessary and irrelevant. The evidence stands thus. Four chemical merchants of experience say that they have always regarded boracic acid as a heavy chemical; three of them go further and say that it has always been treated and regarded in the trade as a heavy chemical. Mr. Parry said the same thing. Mr. Johnson, the sales manager of Borax Consolidated, controls and sells 85 per cent. of the boracic acid sold in this country. Surely he, if anyone, must be familiar with the trade view. Until a few weeks ago, before certain pressure was put upon him, his view was that boracic acid could in no sense be regarded as a fine chemical.

On the other hand, five or six witnesses were called who expressed the opinion that boracic acid was a fine chemical, but not one of them said that it had been so classified or treated by the trade.

The witnesses for the complainants are supported by the evidence to be derived from trade journals. It is, in my opinion, established that trade literature has consistently referred to boracic acid as a heavy chemical. I am not forgetting that it appears in lists of pharmaceutical chemicals, but that fact is almost colourless.

Further, the report issued by the Department of Overseas Trade on the market for heavy chemicals in the Argentine Republic deals with boracic acid as a heavy chemical.

I am satisfied and find as a fact that boracic acid has not been generally regarded as a fine chemical in the trade. The complainants further rely upon the following contentions:—

(a) That the scale of manufacture is undoubtedly large for a fine chemical. This was emphasised by Borax Consolidated in their abandoned complaint.

(b) That about one-fifth of the boracic acid consumed in this country comes from Italy and that whatever may be said of the difficulty of manufacture here the method of production there certainly does not tend to stamp boracic acid as a fine chemical.

Although criticised at a later stage, the evidence of Mr. Funajoli was not seriously challenged in cross-examination. It certainly satisfied me that the production in Italy is simple and does not require that skill and expert supervision which is usually associated with fine-chemical production.

Now, what is there to displace this strong *primâ facie* case for establishing that boracic acid ought not to be included in the list as a fine chemical?

The Board of Trade put in a counter-statement prepared with its usual care and lucidity.

The ground relied upon as justifying the inclusion of boracic acid in the list is that 80 per cent. of the total consumption in this country is absorbed for medicinal and surgical purposes and that a considerable quantity is used for food preservation purposes and only insignificant amounts in the industries.

It is clear that the Board has been misinformed as to the facts.

I accept the evidence of Mr. Johnson that 43 per cent. is used for medicinal and surgical purposes, including lint, 34 per cent. for food purposes, and 23 per cent. for industrial purposes. Even these figures establish that over three-fourths of the consumption of boracic acid is for purposes requiring a high degree of purity.

At the hearing the opponents relied also upon the method of manufacture in England, contending that it required that skilled supervision which is one of the indications that the product is a fine chemical.

I cannot say that I am at all convinced by the evidence on this point. Dr. Bassett certainly said that the operations to prepare boracic acid were extremely complex and required very careful supervision, but when asked what part of the operation was complex he answered that one stage might reasonably be called complex, the stage where arsenic was removed. Now, curiously enough, Mr. Derring, who actually supervises the manufacture, made light of that and said that the removal of arsenic was very simple.

On this point of difficulty I cannot forget the first complaint of Borax Consolidated. That complaint states that the method of production is one of the simplest operations and does not require chemical supervision. I cannot believe that steps such as the formulating and lodging of that complaint were taken without careful consideration. I asked Mr. Johnson if he had made the complaint on his own authority. His answer was "I did, and I did not." I do not know what that means, but he admitted that the managing director was consulted, and I do not believe that the statement did not represent the view of those responsible for it at the time. Having carefully considered the evidence given and bearing in mind the fact that difficulty of manufacture was not put forward by the Board of Trade in its statement and the attitude first taken up by Borax Consolidated, the conclusion I come to on the method of manufacture is that it does not help to weight the scales in favour of boracic acid being a fine chemical.

There remains, however, the very formidable point I have indicated, viz., the fact that three-fourths of the consumption is for medicinal and food purposes demanding considerable purity as a matter of vital importance. Ought this to outweigh the trade classification or usage? I think not. If I could persuade myself that the attainment of the necessary purity required the skilled labour and constant supervision by trained chemists demanded by fine-chemical production I might take a different view. Dr. Bassett put the matter admirably, but I am not persuaded as to the complexity of the operation. He has not seen it, and I repeat it is curious that the complexity he singles out should be described as simple by Mr. Derring. The complainants had no notice that the question of difficulty of production was to be raised. They came quite unprepared to deal with it. The opponents cannot therefore complain if the evidence they adduce is regarded somewhat critically.

On the whole I think that boracic acid is not a fine chemical within the Act, but whether I am right or wrong about that, I am quite satisfied that the position of boracic acid is at least so doubtful that it ought not to be included in the list of dutiable substances and I award that it be removed.

SCIENTIFIC GLASSWARE.

In this case, Jules Lang & Co., represented by Mr. K. Swan, complained of the inclusion in the list of reagent bottles, hydrometer jars, cylindrical measures and conical measures (bell-shaped). Mr. Courtney Terrell appeared for the Board of Trade. The complaint was heard on May 29 and the Referee's award is dated June 12.

Mr. Swan asked for a definition of the term "scientific glassware"; did the word "scientific" apply to the mode of manufacture or to the use? Certain bottles and stoppered jars which were used by confectioners, etc. closely resembled laboratory ware and the Customs were levying duty upon them, although they were not intended for scientific use. He suggested that the appellation "resistant" might suffice to distinguish between the two classes.

In giving evidence for the complainant company, Mr. E. J. Parry defined scientific glassware as glassware which resisted sudden changes of temperature and the action of chemicals, or which was used primarily for carrying out a scientific operation. All the articles mentioned in the complaint were scientific glassware excepting cylindrical and bell-shaped glass measures, but reagent bottles must consist of resistant glass and museum jars must be made of very clear and resistant glass and be provided with air-tight stoppers. Mr. Bush, managing director of Henry W. Bush & Co., Ltd., said that his firm imported reagent bottles and sold them to dealers who supplied them to laboratories, and to pharmacists, etc. as "shop rounds." Bottles consigned to him had been held up by the Customs and he had been fined for not declaring them. His chief business was graduating cylindrical measures imported from America, Belgium and Sweden, and the degree of accuracy of the finished article was 3 to 4 per cent. Mr. F. Lang, proprietor of Jules Lang & Co., said that he had been fined by the Customs for importing, without declaring, stoppered cylinders which were not made for scientific purposes; and stoppered white glass bottles, invoiced as reagent bottles but not intended for use as such, had been treated similarly. His firm had started the manufacture of scientific glassware in 1918, but had since given it up.

Evidence for the Board of Trade was given by Mr. J. H. Gardiner, technical director of James Powell & Sons, Whitefriars, Ltd., who explained that his firm had separate departments for manufacturing domestic and scientific glassware, respectively, and that all the objects mentioned in the complaint were made by the scientific branch from special glass by processes requiring care, precision and accuracy. Mr. D. H. Baird, of Baird & Tatlock (London), Ltd., gave similar evidence. At the instigation of the Government he had started the manufacture of scientific glassware ("Duro" glass) during the war, but had sold that part of his business in 1920. The term "reagent" bottle connoted a specific quality of bottle. True reagent bottles could not be made in the same mould as ordinary bottles; they were practically lead-free, were resistant to the action of chemicals, and were provided with accurately-ground and numbered stoppers. Vendors of ordinary glass bottles did not use the term "reagent bottles." Sir Herbert Jackson said that he could not give a hard and fast definition of scientific glassware, but any glassware traditionally known as such, which had been made with great care, was of high quality and used for scientific purposes was scientific glassware. "Traditionally used for scientific purposes" was the essence of the description. All glass apparatus made for laboratory use, even for use in school laboratories, was scientific glassware. A reagent bottle must be made of clear glass, be accurately stoppered, be appropriately and properly annealed, and capable of withstanding changes of temperature. He would not specify freedom from lead, because some lead glasses were quite safe for laboratory use.

The following is the text of the award:—

In my opinion the question whether the descriptions complained of are properly included in the list of dutiable articles depends upon the meaning of the words used. I am satisfied that all the descriptions complained of are properly included in the list provided that these descriptions are used strictly and within the limits which are defined in this award. Reagent bottles are properly in the list provided that by the expression "reagent bottle" is meant a bottle which is reasonably fit for containing chemical reagents. The legal obligation implied on the sale of such bottles is that the bottle shall be reasonably fit for containing any ordinary chemical reagent, not fit for just a few but fit for any chemical reagent, except possibly some exceptional substance calling for special and exceptional qualities in its container. This obligation means that the bottle must be made of hard suitable glass free from lead. By "free" I mean containing no more than such a trace as does not matter. The neck and stopper must be ground so as to make a perfectly air-tight joint. If a bottle does not fulfil these requirements it is not suitable for containing chemical reagents, and is not scientific glassware. I gather that the distinctive shapes of reagent bottles have been copied and that the description has been applied to inferior bottles and that these practices have led to trouble with the Customs. That trouble is not for me to deal with.

A hydrometer jar means a jar suitable for hydrometer tests. It is of distinctive type, straight sided, of circular or elliptical section and from six to ten inches high. The glass must be good and very clear. The jar must be a very good cylinder and must be capable of standing rapid changes of temperature.

Museum jars, specimen jars and surgical jars.—It is very possible that there is a practical difficulty in the case of these jars because the customary shape and description have been borrowed for all sorts of purposes which are not scientific and do not require scientific glassware. Any jar which is suitable for containing and displaying scientific specimens, not just a few specimens, but any scientific specimen not calling for exceptional treatment is a museum or specimen jar.

All three jars require the same qualities, *i.e.*, they must have clear fronts so that there is no distortion caused by the glass. The edges must be ground very flat and true so that the glass plate laid on them will give an air-tight fit and prevent evaporation. The glass must be sufficiently well-made to prevent contamination of the liquid, if any, containing the specimen.

Cylindrical measures (bell-shaped) and conical measures.—I think that these measures are on the border line, and that the only articles of these descriptions which can properly be considered as scientific glassware are measures which are in fact graduated with scientific accuracy. It is the correct graduation which, according to the evidence, makes them scientific glassware. I award that the descriptions complained of are properly included in the list if and when defined within the limits I have laid down. The complaint therefore fails.

MEETINGS OF OTHER SOCIETIES.

SOCIETY OF GLASS TECHNOLOGY.

At the meeting held in Sheffield on June 21, Prof. W. E. S. Turner announced that the visit of the American Ceramic Society to this country, which was fixed for September of this year, had been postponed until 1923. It was decided to renew the invitation and to ask the Ceramic Society to join in the invitation and the arrangements for the meeting.

Mr. Y. Amenomiya, a Japanese member, contributed a paper on the devitrification caused upon the surface of sheet (window) glass by heat, in which he stated that he had found devitrification to take place at between 700° and 800° C. Mr. R. Kamita described an investigation on the influence of alumina in preventing the devitrification of sheet-glass during the drawing process. He showed that the temperature of devitrification of a standard glass increased with increasing amounts of alumina, and that 5 per cent. of alumina caused the devitrifying temperature to rise by approximately 100° C.

The swelling produced by adding water to sand was discussed by Mr. L. E. Morton, who pointed out that the subject was important as manufacturers still measured out batch materials instead of weighing them. From studies of three typical sands, he concluded that sand containing added water would more than fill a vessel which would contain the same sand when dry, the excess being as much as 12 or 15 per cent. of the total dry sand. The three sands seemed to swell to a maximum extent when about 5 or 6 per cent. of water was added.

In a short paper on the mixing of batch, Prof. Turner compared the efficiency of hand-mixing with machine-mixing. In three samples from a batch mixed by hand the maximum variations were: sand 44—77 per cent.; lime 4·8—8·3 per cent.; whereas in a similar batch mixed mechanically the sand varied from 69 to 73 per cent. and the lime from 4·2 to 6·6 per cent. Machine-mixing, by giving a more regular batch, assisted melting and materially reduced the time required for producing good glass.

THE FARADAY SOCIETY.

A meeting was held in the rooms of the Chemical Society, Burlington House, on June 26. Five papers were read; a sixth paper, on the electrical conductivity of hydrochloric acid and potassium chloride in the presence of sucrose, being taken as read, as the author, Mr. A. J. Kioran, was absent.

Prof. A. W. Porter and Mr. J. J. Hedges presented a paper on the law of distribution of particles in colloidal suspensions, with special reference to Perrin's investigations. Perrin has shown that, when particles are distributed in a dilute colloid solution, the law of distribution is the same as that of the distribution of the molecules in an atmosphere; later, Burton showed that this law does not hold for any considerable distance from the surface, and in the present paper the authors attempt to ascertain the actual distribution from the surface downwards. In the experiments a dilute solution of gamboge was employed and the particles were counted by means of a modified form of ultra-microscope. The results found can be fitted fairly closely to a curve having the equation:—

$$\log_e \frac{n}{1 - bn} + \frac{1}{1 - bn} = Ky + A$$

where n is the number of particles per c.c., y is the depth, and b, K, and A are constants. Although b may be considered as representing the volume of a suspensoid particle plus the ocean of second phase surrounding it, and attached in some way to it, the authors consider it merely as an empirical constant.

A paper describing the electrochemical effects produced by superimposing alternating currents upon direct currents during electrolysis was read by Mr. W. R. Cooper, who classifies the effects according as the alternating current is smaller than, equal to, or greater than the direct current. In all three classes no great difference is found in the amount of copper deposited in an electrolytic cell when a low frequency alternating current is superimposed on the direct current, but an increase of current is obtained irrespective of the relative values. This effect does not pass off as soon as the alternating current is switched off, but dies down during a period which may last for several minutes. Microscopical examination of the electrodes during electrolysis showed the hydrogen bubbles clinging to the platinum electrodes and the oxygen bubbles escaping much more easily. The most interesting observation made with high-frequency alternations was when a very fine wire, just dipping into dilute acid, was used as one electrode, and a comparatively large piece of platinum foil as the other. Under certain conditions a large bubble formed in the electrolyte and travelled up to the electrode. This seemed to result from an audible discharge, which could be seen if the experiment were carried out in the dark.

Prof. T. M. Lowry and Prof. E. E. Walker read a paper on "The Expansion and Shrinkage during Caking of Potassium Carbonate." A sample of potassium carbonate, which had been kept in a paper bag for four or five years, was emptied into an earthenware jar. Five days later it had fractured the jar, and continued to expand after the walls had fallen away. About this time the heat of the laboratory was shut off, and three weeks later the salt began to shrink, and eventually contracted to less than its original volume. Attempts were made to produce expansion in various modifications of potassium carbonate, but without success, though a possible explanation assumed the presence in the material of a sesquihydrate which expanded on conversion into the dihydrate.

In a paper entitled "The Powdering of Minerals by Decrepitation," Prof. T. M. Lowry and Mr. L. P. McHatton described the decrepitation of barytes by heat and attributed it to the presence of occluded water. A semi-quantitative relationship was found between the water content of the barytes and the fineness of the powder produced. Quantitative experiments were also described on the relationship between the loss of weight and the fineness of the powder produced by the decrepitation of celestine, croceite, and common salt.

The last paper was on "The Systems in which Metals Crystallise," by Dr. J. L. Haughton and Miss G. W. Ford. In most cases the system in which a metal crystallises depends on its position in the periodic table, and alloys that form a homogeneous series of solid solutions right across the diagram crystallise in the same system. There does not appear to be any relationship between the changes which occur in the physical properties of metals at the melting-point and their crystalline habit, with the possible exception of the resistivity of the metals in the odd series of Group 5.

PERSONALIA.

Sir William J. Pope has been appointed president of the International Union for Pure and Applied Chemistry.

Sir Humphrey Rolleston has been elected president of the Röntgen Society for the session 1922–23.

To Sir Dugald Clerk has been presented the Albert Medal of the Royal Society of Arts, in recognition of his important contributions to the development of the internal-combustion engine.

Dr. W. T. David, professor of engineering in the University College of South Wales, has been appointed to the chair of civil and mechanical engineering in the University of Leeds, in succession to Prof. Goodman.

Mr. D. A. Pritchard, until recently electrochemical superintendent to the United Alkali Co. in England, is now works manager of the Canadian Salt Co., Windsor, Ontario. Mr. W. Kynoch has been appointed superintendent of the Forests Products Laboratories, and Mr. R. E. Gilmore superintendent of the Fuel Testing Laboratories of the Canadian Department of Mines.

Dr. F. G. Cottrell, lately head of the division of chemistry and chemical technology of the National Research Council, U.S.A., has been appointed director of the Fixed Nitrogen Research Laboratory of the Department of Agriculture. Dr. R. C. Tolman, the present holder of this post, has been elected professor of physical chemistry and mathematical physics in the California Institute of Technology at Pasadena.

Other appointments announced in the United States are:—Dr. F. F. Renwick, director of the Redpath Laboratory of the E. I. du Pont de Nemours Co.; Prof. G. A. Hulett, professor of physical chemistry in Princeton University, a member of the United States Academy of Science; Prof. J. M. Bell, head of the chemistry department in the University of North Carolina.

Dr. Duparc, professor of chemistry in Geneva, has accepted the invitation of the Soviet Government to organise the Russian platinum industry; and Dr. H. von Euler-Chelpin, professor of chemistry in the Stockholm "Högskola," has been appointed to a professorship in the University of Vienna, as from January 1, 1923.

Prof. A. Sieverts, of Greifswald, has been called to the chair of inorganic chemistry in the University of Frankfurt. Dr. Neuberg, director of the Kaiser-Wilhelm Biochemical Institute, has been elected ordinary professor in the Berlin Agricultural "Hochschule." Prof. P. P. von Weimarn has been appointed to the Imperial Institute for Technical Research, Ozaka, Japan, where he will equip a laboratory for research in colloid chemistry.

* * *

The deaths are announced of Jules Domergue, director of the Syndicat des Fabricants de Sucre de France since 1887; Thomas Gutler, who founded the beet-sugar industry in Utah and Idaho, U.S.A., aged 78 years; and Johann Pokorny, the sugar technologist, of Prague, at the age of 72 years.

Prof. Otto Lehmann, the discoverer of liquid crystals, and professor of physics in the Technical "Hochschule" of Karlsruhe since 1889, died on June 20 at the age of 67 years. Other deaths announced from Germany are:—Dr. F. Voigtländer, honorary professor in the University of Hamburg and director of the department of applied chemistry in the Research Office, Hamburg, aged 60 years; and Dr. A. von Wacker, director and co-founder of the Dr. A. Wacker Gesellschaft für Elektrochemische Industrie.

NEWS AND NOTES.

UNITED STATES.

Reported Disintegration of Tungsten.—In a letter published in a recent issue of *Chemical and Metallurgical Engineering*, Dr. G. L. Wendt replies to criticisms of the work by himself and C. E. Irion on the atomic disintegration of tungsten (*cf.* J., 1922, 131 R). Dr. Wendt states that the only spectrum unmistakably shown by the gases produced by the high-temperature explosion was that of helium. The background showed what seemed to be the banded spectrum of nitrogen, and the faint evidence of the strongest green line of mercury was possibly due to the backward diffusion of mercury vapour from the exhaust pump. An average of slightly more than 1 c.c. of gas was produced by exploding 0·0005 mg. of wire, and as the gas would correspond, if it is all helium, to nearly one-half the material of the wire, this should exclude the possibility that gases were adsorbed or occluded. The fact that no hydrogen lines were observed is of interest because the atomic weight of tungsten is an exact multiple of that of helium; and also because Sir E. Rutherford (*Phil. Mag*, 42, p. 809) produced hydrogen in small quantities from elements (B, N, F, Na,P) whose atomic weights were not multiples of four, but not from elements with atomic weights that are multiples of the atomic weight of helium. An account of the work is to appear in the *Journal* of the American Chemical Society.

Recent Research Work on Fertilisers.—Among the papers read before the Division of Fertiliser Chemistry at the Spring Meeting of the American Chemical Society was one on the fertilising value of sulphur by Mr. L. S. Bushnell, who quoted the results of experiments to show that increased yields of from 50 to 1000 per cent. have been obtained by using sulphur with alfalfa and other leguminous crops; that soils cultivated for several years contain relatively less sulphur than corresponding virgin soils; and that the fertilising value of ammonium sulphate and acid phosphate is sometimes due to their sulphur content and not to that of nitrogen or phosphorus.

Messrs. W. H. Waggaman and H. W. Easterwood described experiments on the applicability of the furnace process for producing phosphoric acid to run-of-mine phosphate. Much waste phosphate material, sufficiently rich in clay, can be briquetted after grinding to pass a 10-mesh sieve. Two methods of incorporating the necessary water were described, an average of 10 per cent. of water being found satisfactory when the briquettes were made under a pressure of 2500 lb. per sq inch. The possibility of using coal as a reducing agent in making such briquettes was favourably regarded, and it was stated that furnace tests were to be made to determine the applicability of the furnace process of producing phosphoric acid to the Florida and Tennessee phosphates.

Cyanamide used in certain fertiliser mixtures was stated by Mr. W. S. Landis to be rapidly converted into urea or other salts, but not into dicyanodiamide; when dicyanodiamide was intentionally added to them it disappeared on mixing.

The fertilising value of wool-scouring wastes was discussed by Dr. F. P. Veitch, who observed that the annual loss of this waste amounted to over 60,000 tons of fertiliser material containing the equivalent of 96,000 t. of kainit and 3600 t. of tankage. The 267,857 t. of unscoured wool used annually in the United States contains an average, for all grades, of 4 per cent. of potash (K_2O), 0·5 per cent. of nitrogen, and 15 per cent. of grease, both nitrogen and potash being water-soluble. "Base goods" containing 6 per cent. of water-soluble potash and 6 per cent. of nitrogen, and in excellent mechanical condition for application to the soil, have been prepared from concentrated wool-scouring wastes, and it is hoped that this important source of fertilising material will soon be available in large quantities.

AUSTRALIA.

Carbide Manufacture in Tasmania.—The Hydro-Electric Power and Metallurgical Co., which has recently changed its name to the "Carbide and Electro-Products, Ltd," has decided to increase its power consumption from 3500 to 5000 electrical h.-p., so that the annual output of its carbide factory at Electrona, Hobart, will probably be raised by at least 1000 tons. In the interest of economy crude limestone from the company's quarry at Nor'-West Bay is to be burnt on the spot instead of at the carbide factory.—(*Ind. Austr., Apr.* 27, 1922.)

Pottery Clay from Victoria.—An account of the examination of a sample of white clay from a deposit near Bendigo, in the State of Victoria, is given in a recent issue of the *Bulletin* of the Imperial Institute (XIX, 4, 1921). The clay contained about 4 per cent. of gritty matter, which had to be removed by washing, and analysis of the washed material indicated that the content of alumina was too low, and that of other metallic oxides and silica too high for the sample to be regarded as a china-clay of first-class quality. After washing, the clay would be suitable for making white permeable pottery, which can be glazed to yield a fine white earthenware. It is unsuitable for making hard porcelain, but could probably be used in conjunction with suitable felspathic and siliceous materials for producing "semi-porcelain" or impermeable stoneware. The washed clay could be mixed with grog for making second-grade refractory bricks.

FRANCE.

Industrial Notes.—*Chemical Industry.*—According to the German Press the agreement that is reported to have been made between the German dye trust and the Compagnie Nationale des Matières Colorantes et de Produits Chimiques and the negotiations between the German dye trust and the British Dyestuffs Corporation are the prelude to a vast international chemical combine to include Germany, France, Great Britain and Italy.

There is a notable improvement in the demand for chemicals, especially for products such as acetic anhydride, acetone, etc. used in making non-inflammable acetyl-cellulose films. Various improvements have been made in the methods of manufacturing cellulose products; thus the "cellophane" made by the Thaou-les-Vosges chemical factory is finding increasing use and a firm in Lyon is producing a new acetyl-cellulose silk which is claimed to be as strong and flexible as natural silk but more lustrous. The small demand for coal-tar products has led to a decline in prices, the quotation for benzene having fallen from 150 to 120—125 francs per 100 kg. and for toluene from 210—215 fr. to 190—200 fr. per 100 kg. Prices of paint products and mineral solvents, however, are tending upwards, and carbon tetrachloride now stands 20 fr. higher at 240 fr. per kg. It is expected that the price of zinc oxide will fall as the large new factory of the Société Française du Zinc at the Etang de Berre is now in operation. The fertiliser season is now over and orders for nitrate are not expected until the autumn. High prices, due to the heavy cost of transport, labour and sulphuric acid have greatly reduced the demand for superphosphate; thus the French consumption has declined from 1,200,000 metric t. in 1914, to only 660,000 t. in 1921, and the European consumption has fallen from 5 million t. in 1913 to 2 million t. in 1921. Despite the new reduction in the price of alcohol, the demand has not revived and stocks are growing rapidly; State control is proving as great a hindrance to the alcohol industry as it has to that of tobacco. The price per hectolitre of alcohol used in making products for the home market is 250 fr. and in making products for export 180 to 200 fr., so that manufacturers of drugs and perfumes find difficulty in competing in the foreign market as there is no margin for reducing costs.

GENERAL.

A Green Photographic Sensitiser.—The assistance which photography can render the scientific investigator has hitherto been somewhat limited by reason of the fact that quantitative measurements of the distribution of energy, even throughout the visible spectrum, have been vitiated by the well-known selective sensitiveness of photographic gelatino-bromide emulsions. The greatest deficiency of sensitiveness, and moreover that which has most effectively withstood all efforts to remove it, occurs in the green and greenish-yellow portions of the spectrum. The announcement of the discovery of a new green sensitiser by Dr. W. H. Mills and Sir W. J. Pope in the May issue of the *Journal of the Chemical Society* will therefore be welcomed as a step towards the realisation of a truly panchromatic sensitive emulsion. The compound, of which the "bathing" action is claimed to impart a uniform sensitiveness extending almost to the D line, is 2.*p*- dimethylaminostyrylpyridine methiodide, and results from the condensation of α-picoline methiodide with dimethylaminobenzaldehyde in alcoholic solution, in the presence of piperidine, by boiling for 5 hours. Recrystallised from methyl alcohol, it appears as bright red prisms exhibiting a blue reflex and melting at 275° C. A 1:30,000 to 1:40,000 aqueous solution constitutes the sensitising bath.

This is the first green sensitiser of which the constitution has been published; if its use does not lead to the formation of fog—an all too evident tendency of sensitising dyes—and if it can be successfully applied in conjunction with the known red sensitisers, the science of photography, as well as the science which is anxious to employ photography more and more as its unbiassed "eye," will be immensely richer for the discovery.

Hops.—A series of papers published by A. Amos in the *Journal of the Ministry of Agriculture* contains some very useful information on the cultivation of hops. The importance of adequate manuring is emphasised and schemes of typical manuring are given. The fourth paper (in the April issue) on commercial varieties of hops is of much interest to the brewer. The good and poor qualities of each variety are discussed. One of them (Tolhurst), which is evidently a favourite in some districts on account of its good cropping power, is of indifferent quality from the brewer's point of view, and its cultivation is to be discouraged.

Research in the Brewing Industry.—The research scheme of the Institute of Brewing is under the control of a representative committee of brewery directors, brewers, and agricultural and brewing scientists. There is no director of research, but special sub-committees deal with various aspects of the work in hand. Problems relating to the raw material of the fermentation industry are being investigated on sound scientific lines.

The latest report on the progress of the scheme has recently been issued by the Institute. The work of Mr. E. S. Salmon on the raising of new varieties of hops is described, and tests from the standpoint of yield, disease-resistance and brewing qualities of the hops are showing valuable results. The "nettlehead" disease, which has caused the loss of many promising varieties, is about to be investigated by Prof. V. H. Blackman; and manurial experiments have also been carried through. The drying of hops is receiving attention. A description with illustrations is given of an experimental oast designed by Mr. A. H. Burgess. The oast is not intended to be a model commercial plant, but is constructed to keep the various factors concerned in the process of drying under strict control. Prof. F. L. Pyman is continuing the difficult chemical investigation of the constituents of the hop upon which the preservative qualities depend.

The tainting of the beer stored in casks made of American oak seems to be caused by something extracted from the wood by the beer. Prof. Groom reports that micro-organisms appear to play no direct part in it, nor does the trouble lie in an unsuitable method of cutting the staves and end pieces. The possibility that there is some indirect relationship between the amount of starch in the oak and its suitability for cask-making is suggested and discussed. The time of felling the trees may also be of importance, and the help of the U.S. Forest Service in settling this point is being invited (*cf.* J., 1921, 32 R, 256 R, 370 R; 1922, 193 R).

The Ceramic Industry in China.—The Chinese ceramic industry has made little progress, despite its 2000 years of existence, and primitive kilns and methods are still used. Both the Government and the province of Kiangsi support a ceramic laboratory, but apparently no attempt has been made to develop production on a large scale. Nevertheless, the exports of ceramic products greatly exceed the imports; in 1920, 16,402 short tons was exported and 13,027 t. imported. The chief centres of the porcelain industry are at King Teh Chen, south of Kiukiang, Te Hua, near Hing Wah, and Shekwan, near Canton. Important deposits of high-grade kaolin are found in several localities but none is situated conveniently for supplying foreign markets; probably better situated deposits could be found. There are several undeveloped deposits in the province of Fukien, but the most promising is situated in the province of Kwantung, where there is no local industry but abundant labour.—(*U.S. Com. Rep.*, *Apr.* 10, 1922.)

Exports of Minerals from Tunis.—The quantities of minerals exported from Tunis in 1921 as compared with 1913 (shown in parentheses) were as follows:—Phosphates, natural, 1,455,239 metric tons (1,984,000 t.); iron ore, 204,012 t. (594,200 t.); lead ore, 5997 t. (59,446 t.); zinc ore, 7812 t. (30,627 t.). Official statistics do not record an export of lead metal in 1913, but in 1921, 15,230 t. was shipped. Of the phosphate exported in 1921, France took 576,277 t., Italy 522,012 t., Great Britain 84,377 t., and Belgium 72,565 t. The iron ore went chiefly to Great Britain, Germany and France, the lead to Spain and France, and the zinc ore to Belgium and France.—(*U.S. Com. Rep.*, *May* 8, 1922.)

Lead and Zinc in 1921.—The Imperial Mineral Resources Bureau has compiled the following advance statistics showing the world's production, imports and exports, of lead and zinc during 1921:—

LEAD.

			1921 Long tons.
United Kingdom	Imports ..	Pig and sheet	132,602
	Exports ..	Pig lead	11,098
Northern Rhodesia	Production	Lead	17,686
	Exports ..	Pig lead	18,348
Union of South Africa	Production	Ore	189
	Imports ..	Pig and sheet	362
	Exports ..	Ore	4
South W. Africa Protectorate..	Production	Copper and lead ore ..	72,643
	Exports ..	Raw lead	198
Canada	Production	Refined lead	25,732
	Imports ..	Bars, sheets, pig and block	492
	Exports ..	Pig lead and lead contained in ore	13,408
Burma	Production	Lead	25,000
India	Imports ..	Lead ore	102
		Pig lead	311
	Exports ..	Pig lead	30,624
Australia ..	Production	Lead contained in ore and concentrates ..	83,878
		Refined metal produced in Australia, and metal in bullion and in ore and concentrates exported	62,777
	Exports ..	Pig lead and lead bullion	33,749
		In concentrates and ores	6,448
Belgium ..	Imports ..	Lead	16,384
	Exports ..	Lead	25,133
France	Imports ..	Ore	13,773
		Pig lead, argentiferous and non-argentiferous	33,043
	Exports ..	Ore	3,685
		Pig lead, argentiferous and non-argentiferous	8,917
Germany ..	Production	Lead	65,000
Italy	Production	Lead ore and argentiferous lead ore	26,100
		Lead	11,300
Norway ..	Imports ..	Crude lead	124
Russia	Production	Lead-zinc ore	3,710
Spain	Production	Lead	100,000
Algeria	Exports ..	Ore	11,237
Tunis	Exports..	Ore	5,901
		Metal	14,985
Mexico	Exports ..	Metal	59,541
United States ..	Production	Primary domestic lead..	170,000
		Soft lead	129,500
		Desilverised soft lead ..	49,000
		Refined lead from domestic ores	348,500
		Smelted and refined from foreign ore and bullion	44,500
		Total lead smelted or refined..	393,000
		Antimonial lead ..	7,100
	Imports ..	Lead content of ore and bullion..	38,378
		Pig, bar and old ..	27,948
	Exports ..	Pig and bar	23,515

ZINC.

			1921. Long tons.
United Kingdom	Production	Spelter	10,000
	Imports ..	"	72,486
	Exports ..	Crude and manufactured	7,424
Northern Rhodesia	Production	Ore	20
Union of South Africa	Imports ..	Unmanufactured zinc ..	1,372
Canada	Production	Smelter production ..	23,703
	Imports ..	Spelter	496
	Exports ..	Ore	46
		Spelter	11,454
India	Imports ..	Spelter	3,100
	Exports ..	Zinc or spelter of all kinds	4,000
Australia ..	Production	In lead and zinc concentrates	139,460
		Refined metal produced in Australia, and metal in ore and concentrates exported	21,297
	Exports ..	Spelter and zinc ..	1,043
		In concentrates and ores	19,616
Belgium ..	Production	Spelter	65,402
	Imports ..	Ore	186,057
	Exports ..	Spelter	37,581
France	Imports ..	Ore	40,717
		Crude zinc	11,190
	Exports ..	Ore	8,154
		Crude zinc	4,829
Germany ..	Production	Spelter	120,000
Italy		Ore	68,000
		Spelter	370
Netherlands ..		Spelter	3,000
Norway.. ..		Spelter	12,000
	Imports ..	"	6,955
	Exports ..	"	16,930
Poland	Production	Spelter	5,000
Sweden	Production	Spelter	6,000
Algeria	Exports ..	Ore	17,255
Tunis	Exports ..	Ore	7,686
United States ..	Production	Primary metallic zinc— From domestic ores ..	173,200
		" foreign " ..	2,200
			175,400
		Re-distilled secondary zinc	15,200
		Total of distilled electrolytic zinc	190,600
	Imports ..	Ore	6,731
		Lead content of ore ..	2,415
		Blocks, pigs and old ..	6,017
	Exports ..	Pigs, slabs, etc.	2,136
Japan	Production	Spelter	7,000

New German Committee for the Standardisation of Non-Ferrous Metals.—The standardisation of metals and metallic alloys in Germany has hitherto been entrusted to a sub-committee of the standardisation committee for German industry as a whole, but it has now been decided to form an independent organisation to be known as the "Fachnormenauschuss für Nicht-Eisen-Metalle" (Berlin N.W.7, Sommerstrasse 4a). The expenses of the new committee will be paid by contributions from producers and consumers. The working committees on copper and copper alloys, aluminium and its alloys, lead, tin and its alloys, low-tension cables, etc. will not be affected, but a new working committee has been formed to deal with commercial analyses of non-ferrous metals.—(*Metall u. Erz*, *May* 8, 1922.)

Potash Production in the Far East.—Japan is the only Far-Eastern country that produces potash in quantity, although most Asiatic countries possess potential supplies in the form of seaweed. Thus the ash of seaweed found abundantly on the Coast of the Philippine Islands contains about 45 per cent. of potash, but it has not yet been utilised industrially. Three or four companies are engaged in the potash industry in Japan, and in 1920 they exported 1143 tons of potassium chloride in addition to 834 t. of potassium carbonate, which was shipped to the United States. The industry is worked on a small scale in China, chiefly in Kwantung province, Canton being the exporting centre; potash worth 40,000 to 50,000 taels (tael=roughly 3s. 7d.) is exported annually, mainly to Hongkong. Small quantities of potash are also exported from the Dutch East Indies and from the Straits Settlements.—(*Ch. of Comm. J.*, *May* 19, 1922.)

New Commission for the Perfumery Industry in Italy.—By a decree dated March 30 the Italian Ministry of Industry has appointed a commission composed of representatives of the Ministry and of the floricultural and perfumery industries to report on means for improving those industries.—(*G. Chim. Ind. ed App., May,* 1922.)

Production of Gums in the Red-Sea District.—In order of importance, the principal gums produced in the Red-Sea district are gum myrrh, from Abyssinia and Arabia, gum arabic, from Somaliland and Mokalla, and gum frankincense, from Somaliland, the Yemen, and the island of Socotra. Gum myrrh from Abyssinia is considered the best, but gums from the interior of Africa have to be cleaned and prepared for the export trade at Aden. Exports of these gums, almost entirely from Aden, were as follows in 1920 and 1921:—

	1920.		1921.
	Long tons.		
Gum myrrh	1057·5	..	678·6
Gum arabic	509	..	271·7
Gum frankincense ..	1440·4	..	766·1

The production of gums in Arabia has declined owing to internal unrest.—(*U.S. Com. Rep., May* 8, 1922.)

PARLIAMENTARY NEWS.

Imports of Glassware.

Answering Mr. Gilbert, Sir W. Mitchell-Thomson gave the quantity and value of the glassware imported from Germany during the year ended March 31, 1922, as follows:—Domestic and fancy glassware, including cooking utensils, table and ornamental glassware, 2718·7 tons, £105,375; illuminating glassware, globes and shades (other than oil-lamp chimneys), 1990·2 t., £73,103; other illuminating glassware (other than oil-lamp chimneys, electric-lamp bulbs and miner's lamp glasses), 21·5 t., £852.—(June 26.)

Fuel Oil.

Mr. Bridgeman informed Mr. L. Malone that the Anglo-Persian Oil Company's refinery at Llandarcy, Swansea, would be used for treating crude petroleum only. The Government did not interfere in the company's commercial activities and the use of the refinery for treating oil produced by the destructive distillation of coal would be a matter for the company and colliery interests. The increasing use of fuel oil was but a small factor among the causes of unemployment in coalfields. The development of home supplies of oil was being considered by the Fuel Research Board. —(June 26.)

Exportation of Morphine.

Mr. Shortt informed Mr. Ramsden that the export of morphine from this country was prohibited except under licence and all possible steps were taken to prevent export for other than medical or scientific purposes. As the traffic could be controlled successfully only by international co-operation, the League of Nations was urging its members to adopt and enforce a system of importation certificates at an early date.—(June 28.)

"Reparation" Duty.

Sir C. Oman asked why parcels consisting of single copies of scientific works, ordered by a private individual, passed without paying "reparation" duty if sent through the post, whereas they were charged with the full 26 per cent. levy if sent in a parcel or box through the customs department at Harwich. Sir J. Baird replied that the importation of a single copy of a book as cargo would be quite unusual, but if further information were supplied, an inquiry would be made.—(June 29.)

Answering Mr. Kiley, Sir R. Horne said that neither France, Belgium, nor Italy collected "reparation" duty on German goods, which, if sold to an independent purchaser in one of those countries, would be exempt from the levy on importation into the United Kingdom.—(July 4.)

Imports of Hollow-ware.

In reply to Mr. Gilbert, Sir W. Mitchell-Thomson said that the imports of hollow-ware from Germany during the year ended March 31, 1922, were as follows:—

	Tons.		£
Aluminium hollow-ware, domestic	1,014	..	166,775
Iron and steel hollow-ware, domestic:—			
Cast, enamelled	1,980	..	115,867
Wrought, enamelled	6,968	..	294,275

—(June 26.)

Mr. Baldwin, replying to Mr. Hogge, said it was not intended that enamelled hollow-ware imported into this country to be further enamelled should be exempt from the provisions of the draft Order.—(July 3.)

Dyestuffs (Import Prohibition) Act.

Replying to Capt. Bagley, Sir W. Mitchell-Thomson said that persons interested in importing German dyestuffs into this country had, no doubt, endeavoured to obtain from German makers price quotations that could be used as arguments for modifying the Act, but that had not been done to any great extent.—(June 28.)

Mr. Baldwin said, in reply to Mr. Hogge, that the licensing committee appointed under the Act had met 40 times; the quorum necessary for considering or refusing licences consisted of one independent member, one representative of the dye-makers and one of the dye-users.—(July 3.)

British Dyestuffs Corporation.

In answer to Mr. G. Thorne, Sir W. Mitchell-Thomson said that no reason for modifying the decision not to appoint a committee to inquire into the situation of the Corporation had arisen out of its recent annual meeting.—(June 26.)

Replying to Major Barnes, Mr. Baldwin said that the Government had power to nominate only two representatives on the Board of the Corporation. It would not be necessarily of advantage to require that no member of the board should be a director or interested in other dye or chemical companies or that at least one Government nominee should possess special knowledge of dye-making. Apart from small samples of 1 kg. each, obtained for research and experimental work, the Corporation purchased no German dyestuffs or intermediates during 1921.—(July 3.)

Exports of Perfumery.

Answering Mrs. Wintringham, Mr. Baldwin gave the following figures of exports of perfumery and perfumed spirits in 1920 and 1921:—

		1920.		1921.
Exports of home manufacture:—				
Perfumery containing spirit	lb.	963,707	..	137,945
Perfumery, other	„	4,744,241	..	1,700,422
Spirits, perfumed, in bond ..	galls.	74,518	..	15,406
Spirits, perfumed, not in bond	„	—	..	18,172
Exports of foreign and colonial manufacture:—				
Perfumery containing spirit	lb.	—	..	559
Perfumery, other	„	224,658	..	212,871
Spirits, perfumed	galls.	679	..	674

—(July 3.)

Safeguarding of Industries Act.

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Inquiries. — All committees appointed under Part II. are directed to report on the effect that the imposition of a duty would have on employment in any industry using goods that are the subject of the inquiry.—(June 26.)

Optical and Scientific Instruments.—Complaints of the difficulties in obtaining material for research take no account of the change in the cost of all commodities, and also in industrial conditions in Germany which have resulted in abnormal delay in delivery and a lower standard of quality. British manufacturers are making every effort to improve the quality and reduce the cost of their products, and it would be advantageous if men of science would co-operate sympathetically with them.—(June 26.)

The statement in the last annual report of the Medical Research Council that its operations have been greatly hampered by the high cost of scientific instruments and materials refers to the year ended September 30, 1921, when the Act was not in operation, and thus confirms the view that the increased cost of research is not due mainly, or even very appreciably, to the Act.—(July 3.)

Vulcanised Fibre.—The Committee on vulcanised fibre is not precluded from proceeding with the inquiry because of an increase in the price of the imported article, as the increase may be only temporary or intended to avoid the operation of the Act.—(July 3.)

Glassware.—The practicability of collecting the duties on glassware set out in the draft Order made under Part II of the Act has been discussed by the Board of Trade and the Board of Customs, but it is not intended to consult persons familiar with the trade. Imports of domestic and fancy glassware during the first five months of 1920, 1921, and 1922 were 1550 tons, 1451 t., and 1769 t., respectively.—(July 3, 4.)

Boric Acid.—The duty collected on imported boric acid from October 1, 1921, to June 20, 1922, amounted to £21.—(July 4.)

LEGAL INTELLIGENCE.

Contract for Supply of Explosives. *Hickson and Partners, Ltd., and Others v. The Crown.*

In the King's Bench Division on June 26, Mr. Justice Bailhache heard a petition of right against the Crown by Hickson and Partners, Ltd., of Bradford, Sharp and Mallet, Ltd., of Copley, Brotherton and Co., Ltd., of Leeds, and R. Graesser, Ltd., of Ruabon.

The suppliant companies claimed the balance of £60,000 due for TNT and picric acid supplied to the Government. When they asked for the balance of the contract price, the Crown claimed it was entitled to retain the money as a contribution, under the Munitions (Liability for Explosions) Act, 1916, to a fund for compensating damage caused by explosions to life or the property of third parties. The suppliant companies contended that such retention of moneys was not authorised by the Statute, and that the Crown had levied a contribution that was out of proportion.

After consultation, the parties arrived at a settlement on terms that were not disclosed, the Crown agreeing to pay the taxed costs of the suppliant companies.

REPORTS.

Thirty-ninth Report of the Comptroller-General of Patents, Designs, and Trade Marks, 1921. *London: H.M. Stationery Office. 1922. Price 6d.*

Although less business was done by the Patent Office in 1921 than in 1920, the amount was still above the pre-war average, except in regard to applications for registering designs. The decrease in the number of complete specifications for patents was due to the expiry of the extensions of time granted under the Peace Treaty and the Berne Agreement of 1920, but there was an increase in the number of provisional specifications. The following is a statistical summary of the work done during the past two years:—

	1921.	1920.
Patents:—		
Applications	35,132	36,672
Provisional	24,674	23,255
Complete	19,159	21,796
Sealed	17,697	14,191
Designs:—		
Applications	13,387	13,669
Registered	12,313	13,071
Trade Marks:—		
Applications	11,959	14,064
Registered	7,518	7,122
Letters, etc. dispatched	265,000	263,000
Parcels of publications dispatched	112,000	92,000
Patent specifications sold	270,707	260,368

There were 35 hearings upon oppositions to the grant of patents, and 11 appeals to the Law Officer. Of the 4278 hearings fixed under Sections 7 and 8 of the Acts, 2588 were withdrawn, and in 6 of the 1690 cases decided appeals were made to the Law Officer.

The preponderance of trade marks registered for chemical and allied products is particularly noteworthy.

The number of readers who used the library increased from 120,512 to 129,975. The new classification of the library is now complete; 6567 volumes were added to the library during the year, making the total number of works 60,347 (190,242 volumes, excluding duplicates).

Receipts from patents fees amounted to £445,947, from designs fees £9648, and from trade-marks fees £47,803. The total receipts, £525,500, represent an increase of £37,958 over 1920, and were the largest ever received in any one year. Expenditure totalled £451,912, leaving a surplus of £73,588.

Report on the Economic, Commercial and Industrial Situation of Sweden, Dated March, 1922. *By H. Kershaw, H.M. Commercial Secretary, Stockholm. Department of Overseas Trade. Pp. 60. London: H.M. Stationery Office. 1922. Price 1s. 6d.*

In spite of the apparent advantage of the high exchange-value of Swedish currency and the possession of a credit balance abroad, Sweden suffered severely from industrial depression during 1921. The timber and pulp industries were subject to fluctuating prices, poor demand, and competition from Finland. The export trade in newsprint paper was fairly good, but in other kinds unsatisfactory. In the pottery industry prices were reduced by 40—50 per cent. last autumn owing to lowering of wages and reduced costs of raw materials; competition from Germany then declined significantly. The glass industry has developed considerably. Cement manufacturers have been severely hit by the almost entire suspension of building operations, and by the acute competition from neighbouring countries. With one or two exceptions, all the manufacturers are now united in a single combine.

The greatest depression of all prevailed in the iron and steel industry, whose production in 1921 was only 30 to 40 per cent. of that before the war (cf. J., 1922, 133 R). Although the export of matches s improving and the industry is regaining its former position in foreign markets, stocks are so large that the factories must restrict output for some time. Details of the mineral output (cf. J., 1922, 36 R) for 1921 have not yet been issued, but 1,330,000 t. of iron ore was exported, mainly to Germany, and there are still large stocks. Extensions and enlargements of existing hydro-electric plants have been curtailed until costs have fallen, but new stations and extensions in course of construction will increase the total capacity from 1,200,000 to 1,500,000 effective h.-p. Much attention is being paid to industrial standardisation, especially in the engineering, electrical and woodworking industries.

British methods of trading in Sweden, it is pointed out, need improving; and there will be good openings for British chemicals, china, pottery and cut-glass when conditions improve. German competition is very severe, but defective deliveries from Germany are causing much dissatisfaction.

Report on the Economic, Financial and Industrial Conditions of the Netherlands, Dated February, 1922. *By* R. V. Laming, *H.M. Commercial Secretary, The Hague. Department of Overseas Trade. Pp.* 48. *London: H.M. Stationery Office.* 1922. *Price* 1s. 3d.

The depression in Dutch industry which marked the close of 1920 continued throughout 1921, the decline in foreign, and especially the German, exchanges and the eight-hour day Act being particularly adverse factors. In the coal industry supplies improved, but the output of 3,927,000 tons was not much larger than in 1920, and receipts did not cover costs of production. Work on new shafts was continued and a new canal system has been completed. Owing to the fall in the price of coal, production of lignite declined by 1,181,000 t. to 117,000 t., and the peat industry became stagnant. The salt mine at Winterswijk passed through a difficult period, the duty on refined salt being insufficient to protect the refineries, of which only four are working.

Agriculturally the year 1921 was satisfactory, but the area under and the yield of flax both declined. In the colonies, the agreement between the cinchona factories and the plantations was renewed. Most Dutch East-Indian plantation companies, except, perhaps, the sugar companies, passed through a difficult period and the improvement in the world's market at the end of the year probably saved many of the rubber companies from extinction. A company was formed by the Royal Dutch Petroleum Co. to develop the Djambi oilfields under Government control.

Imports during 1921 declined in value by 1,092,073,970 gulden to 2,240,353,120 gulden, and exports by 331,871,111 gulden to 1,701,491,711 gulden (gulden=1s. 8d. at par), but by weight the former increased by 3·4 and the latter by 1·5 million tons. Exports of coal, 557,400 t., bunker coal, 696,700 t., refined sugar, 159,800 t., and condensed milk, 74,000 t., increased, but those of paper, textiles, vegetable produce, and margarine (69,500 t.) decreased. There was an increase in the importation of earthenware, stone and similar products, but serious declines in metals, minerals, yarn and textiles. Imports of coal amounted to 4,894,000 t. (2,969,000 t. in 1920), the United Kingdom supplying 1,784,000 t. Increases were shown in the volume and decreases in the value of imports of vegetable oil, the raw material being most in demand. Germany took first place in the import trade with 629 mill. gulden, followed by the United States with 392 mill. g., Great Britain with 311 mill. g., and Belgium with 227 mill. g. Of the exports Great Britain took 350, Germany 254, Belgium 167, and the United States 46 mill. g.

At the date of the report trade prospects were far from hopeful. Germany was losing ground owing to delay in executing orders and to insecurity of payment. As the British exchange has remained stable and prices have decreased, the demand for British goods will improve if prices of raw materials continue to decline.

OFFICIAL TRADE INTELLIGENCE.

(*From the Board of Trade Journal for June* 29 *and July* 6.)

OPENINGS FOR BRITISH TRADE.

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent.	Materials.	Reference Number.
Argentina	Pottery	225/6/F.G. M.C./C.
"	Sheet and plate glass	15
Australia	Chemicals, plaster, clays, etc. for the pottery industry ..	3
"	Chemical and pharmaceutical products, drugs	†
British India ..	Cement, soap, chemicals, rubber goods, dyes	8851/E.D./ G.C.
Cuba	Liquid coal-tar disinfectant ..	6257/F.L./ S.C.2
Czechoslovakia ..	Chemicals for the glass, paper and textile industries ..	721
Danzig	Chemicals for sugar-refining, machine oils and fats ..	722
Denmark	Gasworks pitch	5790/F.R./ M.C.
Egypt, India, Turkey	Tinplate	737
France	Paper	723
"	Metals	11
"	Porcelain tiles	12
Holland	Paint, lithopone, turpentine oil, carbolic and nitric acid, graphite, gum arabic, ether, naphthalene, yellow ochre, white soap	16011/F.W./ G.C./A.
"	Firebricks, fireproof cement	16011/F.W./ G.C./D.
Peru	Pottery	225/33/ F.G./M.C.
South Africa ..	Glass, glassware, pottery ..	225/29/ F.G.
" " ..	Galvanised iron	8
United States ..	Drugs, gelatin, citric acid, gum	738
" " ..	Refractory bricks, China clay, coke, pig iron, tinplate, chalk	739

† Ref. No. 412/20/7/3080. Official Secretary, Commercial Bureau, Australia House, Strand, W.C.2.

TARIFF. CUSTOMS. EXCISE.

Australia.—The drawback on goods which have been imported into and undergone further manufacture in the United Kingdom may be deducted from the value declared for customs duty on re-export to Australia.

Barbados.—Customs duties have been increased by one-fifth on all dutiable imports except charcoal, edible oils, cottonseed, and kerosene.

Belgium.—From June 24, an import duty of 10 francs per hectolitre has been imposed on light oils or spirits of a density less than 0·77 at 15° C. derived from mineral oils. From June 30, aniline dyes may only be imported under licence, but do not require a certificate of origin.

Canada.—Recent modifications of the customs tariff affect various kinds of paper.

Egypt.—Consignments of fertilisers will not be admitted after August 1 unless accompanied by an official certificate of analysis.

Fiji.—It is proposed to reduce the export duty on copra from 20s. to 15s. per ton.

France.—The "co-efficients of increase" applied to the import duties on many vegetable oils, mineral and paraffin wax, aluminium sulphate, lactose, and manufactures of copper have been modified.

New Zealand.—Definitions of oils for customs purposes are given in the issue of June 29. Photographic plates are admitted duty-free under the British preferential tariff, but pay a duty of 15 per cent. *ad valorem* under the general tariff.

Poland.—The customs surtax applied to the duties on printing and other paper has been reduced.

St. Christopher and Nevis.—Recent amendments to the customs tariff affect explosives and spirits. The schedule of export duties on sugar, syrup, molasses, cotton, and coconuts has been revised.

Sierra Leone.—The importation of methylated spirits that contain less than 10 per cent. by volume of wood naphtha and 0·385 per cent. of mineral naphtha (sp. gr. 0·800) is prohibited.

TRADE NOTES.

FOREIGN.

German-Swiss Trade in Chemicals.—Official Swiss statistics of the chemical trade between Germany and Switzerland are given below:—

	1913.	1920.	1921.
		Metric tons.	
Swiss imports from Germany:			
Pharmaceutical products	2,997·3	878·3	779·7
Perfumery	64·1	91·9	52·4
Alumina	3,776·4	13,913	13,071·8
Acetic acid, crude	769·3	475·3	312 9
Methyl alcohol	1,208·7	476·1	422·9
Tar-oil derivatives	3,132·7	6,391·0	3,680·7
Dyes	6,371·9	3,369·9	2,870·2
including coal-tar dyes	669·8	495·6	362·4
Chemicals, total	84,217·7	52,522·7	34,403·8
Basic slag	47,748·7	2,054·9	9,137
Potash fertilisers	13,223	12,217·3	6,155
Swiss exports to Germany:			
Calcium carbide	25,013·2	1,736·2	1,250·2
Glue and gelatin	767·4	810·1	651·1
Chemicals, total	49,437·3	5,281·4	3,835·7

The chemicals imported from and exported to Germany by Switzerland in 1921 were valued at 17,841,000 francs and 3,896,000 fr., respectively.—(*Chem. Ind., Apr.* 24, 1922.)

German Company News.—Meister, Lucius u. Brüning, F. Bayer u. Co. and the A.-G. für Anilin-Fabrikation are paying dividends of 30 per cent. each for 1921, *i.e.*, 10 per cent. more than in 1920. The Chemische Fabrik Griesheim-Elektron has raised its dividend from 16 to 27 per cent. Meister, Lucius u. Brüning, whose capital was increased to 430 million mk. in 1921, and 470 mill. mk. in May, 1922, made a net profit of 3·45 mill. (2·74) mk. carried forward 175·80 (64·54) mill. mk. and placed 1 (3·30) mill. mk. to reserve. F. Bayer u. Co., with the same capital, made a net profit of 201·43 (102·17) mk. and carried forward 3·05 (2·49) mill. mk. (*cf.* J., 1922, 174 R).

The Vereinigte Glanzstoffabriken A.-G. in Elberfeld states that there was a strong home demand for its products throughout its past financial year, and that it did practically no export trade, in spite of very attractive foreign prices. Every effort is being made to increase production, and the reconstituted factory in Sydowsaue has already a good production. The firm's interests in Germany and abroad have been extended. The balance for the year was 50,044,132 mk. (42,977,350) out of which dividends amounting to 30 per cent. (20) have been paid, and large sums placed to reserve.

The Schering Chemical Works, Berlin, G.m.b.H., has been formed with a capital of 200,000 mk. to market the products of the Schering Co. abroad and to import and export goods.

The A.-G. Lithoponefabrikation, Berlin, has declared a dividend of 35 per cent. The brisk demand for the company's products still continues and prospects for 1922 are considered favourable.

The Sacharin-Fabrik A.-G. vorm. Fahlberg, List and Co. in Magdeburg is paying a dividend of 15 per cent. and a bonus of 10 per cent., as in the previous year. Prospects are said to be very good.

At the recent meeting of the Gesellschaft für Linde's Eismaschinen A.-G., it was decided to distribute a dividend of 25 (20) per cent., and to double the share capital.—(*Chem. Ind., Apr.* 17, 24, 1922.)

Foreign Chemical Trade of Sweden in 1920 and 1921.—The imports and exports of chemicals and related products in 1920 and 1921 were as follows:—

	1920.	1921.
	Metric tons.	
Imports:—		
Sodium nitrate	23,048·6	26,050·9
Caustic soda and potash	5,375·5	4,224·4
Potassium chloride	6,058·2	128·4
Chloride of lime	9,028·7	1,853·3
Sodium sulphate and bisulphate	50,337·6	13,453·1
Calcium nitrate	22,302·5	14,855·6
Potassium carbonate	1,909·1	693·8
Soda, sodium bicarbonate	18,783·4	8,864·4
Potash salts (Stassfurt)	49,508·2	37,625·4
Thomas phosphate	—	5,801·5
Phosphate, crude	112,853·3	70,227·8
Mineral oils	189,729·8	145,589·2
Coal tar	11,370	2,818·1
Vegetable oils and fats	17,690·3	12,196·2
Zinc white, lithopone, barytes	5,310·6	5,037·8
Vegetable tanning materials, extracts	3,589	4,007·4
Sugar, refined	29,965	6,800·6
Hides and skins, raw	11,911·5	9,945·1
Salt, domestic	26,843·4	26,765·3
Coke	358,259	235,022
Coal	2,806,303	1,458,188
Sulphur	57,659·5	21,037·9
Pyrites	114,600	58,003
Pyrites cinders	18,369	15,833·9
Iron and steel	115,351	58,065
Iron, pig and scrap	97,526	23,514
Copper, crude	18,178	6,192
Exports:—		
Calcium and barium carbides	7,897·2	6,544
Potassium and sodium chlorates	2,785·3	1,582
Calcium cyanamide	100·2	
Copper sulphate	151·6	69·7
Superphosphate	42,375·7	18,382·1
Other chemicals	1,650	1,445·5
Pulp, wood:—		
Mechanical, wet	214,210	88,590
Mechanical, dry	57,755	15,290
Sulphite cellulose, bleached	44,162	16,158
Sulphite cellulose, unbleached, wet	40,733	5,614
Sulphite cellulose, unbleached, dry	511,859	298,562
Sulphate cellulose	140,548	102,701
Cardboard, paper, etc.	284,998	183,095
Cement	68,131	28,939
Felspar	16,947	20,252
Matches, wooden	36,450	19,975
Matches, safety	34,800·4	18,519·5
Iron and steel and manufactures of	222,677	124,630

Preliminary statistics give the value of Swedish imports as 3,373,484,826 kronor in 1920, and 1,266,237,485 kr. in 1921 and of the exports as 2,293,587,083 kr. and 1,097,273,992 kr. in the two years, respectively (krona = 1s. 1½d. at par, now roughly 1s. 2d.).

REVIEWS.

Gas Chemists' Handbook. *Compiled by the Chemical Committee, Technical Section, of the American Gas Association. Second edition, March, 1922. Published by the American Gas Association. Price $6 net.*

The work under review is published by the American Gas Association for the use of chemists in gas undertakings, for whom it will form a manual of great value, containing as it does a fairly complete account of the analytical and control methods commonly used there in gas works and coke-oven installations. The different sections have been written by chemists actually engaged in the work who for the most part give a clear and well-reasoned account of the methods described and of the precautions necessary in carrying them out. For British chemists the value of parts of the book will be less than for chemists in America, as certain of the methods described are inapplicable to British conditions, partly because in the different countries the type of apparatus employed has developed on different lines (*e.g.*, in the case of gas analysis), and partly because several of the methods are of an empirical nature, in which certain specified conditions of test must be complied with, and the conditions agreed upon differ in the two countries. Nevertheless a very considerable proportion of the book will be equally useful here, and even where the methods employed differ, a study of the other methods may often be helpful in devising means of improving the tests employed here in speed or accuracy or in both respects.

The very important matter of the correct sampling of the materials tested, whether solid, liquid or gaseous, frequently so inadequately treated in books of this kind, receives extended treatment, the methods given being, for the most part, those prescribed by the American Society for Testing Materials and the Bureau of Mines. Space does not permit of an extended criticism of the methods of analysis prescribed, but in general these appear to be satisfactory, and in accordance with present knowledge. A point to be commended is the statement in connexion with many of the tests of the "tolerance" which is allowable between duplicate tests made by the same observer, and also between different observers testing the same sample.

On the other hand, certain of the methods given seem to be distinctly inferior to those used for the same purpose in this country. For example, the most unsatisfactory chapter in the book is that relating to cyanogen (possibly because very little in the way of extraction of cyanide products is carried out in American gas works). Practically the only method described for the determination of ferrocyanide is that of titration with copper sulphate according to the plan first described by Bohlig in 1862, and no mention is made of the more recent methods, such as those of Feld and Williams, in which the amount of hydrocyanic acid in the products is determined, and which are much more accurate and more easily and quickly carried out. Sulphocyanides, which are here often of considerable importance, barely receive mention, and no methods of analysis are given. The method given for the determination of naphthalene in gas by means of picric acid, appears very cumbersome and liable to considerable experimental error, and inferior to several of the modifications of the picric-acid method in use here. No mention is made of the method now in general use here of determining the amount of sulphur, excluding tarry matter, in spent oxide, by heating the extracted sulphur and tar with concentrated sulphuric acid at 100° C., which is far more preferable to the tedious and unpleasant method of treating the mixture of sulphur and tar with nitric acid and chlorate, and subsequently precipitating the sulphuric acid formed as barium sulphate.

The book is well printed and illustrated, and although, for the reasons given above, it cannot be as suitable to British as to American chemists, it will nevertheless be a valuable addition to the laboratory library in gas works and coke-oven installations in this country.

H. G. Colman.

Sewerage and Sewage Treatment. *By Harold E. Babbitt. Pp. xii.+531. (New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd. 1922). Price 25s. net.*

This book, as the author points out in the preface, is the development of a series of classroom and lecture notes. It would, therefore, not be fair to compare it with the many larger treatises which have been compiled on these two wide and complex subjects, but there are, nevertheless, in the text illustrations, tables, diagrams and data which will help both the student of sanitary science and the sanitary engineer.

Introducing each branch of the subject with a discourse on the pure theory and passing on to a description of the execution of the work and the finished plant (in some cases with notes of the working of the installations), the author impresses the reader with the feeling that he is well abreast of the times in his information. Since the subject of sewage treatment and disposal is one which must of necessity be regarded in the light of theory and experience combined, this academic method should appeal to the student.

Although it is not reasonable to look for a chapter on every branch of the subject in a work of this size, it will be found that the author has covered most of the ground available to him without going into too many details.

Most writers deal with the sewage problem as the result of having studied it in different countries, but the author has confined his remarks and examples exclusively to American practice, a fact which should be borne in mind by the reader since the American engineer does not invariably aim at the same goal as his brother professional in this country. For instance, quickness of construction and cheapness of production are not infrequently accepted in the States as meritorious when they would not be so accepted in England if they militated in the least degree against efficiency.

The careful study of what is being done in any one country where sanitation is taken seriously and the tale of successes, failures and general vicissitudes through which the sewage problem has passed are bound to be educative, and are interestingly told by the author to his readers.

As America is the home of the system known under the name of Dilution, one would naturally expect a sound practical reference to it, and in this the reader will not be disappointed.

The chapters on Work Preliminary to Design (of sewerage systems), Quantity of Sewage, and Pumps and Pumping Stations contain much valuable and interesting instruction and include data on construction and maintenance, on the selection and characteristics of the different makes of pumps and on general equipment, sufficient for most needs of the sanitary engineer.

Other chapters of special note to the reader are found under the headings Sedimentation of Sewage and Activated Sludge. In these the principles of the working of the Imhoff Tank and its design and treatment are dealt with fully, whilst a table of bibliographical references on activated sludge emphasises the fact that only by carefully following detailed descriptions of what has been and is being done in various places can one hope to strike a true balance of the relative merits and demerits of this method of sewage purification, which is still in its infancy.

The twenty-one chapters of this book form not only an attractive synopsis of the history of sanitation and the development of sewage purification written by the able pen of a man who has kept pace with the times, but they contain a wealth of illustrations, tables, diagrams, costs, quotations from specifications, and descriptions of execution of work.

J. D. WATSON.

THE CORROSION OF IRON. *By* DR. J. NEWTON FRIEND. *Carnegie Scholarship Memoirs. Vol. XI. Pp.* vi+161. *Published by the Iron and Steel Institute,* 28, *Victoria Street, London, S.W.* 1. 1922. *Price* 16*s.*

This is a special volume, issued by the Iron and Steel Institute as a Carnegie Memoir. It deals with the present state of knowledge on the corrosion of cast iron and steel: the protection of iron; the influence of temperature on the rate of corrosion; and the colloid theory of corrosion. This theory has been developed by Dr. Friend, and a number of new and interesting observations and experiments are recorded. The report is likely to be a standard of reference, and should be read by all interested in this subject.

We have received the subjoined correspondence relating to the review of Mr. F. F. P. Bisacre's book "Applied Calculus" which appeared in our issue for May 15.

Mr. Bisacre writes:—

"Certain questions of fact arise in connexion with the review to a few of which I should like to direct your attention. (1) The reviewer states that "In this work the conception of o—the vanishingly small infinitesimal—is developed exclusively by the method of limiting values."

The two methods by which the Calculus may be approached are both given in the book, namely, the usual method of Limits, and the method of "Infinitesimals," but "the conception of o—the vanishingly small infinitesimal"—is not developed in the book for the reason that it is an exploded doctrine of the seventeenth century. The work of Weierstrass, Cantor, Hardy, Hobson and Whitehead—to name a few pure mathematicians—has finally disposed of a doctrine that Bishop Berkeley poked fun at so successfully. The reviewer must forgive me for trying to avoid the false doctrines of the past.

(2) In the reviewer's remarks on my treatment of the exponential function, after saying that the author does so and so, he says: ". . . he proves that the derivative of e^y is e^y." The author neither *proves* nor pretends to *prove* this, in a mathematical sense. The method he has used is entirely an experimental one, which leads the reader, in a practical fashion, to discover for himself, with the aid of a book of tables, the properties of the exponential function and logarithms, and the author says this and disclaims any pretence to mathematical rigour in the following passage: "The theory of these functions is difficult, and proved a formidable stumbling-block in the history of mathematics. The theory is best worked out by methods beyond the scope of this book, and for the present we shall take the tables for granted, and endeavour to ascertain the most important properties of the functions from these tables."

(3) In criticising the method of obtaining the derivative of sin x, the reviewer has left out three essential lines of working and two references, and goes on to say: "To students who are not expected to have a knowledge of algebra beyond quadratic equations, the seeing of this equation means that they have advanced further in trigonometry than is usually taught to such." What the author actually says in the Preface as to preliminary mathematical equipment is this: "All the mathematics that the student is assumed to know is algebra up to quadratic equations; *elementary trigonometry up to the formulæ of sines, cosines and tangents of compound angles;* the elements of geometry; and the method of graphs."

(4) The reviewer writes as follows: "In the Preface the author states that infinite series are avoided altogether as being difficult and unconvincing, yet he is driven to Taylor's series; . . ." What the author says is "Infinite series are essentially difficult and unconvincing *unless treated rigorously*—as the old conundrum of Achilles and the tortoise shows—and there is no need to use them in the elementary parts of the subject." As to the reference to Taylor's series, there is not a Taylor's series in the whole book!

PUBLICATIONS RECEIVED.

INORGANIC CHEMISTRY. *By* PROF. T. M. LOWRY. *Pp.* 943. (*London: Macmillan and Co., Ltd.* 1922). *Price* 28*s. net.*

CATALYSIS WITH SPECIAL REFERENCE TO NEWER THEORIES OF CHEMICAL ACTION. *A General Discussion held on September* 28, 1921, *by the Faraday Society. Reprinted from the Transactions of the Faraday Society, Vol. XVII. Part* 3, *May,* 1922. *Pp.* 546—675. *Price* 9*s.*

L'AZOTE: LA FIXATION DE L'AZOTE ATMOSPHÉRIQUE ET SON AVENIR INDUSTRIEL. *By* PROF. L. HACKSPILL. *Encyclopédie Léauté. Pp.* 271. (*Paris: Masson et Cie. and Gauthier-Villars et Cie.* 1922). *Price* 14 *fr.*

LES PROGRÈS DE LA MÉTALLURGIE DU CUIVRE. *By* PROF. A. CONDUCHÉ. *Encyclopédie Léauté. Pp.* 254. (*Paris: Masson et Cie. and Gauthier-Villars et Cie.* 1922). *Price* 14 *fr.*

LES COLLOÏDES. *By* J. DUCLAUX. *Second edition, revised and enlarged. Pp.* 305. (*Paris: Gauthier-Villars et Cie.* 1922). *Price* 10 *fr.*

DER PAPIER-FABRIKANT. *Vol.* 20, *No.* 23A. *Special edition for the Jubilee of the Verein Deutscher Papierfabrikanten. Pp.* 408. (*Berlin: Verlag Otto Elsner.* 1922). *Price* 4*s.* 6*d.*

DIE LÖSUNGSMITTEL DER FETTE, OELE, WACHSE UND HARZE. *By* DR. H. WOLFF. *Monographs on the Chemistry of Fats, edited by* PROF. K. H. BAUER. *Pp.* 118. (*Stuttgart: Wissenschaftliche Verlagsgesellschaft.* 1922). *Price* 9*s.*

WERKSTOFFE: HANDWÖRTERBUCH DER TECHNISCHEN WAREN UND IHRER BESTANDTEILE. *Vol. I. A.—F. Vol. II. G.—R. Vol. III. S.—Z. By* PROF. PAUL KRAIS *and collaborators. Pp.* 529, 784, *and* 728, *respectively.* (*Leipzig: J. A. Barth.* 1921). *Price, paper,* 450 *marks, bound,* 540 *mk.*

REPORT OF THE FUEL RESEARCH BOARD FOR THE YEARS 1920, 1921. SECOND SECTION: LOW-TEMPERATURE CARBONISATION. *Department of Scientific and Industrial Research. Pp.* 73. (*London: H.M. Stationery Office.* 1922). *Price* 2*s.*

REVIEW

Vol. XLI] JULY 31, 1922 [No. 14

THE ANNUAL MEETING IN GLASGOW

VISIT TO THE ARDEER FACTORY OF NOBEL'S EXPLOSIVES CO., Ltd.

At the invitation of the Directors of Nobel Industries, Ltd., 100 members visited the above factory on Saturday, July 8. The party travelled by special train from St. Enoch Station, Glasgow, and on reaching Stevenston was conveyed on the company's private line to the Ardeer Factory. On behalf of Nobel Industries, Ltd., the guests were welcomed by Sir Ralph Anstruther, Lord Cochrane and Mr. Rogers, and by Mr. J. A. Cockburn, works manager of the factory.

The visitors were divided into parties, and each party was conducted through selected portions of the factory by a member of the chemical staff.

The site of this factory was selected by Alfred Nobel in 1871. On its front it faces the Firth of Clyde, and the factory covers an area considerably over a thousand acres. The guests first of all visited the boiler station, where 19 Lancashire boilers distribute steam through more than 20 miles of piping. The fuel for these boilers is entirely mechanically handled. After visiting the Power Station, where the turbo generators and air-compressors were examined, the parties entered the "danger" area and were conducted to the summit of one of the "nitroglycerin" hills, from which an extensive view of the factory was obtained. It was at once apparent—and the photograph makes this clear—that the term "factory" is rather misleading, for, instead of one building or group of allied buildings, the Ardeer works consists of hundreds of distinct and widely separated houses, many of which are surrounded by high sand-embankments.

The plant for the manufacture of nitroglycerin was briefly described, and a typical nitrating house was shown, the lead-lined nitrators in which yield one ton of nitroglycerin per charge.

The parties then descended the hill and passed through a portion of the Blasting Department. Although no more than a department at Ardeer, it is the largest blasting-explosives factory in Europe. After visiting one of the "Gelatin" houses where blasting gelatin and gelignites are made, each party was conducted to the Dynamite Huts, where an exhibit of various blasting and propellant explosives was inspected. Blasting explosives may be broadly classified in two sections: the gelatinous type and the powder type. Among the former class may be mentioned Blasting Gelatin, Gelatin Dynamite and Gelignites, whilst Samsonite No. 3 and Super Rippite No. 2 are "permitted" gelatinous explosives, *i.e.*, their use in fiery mines is sanctioned by the Home Office. It is interesting to note that, after the invention of dynamite by Nobel in 1866, he continued his researches in the hope of obtaining some substance which, while itself powerfully explosive, would dissolve in nitroglycerin and convert it into a jelly. The outcome of these investigations was the discovery of Blasting Gelatin in 1875. Among the "permitted" powder explosives may be mentioned Viking Powders Nos. 1 and 2, Thames Powder No. 2, Rex Powder, Stomonal No. 1, Super-Cliffite No. 3, and Dynobel No. 3. A very large number of blasting explosives, among which may be mentioned Quarry Monobel and Rockite, are made for ordinary and special blasting purposes.

Another interesting exhibit was that of Tonite, a compressed mixture of barium nitrate and guncotton. This explosive is manufactured for use in submarine demolition, in distress-signal work, and for blasting. Tin canisters were exhibited which contained quantities of Tonite up to 200 lb. These larger charges are prepared for submarine and special demolition purposes. A number of distress signals, which may be fired either by ordinary ignition or by percussion, were also inspected.

The next hut contained an exhibit of propellant explosives manufactured for military, naval, and sporting purposes. Cordites of all sizes, from those for the 15-inch gun to the magazine rifle and revolver, were inspected. A specially interesting exhibit was a comparatively new propellant called "Ardeer Cordite." During the last few years much research work has been carried out at Ardeer on the preparation of cordite without the use of alcohol and other volatile solvents, thereby avoiding the use of potential foodstuffs in times of national emergency. A process on these lines has now been devised whereby "Ardeer Cordite" in any size may be prepared from nitroglycerin and nitrocotton, and despatched for proof and use in a single day. This cordite possesses many desirable features, not only as regards ballistics and stability, but also from the standpoint of manufacture. Among the manufacturing advantages may be mentioned the fact that wet nitrocotton is used, thereby avoiding the dangers always incident upon the drying of nitrocottons. Nitrocellulose powders, both for field guns and rifles, were exhibited, including the special powders used in the match rifle competitions at Bisley and progressive powders for use in high-velocity military rifles. Many varieties of sporting powders of both condensed and bulk nitro types were shown. Ballistite, the standard condensed powder invented by Nobel in 1888, and the forerunner of cordite, was exhibited in various sizes both for use in small arms and ordnance. This was the propellant used for the trench mortar during the late war. The bulk nitro types of sporting powders, of which E.C., Empire and Schultze powders were shown, are characterised by the necessary charge occupying the same volume as the older, heavier charges of black powder.

Leaving the "danger" area, the parties proceeded to the Acids Department and inspected the glycerin-distillation plant, where saponification and soap-lye glycerins are distilled prior to their conversion into nitroglycerin. One of the Tentelew units, for the manufacture of oleum, was next inspected. Arsenical pyrites is used as the source of sulphur in this contact process, and this factory is the only private factory in the Kingdom where the Tentelew process is employed. Nitric acid, of concentration up to 90 per cent., is made from sodium nitrate, and the mixed sulphuric and nitric acids are subsequently employed for the manufacture of nitroglycerin and of various types of nitrocotton. A short inspection was also made of the towers used for denitrating spent acids and the concentration of weak nitric acid. Kessler plants are employed for the concentration of sulphuric acid obtained from the various refuse acids. In this department lead nitrate is manufactured for the preparation of pigments, and there is also a plant for the purification of trinitrotoluene.

Unfortunately, time did not permit of a tour round the Research Department. This section consists of extensive laboratories equipped for special purposes and is staffed by 30 chemists and physicists, together with many specially trained assistants. During the winter months classes in chemistry and closely related subjects are conducted for the benefit of the apprentices and assistants, and these classes are recognised as a part of the diploma course of the Royal Technical College, Glasgow. The department is organised so that there is always intimate contact between manufacture and research, whilst special laboratories have been erected where semi-manufacturing experiments may be carried out. The department has repeatedly worked in collaboration with Government departments, and is at present giving assistance to the committee recently appointed by the Government to consider the testing of permitted explosives. The Library, containing over eight thousand volumes, is unique among commercial libraries, and a librarian, a staff of indexers and reporters are continuously employed in the abstraction, indexing and distribution of scientific and other useful information. The majority of pure and applied scientific journals, both British and foreign, are always available. In addition, a card-indexing system was instituted some years ago and now embodies over a quarter of a million cards (*cf.* J., 1919, 37R).

A most interesting exhibition of the products of the various factories of Nobel Industries, Ltd., was inspected in one of the large rooms of the general offices. Samples were on view from the following constituent companies:—Nobel's Explosives Co., Ltd.; Kynoch, Ltd.; Curtis's & Harvey, Ltd.; Lighting Trades, Ltd.; Necol Industrial Collodions, Ltd.; Eley Bros., Ltd.; British Pluviusin Co. (1920), Ltd.

After this inspection the guests were entertained to lunch. Sir Ralph Anstruther presided, and at the conclusion proposed the toast of the Society of Chemical Industry, to which Dr. E. F. Armstrong, in the unavoidable absence of the President, Dr. R. F. Ruttan, replied.

After lunch the visitors proceeded to the Testing Station and inspected the apparatus for testing blasting explosives. The firing pit, consisting of a large steel autoclave buried in sand and used for firing explosives at a loading density comparable with that employed in mines, was first examined. The apparatus is arranged so that samples of the gases, evolved on explosion, may be easily withdrawn and analysed. Two ballistic mortars used for determining the strength of explosives were then shown; one of these is an exact replica of that used by the Home Office for testing the strength of permitted explosives. An apparatus for determining the length and duration of flame of blasting explosives was examined and several photographs illustrating the flames obtained with various types of blasting explosives were exhibited. In the calorimeter room a selection of calorimeters for use in measuring the heat evolved on exploding both blasting and propellant explosives was seen. The Bichel pressure-gauges used to measure the pressure developed by explosives when detonating were inspected, together with typical charts obtained in this test. This apparatus consists of a strong steel cylinder resting on a concrete foundation. The charge to be tested is placed in the chamber on a small wirework tripod and fitted with an electric detonator fuse, of which the wires are carried through the walls of the cylinder. The explosive chamber is closed by means of a strong steel cover and the air in the chamber may be exhausted. Vertically above the test charge is an adjustable valve-attachment, and a pencil

THE ARDEER FACTORY OF NOBEL'S EXPLOSIVES CO., LTD.

or stylo is adapted diagrammatically to mark a rotary drum set in motion by a motor. In the same room, the Fall Hammer Apparatus used for determining the sensitiveness to shock of various explosives was exhibited. The next apparatus examined was the Mettegang Recorder used for determining the rate of detonation of explosives, and the method of working of the apparatus was portrayed diagrammatically. The action of this recorder is purely electrical, so that errors of observation are eliminated to a great extent.

The visitors then passed through the engineering and instrument-makers' workshop, where much of the finer apparatus used in the examination of explosives is made, and proceeded to an experimental press house erected solely for studying the phenomena underlying the pressing of gelatinised propellant explosives. The climatic magazines were pointed out, where experimental explosives are stored in hot dry and in hot, moist atmospheres and their stability under these storage conditions examined. These magazines are constructed so that the regulation and measurement of temperature are entirely automatic. Further, the explosive samples are stored in separate fire-proof cells, so that the decomposition and ignition of one sample cannot be communicated to the samples in the adjacent cells.

The last inspection was that of the Safety Explosives Gallery. This gallery is an exact replica of the Home Office Gallery at Rotherham, where the Government testing of proposed "permitted" explosives is carried out. The test consists of finding the maximum charge of the explosive which fails to ignite both a sensitive mixture of coal gas and air and a mixture of coal dust and air. Testing is continued until the maximum charge is found which does not ignite these mixtures for five successive shots. This maximum charge is called the "charge-limit" of the explosive and in fiery mines not more than this quantity is allowed to be used in one borehole.

DEMONSTRATIONS

Preliminary experiments were carried out to show the various methods of firing explosives and the difference between burning and detonation. The difference between explosion depending on rapid burning and explosion due to detonation was illustrated by firing gunpowder by safety-fuse alone and dynamite by a detonator fired by safety-fuse and by a detonator fired electrically. The difference between burning and detonating the same explosive was effectively displayed by igniting a cartridge of Cambrite No. 2 by a flame and a similar cartridge of the same explosive detonated by a No. 6 detonator.

The carrying out of the following tests was then demonstrated :—

(*a*) *The Lead Block Test*, in which a definite weight of explosive is fired in a cavity in a lead cylinder and the increase in volume of the cavity measured. This increase gives a rough indication of the shattering power of the explosive.

(*b*) *The Ballistic Mortar Test*, in which the explosive is contained in a cavity in the side of a steel mortar which forms the bob of a large pendulum. The shot is tamped by a steel block which forms a sliding fit in the first block. When the shot is fired the magnitude of the recoil of this large pendulum gives a measure of the heaving effect of the explosive.

(*c*) *The A.D.C. Test* for determining the maximum length of air-gap through which explosion can be transmitted from one cartridge to another.

(*d*) *The Velocity of Detonation Test*: by the D'Autriche method. This method is not an absolute method such as that in which the Mettegang recorder is employed. TNT fuse, a thin lead tube containing a core of compressed trinitrotoluene, is employed in this test and the results obtained depend on the rate and uniformity of detonation of this fuse.

(*e*) *Safety Explosives Gallery Test*: Shots were fired showing the ignition of coal-gas – air mixtures and of coal-dust – air mixtures by means of explosives.

The guests were then assembled in order to observe a demonstration of some of the properties and practical applications of explosives. The first experiment, in which a cartridge of Blasting Gelatin was placed (*a*) a little distance above an iron plate, (*b*) in contact with a plate, and (*c*) "tamped" or confined on a plate, illustrated the effect of "tamping" an explosive. The last method is much used for cutting steel plate in the destruction of old ships. The next experiment illustrated a typical application of explosives in the removal of obstacles. A row of cartridges was laid close up to the foot of a wooden palisade and confined by a banking of earth. A single shot served to remove completely the whole of the palisade. An example of the application of explosives in modern agriculture was illustrated by constructing a trench by a single detonation. In the next experiment a large cast-iron ring, weighing over 3 tons, was satisfactorily broken up for the scrap-iron heap by the application of a "plastic" shot to the inner face of the portion of the ring in contact with the ground. As a companion experiment a large iron pot, weighing over 5 tons, filled with water, was completely demolished by a single explosive charge fired under the water. In this case the application of a "plastic" shot would be unsatisfactory, owing to the shape of the pot and the danger that would be incurred from flying metal. A series of distress and sound signals was next discharged. Distress signals are very complicated in design, but consist, essentially, of a charge of gunpowder for propelling the signal from the firing socket into the air, a charge of colour composition, which is expelled away from the main charge by a small compressed gunpowder charge, and a main charge of Tonite which is detonated by means of a time-fuse and detonator. Sound signals are used in lighthouses during foggy weather. They consist of a charge of compressed Tonite and are inserted in a revolving-wheel device which detonates them at regular intervals by means of a detonator inserted in them. The last experiment illustrated the use of explosives in labour-saving by the demolition of a chimney stack. Owing to the proximity of the stack to other buildings, it had to be brought down in a definite direction. Bricks were removed from the base of the stack, leaving supporting pillars on that side of the stack towards which it was required to fall. These pillars were then bored and charged with the requisite weight of explosive.

The thanks of the Society are due to Sir Harry McGowan and the Directors of Nobel Industries, Ltd., for their hospitality; to the members of the Chemical Staff who acted as guides and interpreters; and, not least, to Dr. H. Hepworth for supplying the above account of the visit.

CATALYSIS THROUGH AMERICAN SPECTACLES

E. F. ARMSTRONG and T. P. HILDITCH

THE Committee on Contact Catalysis of the Division of Chemistry and Chemical Technology of the American National Research Council has published its first report, written by the Chairman, Prof. W. D. Bancroft, in the form of a serial story appearing in the pages of the *Journal of Industrial and Engineering Chemistry* (April-July, 1922).

The subject is surveyed thoroughly and incisively, the views of the upholders of various theories are given exhaustively and illustrated by well-chosen extracts from their published papers, and the report is enlivened by considerable humour—a mode of treatment which may be recommended to the discreet attention of most writers of scientific literature. The Committee states that it seemed the best thing it could do in its first report was to outline, as clearly as possible, the present situation in regard to contact catalysis. After that, it should be a relatively simple matter to determine what to do next. One rather gathers that the result has been to discover objections to all the theories of contact catalysis at present in the field, so that "what to do next" should resolve itself into the establishment of a really satisfactory sound explanation, pleasing alike to physical chemists of all schools and also, let us hope, to the mere chemist.

The "radiation" hypothesis fares worst: the paucity of experimental evidence, or, rather, the apparent indifference of its exponents to the desirability of experimentally, as well as hypothetically, correlating infra-red absorption with catalytic action in as many cases as possible, is stressed, and the conclusion reached is that "it is quite extraordinary that a theory like this should get a scientific standing with apparently nothing back of it." It is, however, in regard to the treatment of the other two hypotheses—"intermediate compound" and "adsorption"—that we are tempted to join issue with the Committee, which seems very impossible to please: but perhaps destructive criticism is so easy.

The present writers' disavowal of precise knowledge of most of the "unstable intermediate compounds" (in the transient existence of which they have been led to believe from a consideration of the chemical transformations in hand) is quoted *in extenso*, including the statement that they might well be as "indefinite" as the adsorption of dye by fibre,[1] and is followed by the criticism that though we believe firmly in the formation of definite intermediate compounds, our conception of an intermediate compound is so elastic and our knowledge of the compositions of the assumed intermediate compounds is so limited that there would probably be no difficulty in re-writing all our results in terms of adsorption.

Yet, when the latter view is considered in detail, it receives somewhat rough handling: "If we adopt Langmuir's views of oriented adsorption, all sorts of things become possible"—but "such a suggestion is of very little value unless it can be made definite . . . it may well be that some entirely different hypothesis will prove necessary . . . for the moment it looks as though the organic chemist were the safer man to follow . . . the identification of the intermediate compounds does not account for the catalytic action. On the other hand, it is impossible to take the next step until the intermediate compounds have been identified." This, in sporting language, looks like backing each theory both ways; at the same time the Committee concludes that the difference between what is meant by those who talk of "definite" or "indefinite intermediate compounds," and those who refer to "adsorption" is "psychological and not chemical."

The possibility of explaining catalysis by means of the kinetic theory of molecular collisions—the function of a catalyst being then in some way to increase the opportunities for collisions of molecules, perhaps in specific positions, is considered in some detail, but the Committee is apparently inclined to the view that on the whole "activation by adsorption" affords a better explanation. The vagueness of what is implied by "activation" is fully appreciated by the Committee, as may be seen from its reference to Baly's hypothesis on "opening up fields of force," but it seems to feel that Langmuir's theory of "oriented adsorption " offers the possibility of an explanation of the supposed activation, for the last word is a suggestion that Langmuir's theory would throw more light on the real problem of contact catalysis if it were developed so as to show, for example, that an ester was adsorbed in different ways by different catalytic agents, and that the reaction took place at the point of the molecule " where the ester tied on to the adsorbent, forming the indefinite compound."

---

[1] Proc. Roy. Soc., 1920, **98A**, 37

Whether this is psychological or etymological difference, it is perfectly plain that the Committee's final conclusion, the Langmuir theory of adsorption, in so far as it applies to catalysis, and our own intermediate-compound theory, all come to the same thing. Frankly, we are tiring of etymological splitting of hairs in this matter. Organic chemists will always regard these things from their own standpoint, and so will physical chemists or pure physicists; but what we maintain is that in recent work on catalysis the " adsorption " school of physicists and the " intermediate-compound " group of organic chemists have developed theories which are on closely converging lines, and we suggest that the next move is a definite acceptance of this fact by both sides, followed by mutual exchange of views to facilitate further progress. If the organic chemist, for example, were to state frankly the details which do not at the moment fit in closely with his point of view, and mutual examination of temporarily irreconcilable data were undertaken by representatives of the chemical and physical views from their respective standpoints, it is more likely that progress would be resumed than if the apparently interminable discussion on terminology were pursued further.

The reluctance of some chemists (we had almost written catalytic chemists) to have anything to do with chemical compounds, however unstable, is hard to understand, but is well illustrated by the Committee's failure to grasp why, if the dehydration of alcohol by alumina depends on the intermediate formation of aluminium ethylate, kaolin should act almost as well as alumina, since " the formation of a definite kaolin ethylate seems improbable." Now, surely it is common knowledge that kaolin and the many other complex silicates and alumino-silicates, although definite in one sense, are indefinite in that various molecular proportions of the constituent oxides may be found combined together and *may act to some extent independently of the total molecule as such.* Thus, in some other complex silicates, the zeolites, it is actually and readily possible to replace some of the bases by others, for example, soda by lime, and *vice versa*, without affecting in any way the alumino-silicate part of the complex. Since then the complex silicate molecule is so flexible that part of it can be chemically interchanged without disrupting the whole, it is equally possible for the alumina in kaolin to carry on transient combination with alcohol without affecting the rest of the kaolin molecule. The phenomenon of base-exchange in the zeolites is a particularly beautiful analogy of the ease of intra-molecular chemical interaction which, although non-catalytic, should be borne in mind before dismissing too lightly the probability of intermediate-compound formation during catalysis.

The action of " promoters " is dealt with briefly in the report, reference being made to Pease and Taylor's summary of the data on this branch of the subject.[2] Whilst quoting Rideal and Taylor's supposition that the promoter alters the proportion in which the interactants are adsorbed at the catalyst surface, the Committee adds an alternative suggestion, namely, that perhaps the catalytic agent activates only one of the reacting substances or activates one chiefly, whilst the promoter activates or increases the activity of the other. The subject of promoter action is, however, so complicated and obscure that a considerable amount of further detailed experimental work is necessary before a general explanation is likely to be discovered. It is shown that the theory of poisoning of contact catalytic agents has been more satisfactorily developed. Any substance which retards, or prevents, the approach of the reacting substances to the catalytic agent will slow down or put an end to the reaction; or, the poisoning of a catalytic agent is due to marked adsorption, which cuts down the adsorption of the reacting substances.

The recent work of Taylor and Burns,[3] of Maxted,[4] and of others is fully discussed and the evidence for the above views concisely summarised. An interesting point is made when it is remarked that " poisoning " of non-catalytic reactions is a familiar phenomenon in the non-corrosion of many oxidisable metals due to a minute protective film of oxide. In this connexion we would draw attention to the unfortunate manner in which physico-chemical theory lags behind technical practice in the realm of catalytic action. It is no secret that, as in other technical applications of catalysis, the matter of " poisons " was one of the greatest difficulties connected with fat-hydrogenation. These difficulties were overcome in works' practice ten years ago mainly by consideration of the possibility of " films " of various kinds preventing contact between catalyst, oil and hydrogen, although the blessed word " adsorption " was not specifically invoked, even though it had by that time been invented.

Rosenmund's[5] employment of suitable " poisons " to modify the action of catalysts is referred to, and this seems to be a field of which the potentialities are by no means yet fully explained.

---

[2] J. Phys. Chem., 1920, 24, 241

[3] J. Amer. Chem. Soc., 1921, 42, 1285

[4] Maxted, J. Chem. Soc., 1919, 115, 1050; 1920, 117, 1280, 1501; 1921, 119, 225

[5] Ber., 1921, 54B, 435, 638, 1092

Other subjects which are dealt with are the mixed oxidation catalysts devised by Lamb, Bray and Frazer,[6] Rideal's attempted connexion between overvoltage and catalytic power,[7] and the apparent stimulation of some catalytic hydrogenations by small quantities of oxygen.[8]

Whilst the report gives a very full account of the present knowledge of the procedure of contact catalysis, we feel that the lines on which further work is apparently recommended to be undertaken are somewhat restricted in scope. In our opinion more attention should be paid to the characteristic side actions which proceed during most cases of catalysis.

Although we have handled the report critically, we do not wish in any way to detract from its great value at the present juncture. The more fully and frankly such problems are discussed the better for chemical progress; all hypotheses are of value provided they are put to the test of experiment and even in catalysis an ounce of practice is worth a great deal of theory. The thanks of all chemists are due to Prof. Bancroft and his colleagues for the labour they have expended on their report.

---

[6] J. Ind. Eng. Chem., 1920, 12, 217

[7] J. Amer. Chem. Soc., 1920, 42, 94

[8] Willstätter & Waldeschmidt-Leitz., Ber., 1921, 54, 113

ASSOCIATION OF BRITISH CHEMICAL MANUFACTURERS

THE sixth annual report of the Association covers the most difficult period, from the trade point of view, which has yet been experienced; but, despite the adverse circumstances, the Association has firmly maintained its numerical strength, improved its finances, and established its position.

For the first time in the history of the Industry a thoroughly representative chemical exhibition was organised by the Association as a section of the British Industries Fair, held at the White City early in 1922. The exhibition created great interest, both in trade and official circles, about fifty members of the Association participated, and although, as was to be expected, they were not overwhelmed with orders, a certain amount of business was done; the real value of the exhibition lay in the education of the public mind as to the scope and possibilities inherent in British chemical industry.

The revision of the Association's Directory has proved to be more complicated and difficult than was anticipated. The Russian and Japanese languages have been replaced by German, and the lists of products and proprietary trade names have been extended. The publication should be ready for distribution at an early date. During the year the Association's pamphlet on "British Research Chemicals" was revised and greatly enlarged to cover about 1800 fine-chemical products, including inorganic chemicals, indicators, and microscopic stains; many thousand copies were distributed to chemists, Trade Commissioners and others interested, in all parts of the world. Information concerning the industry has been contributed to the Press throughout the year, and the public has been kept informed of the progress of the industry.

The Council, having felt that the time had come when an effort should be made to get the terms of contracts with public authorities so amended as to be just and reasonable to both the contracting parties, approached the Federation of British Industries, and this body has set up a committee for the purpose of revising the conditions of forms of contract, tender and specifications in use by Government departments, municipalities and other public bodies. Mr. H. Ferguson represents the Association on this Committee.

Since the conclusion of the war many countries have revised their customs tariffs, and those of Spain and the United States have in particular engaged the attention of the Council. Mr. R. G. Perry has represented the Association on the advisory board nominated by the Federation of British Industries to assist the Board of Trade in its negotiations with the Spanish Government.

Much useful work has been carried out by the Joint Research Committee of the Association and the British Chemical Plant Manufacturers' Association, and an understanding has been reached with the British Engineering Standards Association whereby overlapping of activities will be avoided; the latter Association has issued a Directory, which supplies a long-felt want. The report on the Standardisation of Steam-Jacketed Pans (*cf.* J., 1922, 52 R) aroused great interest throughout the industry, and its excellence is shown by the adoption of the specification by the British Engineering Standards Association as the official British standard. A similar report on standard covers for jacketed pans will be issued shortly. Preliminary reports on the standardisation of cast-iron filter-presses have been issued for criticism (*cf.* J., 1921, 401 R, 1922, 210 R), and the final report is nearly ready for publication. The use of nickel, Monel metal and chromium steel in chemical plant has been investigated.

The Association has taken a sympathetic interest in the inauguration of the Institution of Chemical Engineers, of which the General Manager is vice-chairman. This new organisation should be of considerable benefit both to chemical and plant manufacturers.

Throughout the year the Council has been constantly engaged on the problem of transport. The Railways Bill, which received the Royal Assent in August, 1921, is of great importance to the chemical industry in that, for the first time in the history of railways, it takes away from the railway companies the power of finally deciding what are dangerous goods and invests it in the Railway Rates Tribunal. Further, the rates charged on dangerous goods are in future to be subject to analysis in precisely the same manner as the rates for ordinary merchandise, so that chemical manufacturers will not have to pay for services which are not provided, as hitherto.

Apart from the Railways Act, the Traffic Committee has been fully occupied in dealing with the consequent revision of the General Railway Classification of Goods. Many objections were sent in by various members to the proposals of the railway companies in connexion with the classification of non-dangerous goods, and as the result of meetings held with the companies a number of concessions were obtained (*cf.* J., 1922, 73 R). It was, therefore, only necessary to ask the Rates Advisory Committee to adjudicate upon 20 cases, with the result that decisions favourable to members were given in no less than 15 cases. It is fair to say that no other industry received more concessions than were obtained for the chemical industry.

The classification of dangerous goods has entailed much detailed work by the Traffic Committee, as that body formed the nucleus of the Dangerous Goods Sub-Committee of the Traders' Co-ordinating Committee. The proposals of the railway companies consisted of 49 foolscap pages of printed matter, and some 150 objections were lodged. The Committee has held meetings with the railway companies extending over six days, and the result is that the Rates Advisory Committee will only be called upon to adjudicate in about 30 cases. The work of the Association, through its Traffic Committee, will lead to a very substantial saving in the cost of rail transport when the new rates and charges come into operation.

The railway companies have recently submitted their new general conditions of carriage for the approval of the Railway Rates Tribunal, and these proposals are being carefully examined in conjunction with other traders' organisations, in order that the interests of members may be fully protected. The Council has associated itself with the Federation of British Industries in opposing the Bill presented to Parliament by the North-Western and Midland and West Scottish Group of Railways asking for powers to enable the group to become carriers by road.

In December, 1920, the Home Office circulated a draft of proposed new regulations for factories and workshops. The original draft was severely criticised by members of the Association. The Council took the matter up and, after protracted negotiations, secured the issue of an amended draft, in which all the points raised by the Association were given the fullest consideration.

The Council has also considered the bearing of the following Parliamentary measures upon the interests of chemical manufacturers:—Rating of Machinery Bill, Salmon and Freshwater Fisheries No. 2 Bill, Alkali Works and Registration Acts 1906, Safeguarding of Industries Act, and the Dyestuffs (Import Regulation) Act. In connexion with the last-named, a committee has been appointed to inquire what action, if any, the Council can take to promote co-operation among the interests involved, so as to cheapen the cost of dye production in this country.

THE ANNUAL MEETING

The sixth annual general meeting was held in Burlington House, London, W., on July 13.

Sir John Brunner, Bart., presided, and in moving the adoption of the Report said:—The Association is to be highly congratulated upon the fact that it has secured the services of Mr. Woolcock upon mutually satisfactory terms for a further period of five years. Mr. Woolcock is, to a very large extent, the Association, and we cannot do without him.

There is acute difference of opinion in this country whether a tariff is good for our country or whether it is not; but I think we are all agreed that a tariff in a foreign country is not a good policy, and, unfortunately, since the war all the countries of Europe have set up almost prohibitive tariffs which have done a great deal of mischief in retarding the revival of trade. A new proposal has been presented to the United States Senate, not only with regard to tariffs, but with regard to subsidising the American shipping industry, and I am very pleased to see in the Press that they have found very great difficulty in carrying this almost prohibitive Fordney Bill, and that apparently the whole matter is again going to be dropped, as it was last year. We will, I am sure, keep our eyes upon this matter, and if anything can be done by the Council to mitigate the operation of the American tariff, I am certain the Association will do it.

In the matter of transport we are greatly indebted to Mr. Malacrida and his department. You will have seen in the papers this morning that the railway rates in this country are shortly to be reduced to 75 per cent. above pre-war figures, instead of 100 per cent., and the flat-rate increases are to be reduced from 1s. to 6d., from 9d. to 4d., and from 6d. to 4d. per ton, the flat rate of 3d. being unaffected. The rate for small parcels is to be reduced from 150 per cent. to 100 per cent. I would like to bring to your notice a sentence in the Report which says: "The constant bringing together of industrialists and railway officials has created a new atmosphere, and the relations between them are now on a very satisfactory footing," which is, I think, a great deal more than can be said of the relations of traders and railway companies in the past. It says a great deal for the tact of our officials who have been able to create this friendly feeling with the railway companies. It not only saves traders a great deal of expense but also the railway companies, and if both sides get what they want without expense it always tends to the reduction of rates.

With regard to the Home Office Regulations under the heading "Dangerous and Unhealthy Industries," a term which I personally object to, because there are a great many chemical operations which are no more dangerous to health or to life than working in a cotton factory or even sitting at a desk in the Home Office, I think it is begging the question to call the whole of the chemical industry a dangerous and unhealthy industry. It is one of the difficulties under which legislation of the present day labours that Parliament is so overwhelmed with work that regulations of this character have to be left to the various Departments. However, we have succeeded in this instance in arriving at an agreement with the Home Office which, although it is not entirely satisfactory to us, is one in which we can acquiesce, and one which has practically entailed no expense to the chemical industry of the country.

I think you can be very highly congratulated upon the continued usefulness of this Association to the trade of chemical manufacturers in this country, and so long as the members of the Council continue to work in entire harmony, that state of things will persist. In founding this Association I think that we have done a great stroke of work for the chemical industry, and I trust it will be as prosperous in the future as it has been in the past.

The motion for the adoption of the Report was seconded by Mr. Max Muspratt (vice-chairman).

In the subsequent discussion Dr. E. F. Armstrong said that the subjects of tariffs, licences, and of the whole mechanism of safeguarding industries were extremely complex but unfortunately brought in politics. Those who believed that any other policy than that of Free Trade led to destruction had been able in the case of the chemical industries to sacrifice that view for the greater end of establishing the chemical industries of this country. The heavy chemical industry had, fortunately, perhaps partly for geographical reasons, been able to stand on its own. The dyestuff and fine-chemical industries had found themselves in a more difficult position. To have an industry of that type there must be trained technical men to carry out the work. The most brilliant finance, the most original and remarkable organisation, and even cheap transport were all unavailing in the absence of technical ability, but he felt sure that such ability was plentiful in this country. The chemical industries were of national importance, not only for the products they gave and which surely should be made in this country rather than be brought from abroad, but as training grounds for chemists, the chemist being regarded as a very important servant of the State. If they reviewed the technical men holding more or less responsible positions throughout British industry, ignoring those who were connected with the heavy chemical industry, they would find a great many came out of one or two industrial schools, possibly out of the laboratories of a firm like Nobel's, and the necessity of having such industrial schools was obvious. Unless we established our fine-chemical industry and our dye industry we should have no industrial schools in which to train those chemists who would be at hand in the hour of need, whether in peace or in war.

Mr. E. V. Evans said he thought they must face the fact that the Dyestuffs Act did not afford the measure of protection that the industry really required. That Act was designed to promote the dye industry without prejudice to the textile industry, a matter which Euclid would have shown to be entirely absurd. They would remember that in order to assure that the interests of the textile industry should not be adversely influenced during the growth of the British dye industry, the Act provided that the representatives of the users should be in a majority on the Licensing Committee. The users had not taken undue advantage of their numerical superiority, but the fact was that they possessed this potentiality. Were it not that they were men honestly desiring the dye industry to be harboured in this country, the position would be an impossible one. The question of price was at the moment acute. The position was that if a consumer of dyes could show that he had to pay more than three times the amount for his British dye than he paid for his foreign dye before the war, that was sufficient justification for the importation of the foreign dyestuffs, provided, of course, that the foreign dyestuff was itself sold at a figure which was not more than three times the pre-war foreign price. This factor of three was an exceedingly serious matter to the dye industry at the present moment. He could well understand that some simple colours could be made at this price, but he was certain that the whole dye business could not be worked on that basis, and it was even more impossible to imagine that new ventures could be undertaken with this price factor in operation. It would be a totally different thing if the sales of the dye industry and the output of plant were normal. They had been forced to the conclusion that the best way to resuscitate business in this country was to labour temporarily under this disability; although their representatives had fought strenuously against the acceptance of the price factor, they had been forced to accept it for the present.

Dr. Seligman referred to the work of the Joint Research Committee of the Association and the British Chemical Plant Manufacturers' Association, of which he is chairman. He said that there had been a tendency in the past to standardise everything, irrespective of whether it was amenable to standardisation or not, and the Committee had put the brake on where it was felt desirable, and had probably contributed to more practical results in that way. The Joint Committee had before it a suggestion that it should undertake an investigation into the education of engineers for chemical works. Many members of the Committee hesitated to accept that task. They were not unanimous on the subject, and he thought if it were possible for some of the leading members of the Association to express their views whether it was desirable that the Committee should deal with this subject, it would be a great help to the Committee in reaching a decision. The whole question bristled with knotty points, and many were frankly afraid of it. Members of both the Committee and the Sub-Committees, which it had formed, had worked extremely hard, but he felt that they wanted a little more inspiration than they were getting. If only the members of the Association could give them more problems to tackle, more things which they could look into in a preliminary way, he would feel happy about the future utility of the Joint Committee.

Sir William Pearce said he was afraid that neither the nation nor the House of Commons really realised the enormous importance of synthetic organic chemistry and the great future before it in dyes and fine chemicals. He supposed they would be suspect if they went in for propaganda, but outside and inside the House of Commons the importance of these two branches of their industry was really not properly recognised, and it was a question of education. The dyestuff and fine-chemical industries would be the two great industrial successes of the future, and no nation could afford to do without them. If that view were instilled into the minds of the public and of Parliament the two industries could be secured. The Germans took that view. He had had a remarkable interview with one of the directors of the German "I.G.," who told him that the German Government and people regarded synthetic organic chemistry as the best asset they possessed and the best hope they had of recovering commercial prosperity or supremacy. That was not realised in this country. It would be a good thing if the Council could put the facts of the progress of these industries before the public. It would be welcomed by the members of the House of Commons, very few of whom really understood the great importance of those two industries. They complained to him of lack of information; they did not know the progress of these industries or understand the difficulties, which were stupendous to-day, because not only had they the enormous combination of the German I.G. to contend against, but they had to meet an unexampled slump in the textile trade.

The Rt. Hon. J. W. Wilson said he thought that one of the most important pieces of work during the year was that done at the British Industries Fair. He thoroughly agreed that they had a good deal to learn from Grmany both in unifying interests in different chemical manufactures and in educating the public and, indirectly, the buyers. He was satisfied from what he saw of the Fair that it did a great deal of good in educating the public and in bringing the members and staffs of the various chemical firms and manufacturers together to compare notes and realise that more could be gained by interchange of views than by following the traditional British attitude of looking suspect on everybody who asked a question. He thought there was a great deal more to be done by cultivating friendly relations between buyer and seller than in artificial or temporary barriers and hindrances.

The resolution was adopted and Messrs. Feasey and Co. were reappointed auditors for the ensuing year. Mr. T. Miller-Jones presented the report of the scrutineers, which was received and adopted.

A special general meeting of the Association then followed, at which the Chairman moved and Sir W. Pearce seconded a resolution to reduce the amount of the annual subscription payable by members by 20 per cent. for the year 1922–23. This was carried unanimously.

The meeting terminated with a vote of thanks to Sir John Brunner for his services as chairman during the past two years.

SAFEGUARDING OF INDUSTRIES ACT

SODIUM HYPOSULPHITE "R"

On July 7 and 8 Mr. Cyril Atkinson heard the complaint of R. W. Greeff and Co., Ltd., that "sodium hyposulphite R" had been improperly classified among the articles dutiable under Part I. of the Act. The United Alkali Co., Ltd., and the Board of Trade opposed the complaint.

In his opening speech, Mr. K. Swan, counsel for the complainants, detailed the uses of sodium thiosulphate and then referred to the counter-statement of the Board of Trade, according to which this substance is no longer made from alkali waste but by the action of sulphur dioxide on sodium sulphide, and by boiling sodium sulphite solution with sulphur. None of these processes can be described as fine-chemical. The Board intended "sodium hyposulphite R" to include the substance used for photographic and analytical purposes, which is undoubtedly a fine chemical, being made by fine-chemical manufacturers and classified as such by the Association of British Chemical Manufacturers. The "commercial" quality is less pure and is sold at prices about 50 per cent. lower than those of the "R" quality.

Mr. Swan said his case was that the methods of manufacture were not fine-chemical methods; sodium thiosulphate was used only in negligible quantities as an analytical reagent; it was a well-recognised heavy chemical and made by heavy-chemical manufacturers; the purest qualities were used for industrial purposes (chiefly photography and tanning); and that it was not an analytical reagent within the meaning of the Act. Most of the material consumed in this country came from abroad and was marketed in 1—10 ton lots. He contended that the degree of purity of a substance could not determine its classification as "fine" or "heavy," and that the Board of Trade was not justified in affixing "R" to an admittedly heavy chemical. The "pea" crystals of "hypo" used in photography were not purer than the "commercial" quality.

Evidence for the complainants was given by five trade witnesses, all of whom maintained that there was no appreciable difference in quality between the pea crystals and the larger crystals known as "commercial," and that the difference in price (about £3—£4 per ton) was mainly accounted for by the different methods of packing. Importation, which was large before the war, had practically ceased since the Act came into force.

In reply to Sir Arthur Colefax (counsel for the United Alkali Co.), who adduced prices of £12 10s. and £18 a ton for the two grades quoted in a trade journal for May 5, 1922, Mr. A. H. Gilbert, a chemical dealer, said that price quotations in all the trade papers were most erratic. It was only extreme folly which made purchasers pay the higher price for what was substantially the same article. A great deal of the "hypo" he had sold came from Germany. The term "hypo, photographic" was not recognised by dealers.

Mr. A. F. Butler, director of R. W. Greeff and Co., also affirmed that sodium thiosulphate was regarded by the trade as a heavy chemical. In his firm's price-list it was classified both under "technical" and "photographic" chemicals. When both forms (pea and large crystals) were packed in the same manner, the difference in price was only about 12s. 6d. per ton. Asked by Sir A. Colefax why "sodium hyposulphite, Rhodia brand," was priced in his firm's list of January, 1922, at 20s. per cwt., and classified, not under "Technical Chemicals" but under "Fine Chemicals and Pharmaceutical Products," witness said that Rhodia crystals were a special brand; the list was the only one issued to heavy-chemical manufacturers at the present time, and it contained other heavy chemicals, *e.g.*, oxalic and citric acids.

Mr. R. J. Kindon, of Chas. Zimmermann and Co., (Photographic), Ltd., quoted trade journals in which "hypo" was referred to as a heavy chemical. For about 20 years his firm had sold the "Agfa" brand, which was made by the A.-G. für Anilinfabrikation, of Berlin. The qualities demanded of photographic "hypo" did not include very great purity, but great whiteness, clearness, regularity of size of crystals, and freedom from dust.

Mr. O. F. C. Bromfield, secretary of the British Chemical Trade Association, said that he compiled the London market reports in the *Chemical Trade Journal*, and he contributed market news to the *Chemist and Druggist*, but in the latter case he was not responsible for the classification adopted. He had only been connected with the chemical trade since 1919, and he obtained his information from merchants, not from manufacturers. The classification he adopted was based on trade custom, and he regarded the terms "industrial" and "heavy" as substantially synonymous, and also the terms "fine" and "pharmaceutical."

Mr. E. J. Parry said that the pea crystals and the large crystals were practically identical in chemical composition; he had never seen a sample of "commercial" hypo of less than 98·5 per cent. purity, and the average difference in purity between the two forms was about 0·5 per cent. There was a third form, purified by repeated crystallisation, which was sold at about 2s. 3d. per lb., but it was quite a rarity; its use as an analytical reagent was foolish, because the "commercial" form was as good as the best for that purpose. Its use for analytical work was so small (a small fraction of 1 per cent. of the entire consumption) as to be negligible. Sir A. Colefax mentioned analyses covering 12 years, supplied by the United Alkali Co., and showing that the purity of the commercial quality varied from 93·79 to 97·46 per cent. Mr. Parry said that English manufacturers produced an article analysing 98 to 99 per cent. He admitted that sodium thiosulphate was an analytical reagent in common use and that many important industrial analyses depended upon it. In common with many other photographic chemicals, it was not a fine chemical. The Continental fine-chemical manufacturers who made and sold it, probably did so to keep their trade in photographic chemicals together.

Mr. Whitehead, for the Board of Trade, said that "hypo" of photographic quality was a perfectly well-known commodity. Before the Act came into force, the pea quality was the photographic quality, and would still be if properly and genuinely prepared; but it was now being imported in an impure state, in order to avoid duty.

Sir A. Colefax argued that the words in the Act "analytical reagents, all other fine chemicals," implied that all analytical reagents were fine chemicals. The use in photography of an admittedly heavy chemical justified its classification as a fine chemical, because it was of the definite degree of purity demanded for that purpose. Those who sold the pea quality for photographic purposes were impressed by the necessity for special tests. But there was no need to discuss the claims of "hypo" to be regarded as a fine chemical because it was admitted that the pea quality was a typical, well-known and widely-used analytical reagent.

Mr. E. B. Cook, managing director of Johnson and Sons, Manufacturing Chemists, Ltd., said that his firm sold practically only the fine pea form and the cubic crystals, both of photographic quality. These crystals were clear, of good colour (not yellow), free from moisture, and always analysed over 99 per cent., usually 99·5 per cent. and upwards; any material below 99 per cent. was rejected.

Mr. Swan expressed the opinion that "analytical reagents" meant those analytical reagents which were fine chemicals. Mr. Whitehead said that the view of the Board of Trade was that every analytical reagent was a fine chemical.

The Referee's award, signed on July 17, was as follows:—

Sodium hyposulphite is put on the market in two forms and under two descriptions. There is the ordinary quality known as commercial, which is in the form of large crystals of different shapes and sizes. There is no standard of purity or colour to which it is expected to conform. There is also the quality known as "pea crystals." The material is in the form of small crystals uniform in shape and size. Again there is no fixed standard of purity or colour to which it must conform, but it is expected to be clear, dry, and a very good white. In practice analysis shows that the percentage of purity varies from 99 to 99·5 per cent. At times even a higher degree of purity is obtained. The material is very largely used in photography, and the demand for this purpose has led to the introduction of the description "photographic quality." That description implies that the material is of the highest quality put on the market. To answer that description the material must be in the small crystal form, of very good colour, dry, and of a purity not less than 99 per cent.

There is no dispute but that sodium hyposulphite is an analytical reagent. It is in common use. It would find a place in any list of analytical reagents. The quality used for this purpose is the best obtainable, *i.e.*, the photographic quality.

Sodium hyposulphite has been included in the list published by the Board of Trade with the letter "R" against it, meaning thereby that only the highest quality, viz., the photographic quality, is to be dutiable under the Act. This inclusion in the list is justified by the Board of Trade on the ground that sodium hyposulphite of photographic quality is (1) an analytical reagent and/or (2) a fine chemical.

The complainants concede that it is an analytical reagent, but deny that it is a fine chemical. They contend that as a matter of construction the words in the Schedule only include such analytical reagents as are fine chemicals. They rely strongly on the word "other" in the Schedule. The relevant words to be construed are "synthetic organic chemicals, analytical reagents, all other fine chemicals."

I do not see how the complainants can be right. To hold that synthetic chemicals and analytical reagents are in the Schedule only if they are fine chemicals, quite apart from their claims to that description as being synthetic in the one case or analytical reagents in the other, would be to give no effect to the words preceding "all other fine chemicals."

Some weight must be given to the word "other," and in my opinion the interpretation which gives effect to all the words used is this:—The Legislature intended to protect the fine chemical industry, but the expression "fine chemical" was very vague. It was without any definite meaning. The Legislature deliberately avoided attempting to define fine chemical, but it intended that there should be no mistake about the inclusion within that phrase of synthetic organic chemicals and analytical reagents. The specific inclusion of these chemicals indicates in my opinion that the words "fine chemicals" were intended to be used in a sense wide enough to cover the classes mentioned. Parliament was content to leave the further application of the expression "fine chemicals" to the Board of Trade, and to a Referee, but their hands were to be tied in respect of such chemicals as could with reasonable certainty be described as synthetic organic chemicals or analytical reagents.

As this view seems to me the right one I thought it unnecessary to determine whether or not sodium hyposulphite was a fine chemical independently of its being an analytical reagent.

In my opinion, once it is conceded that sodium hyposulphite is an analytical reagent in regular use, the complainants' case falls to the ground, and I have no option but to award that the substance in question in its purest form is rightly included in the list as an analytical reagent. Only the purest form of the chemical is within the Schedule. It is only that form which is used as a chemical reagent.

I think that it is advisable to be a little more definite as to what is meant by the letter "R" in this particular case. It is stated on behalf of the Board of Trade that only the quality known as "photographic" is intended to be included, and I think that it would be wiser to state that in the list.

I wish it to be clearly understood that the mere fact that sodium hyposulphite is in pea-crystal form does not prove that it is of photographic quality. In my opinion photographic quality indicates that the chemical is in the form of small uniform crystals, that it has great purity of colour, and is of 99 per cent. (or thereabouts) purity and upwards. No objection is offered by the Board to the addition of the words "photographic quality."

I therefore award that the list be amended by inserting after the words "sodium hyposulphite" the words "photographic quality." The complaint fails. No order as to costs.

PERSONALIA

Dr. J. C. Drummond has been appointed to the chair of biochemistry at University College, London.

Mr. Max Muspratt has succeeded Sir John Brunner as chairman of the Association of British Chemical Manufacturers.

The honorary degree of D.Sc. of the University of Oxford has been conferred on Prof. J. Perrin of Paris and on Prof. F. Gowland Hopkins of Cambridge.

Mr. S. Pexton has been elected to the gas research fellowship founded by the Institution of Gas Engineers, and Mr. W. H. B. Hall, of the South Metropolitan Gas Co., to the Corbett Woodall Scholarship, both tenable at the University of Leeds.

The Commissioners of the Exhibition of 1851 have awarded a Senior Studentship to Mr. J. S. Buck, research student in chemistry, Liverpool; and on their nomination Mr. D. F. Stedman, University of British Columbia, and Mr. J. C. Smith, University of New Zealand, have been awarded Science Research Scholarships (Overseas) for physical chemistry and chemistry, respectively.

Dr. Lennart Smith has been appointed professor of chemistry in the University of Lund, Sweden.

Mr. L. M. Tolman, chief chemist to Wilson and Co., Chicago, has been elected president of the American Oil Chemists' Society.

Prof. A. Pictet, professor of chemistry in the University of Geneva, has been elected a corresponding member of the French Academy of Sciences.

Prof. C. H. Warren, professor of mineralogy in the Massachusetts Institute of Technology, is to succeed Mr. Russell H. Chittenton as director of the Sheffield Scientific School.

Mr. H. G. Tanner, chief chemist at the Experimental Potash Plant, Summerland, Cal., U.S.A., has been appointed to a professorship of chemistry in the University of Oregon.

Dr. Max Volmer, extraordinary professor in the University of Hamburg, has been appointed ordinary professor of chemistry in the Berlin Technical *Hochschule*. Professor M. Volmer has been appointed professor of physical chemistry and director of the Institute of Physical Chemistry in Berlin. Doctors A. Gutbier and R. Stoermer have been appointed to the chairs of chemistry in the Universities of Jena and Rostock, respectively.

NEWS AND NOTES

UNITED STATES

The Sequestrated German Patents

President Harding has ordered the Alien Property Custodian to demand the return of the sequestrated German patents that were sold to the Chemical Foundation, Inc. The demand, which affects 4000 patents and other property, is said to be based on the ground that the German patents were sold at prices insufficient to protect the interests of the former German owners for whom the Alien Property Custodian acts as trustee. The patents were sold in 1919 to the Chemical Foundation for $250,000, but their value is problematical, as the policy of the Foundation has been to issue non-exclusive licences for working them; and it is also said that less than 2 per cent. of them had been found of use. Mr. Francis P. Garvan, president of the Foundation, stated in an interview that the action was taken without giving any notice to the United States organic-chemical industry or to the Chemical Foundation, and was begun, so he was informed, after the representatives of the German "Interessengemeinschaft" and the German Government, but not American interests, had been heard by the United States Attorney-General. It is stated that the demand will be refused and the issue decided in the District of Columbia Court.—(*Oil, Paint and Drug Rep., July* 10, 1922.)

Lethal Gases for Exterminating Pests

Experiments on the use of poison gases for exterminating obnoxious birds, rodents and insects are to be undertaken in the autumn by the U.S. Chemical Warfare Service and the Biological Survey. Chlorine, when handled properly, has already given good results against "pocket gophers" and ground squirrels, and phosgene has been used successfully against rats in Porto Rico. The effects of various gases on the insect pests of growing plants and stored grain have been tested, but a substitute for hydrogen cyanide or carbon bisulphide has not yet been found.

Stone in 1919

The U.S. Geological Survey states that about 65,539,000 short tons of stone was sold in the United States in 1919, or 4 per cent. less than in 1918 and 22 per cent. less than in 1917. A total of 21,315,300 t. of limestone and marble was sold as furnace flux, 1,060,741 t. of ganister (quartzite), mica schist and dolomite as refractory stone, and 4,370,936 t. for other industrial uses. The industrial consumption of limestone was as follows:—Alkali works, 2,215,660 t.; sugar factories, 503,835 t.; glass factories, 166,106 t.; paper mills, 92,421 t.; agriculture, 1,392,914 t. In addition, 864,441 t. of limestone was sold as a filler for asphalt, paint, rubber, soap, for making basic magnesium carbonate, to alcohol and calcium-carbide factories, and for making refractories.

FRANCE

Industrial Notes

Chemical Industry.—The chemical market is firm and the demand for sulphuric acid and for fertilisers is brisk. The price of sodium nitrate tends to rise, but that of ammonium sulphate has declined to 90—92 fr. per 100 kg. There is a keen demand for cyanamide, owing to the fall in price, and most of the cyanamide factories will be occupied for some weeks ahead. Prices of turpentine oil remain firm but may increase as there is a good demand from London and supplies are not coming from the United States. The demand for synthetic perfumes has improved slightly, but the prohibitive prices of the natural products are not conducive to business. The weather remains favourable for the next sugar-beet crop, which is estimated at 500,000 t., *i.e.*, 200,000 t. more than last year's crop.

CANADA

Production of Chemicals

According to a return of the Dominion Bureau of Statistics the production of chemicals and allied products in Canada for the years 1919–20–21 was valued as follows:—$94,000,000, $118,000,000 and less than $76,000,000. The following is a summary of the principal statistics for the three years:—

	1919	1920	1921
Plants	425	450	442
Capital	$109,268,000	$116,056,000	$106,525,000
Employees	14,946	16,526	12,139
Salaries and wages	15,948,000	21,148,000	15,463,000
Cost of materials	47,216,000	58,754,000	35,148,000

Platinum, etc. in Northern Ontario

There has recently been discovered at Shebandowan Lake, Northern Ontario, an interesting occurrence of a nickel-copper-cobalt mineral relatively rich in the metals of the platinum group. The above lake is situated 70 miles west of Port Arthur, Ont., and five miles north of the Canadian Northern Railway. Some of the massive ore carries 8 to 12 per cent. of nickel, and the average rocky material, not hand-sorted, about 6 per cent. nickel, copper and cobalt. The analysis of a sample submitted to the Geological Survey, Ottawa, gave 16 oz. of platinum metals to the ton, and iron, 24·8%; nickel, 3·3%; copper, 5·5%; and sulphur, 20·6%.

Pulp and Paper

The Belgian Industrial Co. at Shawinigan, Que., is extending its paper mill at a cost of $1,500,000 to $2,000,000, exclusive of the cost of machinery.

The plant of Kaministiquia Pulp and Paper Co., at Port Arthur, Ont., has been sold to the Consolidated Water Power and Paper Co. of Wisconsin Rapids, Wisconsin. The mill makes ground woodpulp.

Production has been started by the International Paper Co. at its new plant located at Three Rivers, Quebec. When in full operation the plant will have a daily output of 384 tons of paper.

Construction upon the large pulp and paper mills at Prince George, Northern British Columbia, was due to begin in June. Initially the capacity will be 150 tons daily, but provision is being made to increase the output. The company, to be known as the Bathurst Co., Ltd., has an initial capitalisation of $3,000,000. Over 200 sq. miles of timber land have been secured east of Prince George, on the Fraser River. The promoters of the company include Lord Beaverbrook, Sir Chas. Gordon, Montreal, Mr. Frank Jones, president of the Canadian Cement Co., Peck Bros., Pennsylvania, and others. Angus McLean, of Bathurst, N.B., is president.

Metallurgical Industries

Nickel.—The mines and smelter of the International Nickel Co., at Copper Cliff, Ont., which have been closed down for many months, will be started not later than September 1. The sales of nickel by this company last year were less than in any year since 1904. The new plant at New Hunnington, W. Va., will cost $3,400,000, inclusive of equipment. The company's plant at Port Colborne, Ont., has restarted operations. Orders have been coming in freely and stock on hand is being depleted. One million pounds of nickel will ultimately be refined monthly. The smelter at Sudbury, Ont., is expected to recommence operations this autumn.

The largest shipment of nickel matte ever forwarded from Northern Ontario was recently sent to the Mond Nickel Co., at Clydach, S. Wales, from its works at Coniston, Ont. The shipment exceeded 1000 tons and the matte contained about 55 per cent. nickel and 45 per cent. copper.

The British America Nickel Corporation, Deschenes, Que., has a large stock of refined metals on hand, and it is questionable if this refinery will operate on any extensive scale this year. The British Government is holder of £3,000,000 "A" income bonds of this concern.

Iron and Steel.—There is a very marked improvement among the factories engaged in the manufacture of iron and steel and their products. A few months ago the majority of these works were working at less than 25 per cent. capacity, but to-day some are in full operation and others are working at half capacity. It is expected that another extension will soon be made to the plant of Baldwin's, Ltd., Toronto, which manufactures tin and galvanised plates. Two mills have been installed since January, making a total of five now in operation. The construction of the $20,000,000 steel plant at Ojibway, near Windsor, Ont., is being pushed with greater activity.

The plant of the Electric Steel and Metals, Ltd., at Welland, has been sold to a United States organisation. This plant, which was erected at the beginning of the war to make munitions, has been standing idle since this remunerative business ceased. The new management proposes to convert the plant into a steel rolling mill.

BRITISH INDIA

Forecast of Winter Oilseed Crops

The final general memorandum forecasts the winter-oilseed crops for 1921–22 as follows:—Linseed: acreage 2,993,000, yield 434,000 tons; rape and mustard: acreage 6,104,000, yield 1,142,000 t. Compared with the estimates of the previous year the linseed crop shows an increase in yield of 61 per cent. and the rape and mustard crop an increase of 33 per cent.—(*Ind. Tr. J., June* 8, 1922.)

GENERAL

The Federal Council

The hon. treasurer of the Federal Council for Pure and Applied Chemistry notifies that the Council has appointed a committee to raise funds for the expenses of the meeting of the International Union to be held in Cambridge next summer, and for the general purposes of the Council, including a nucleus for a fund to provide better accommodation for the various chemical societies. The committee consists of Sir William Pope, Dr. E. F. Armstrong, Mr. E. V. Evans, Dr. S. Miall, Mr. Emile Mond, and Mr. W. J. U. Woolcock.

New Photographic Desensitisers

World-wide interest was aroused by the announcement some two years ago that Phenosafranine, and its slightly more soluble homologue Tolusafranine, could be successfully employed in dilute aqueous solution as desensitisers, their action being so effective as to allow of panchromatic gelatinobromide emulsions being developed in bright orange light—or even by candle light—without the production of light fog. Both the above-mentioned safranines, however, exhibit an undesirable affinity for animal membranes—a property which led to pronounced staining of the sensitive surface of photographic plates. Somewhat protracted washing was necessary to remove the stain; in fact, the difficulty of removing the dye from emulsion coated on a film base practically ruled the dyes out of court. Research has naturally been directed, therefore, to the discovery of efficient colourless, or at least non-staining, desensitisers, and a gratifying measure of success has attended the work of Dr. E. König, of the Höchst Farbwerke, who has lately (Phot. Rund., 1922, **59**, 89; B. J. Phot., 1922, **69**, 351) introduced two products, *Pinakryptol*, a mixture of a colourless compound with a small proportion of the green dye issued in the pure state as *Pinakryptol Green*.

The colourless component of Pinakryptol is relatively insoluble, a 1:5000 aqueous solution of the mixture being difficult to prepare. If such a solution—of a muddy green colour—be allowed to act for 1½ to 2 minutes, it reduces the sensitiveness of a modern super-speed emulsion to approximately 1-1100th of its original value. As a general desensitiser it thus rivals phenosafranine, showing even more pronounced desensitising powers on orthochromatic or panchromatic emulsions, and, were it not for the drawback that marked alterations in the speed of action of various developers result from the bathing, Pinakryptol would be a most useful desensitiser. Its velocity of action during the desensitisation is not as high as is desirable, and it does not lend itself, therefore, to the method of application in which it is combined with the developing solution, except under "stand" or "tank" development conditions.

Pinakryptol Green, in spite of its strong family resemblance to the basic dyes, is practically devoid of affinity for gelatin, and, because of its relative ease of solution—a 1:500 stock solution being readily prepared in the cold—it is to be preferred to Pinakryptol. A 1:5000 solution desensitises in one minute, giving a reduction, in the case of super-speed emulsions, to a value of 1-1500th that of the original sensitiveness. The depression of sensitiveness to the longer wave-lengths is remarkably great, and the green colour of the solution, mechanically retained by the film after the bathing operation, allows of the fogless development of the most highly sensitive panchromatic emulsions, in the comfort of a bright yellow-orange light.

Very slight disturbance of the characteristics of the various developers occurs in the presence of Pinakryptol Green; and since, as is also the case with Pinakryptol, no destruction of the latent image occurs when this desensitiser is used, an extended application of the process, particularly by panchromatic workers, may be confidently anticipated.

The Colour Users' Association

The report for the year ended April 30 states that the membership is now 240 and that it represents 90 per cent. of the colour consumption of the country. Colours imported under the Peace Treaty are now selected by the Association in co-operation with the Board of Trade and are reserved for purchase by members for 14 days after arrival. By personal applications to the Board of Trade, the Vigilance Committee has secured the removal of certain chemicals from the Schedule to the Safeguarding of Industries Act. The membership had been classified into twelve trade groups, each group comprising members having common interests. Receipts during the year amounted to £3336, and disbursements to £2765, and there is a balance of £6620 in the bank derived mainly from commissions paid by the Central Importing Agency on sales of the Association's stock.

Carbonic Oxide in Tobacco Smoke

Prof. H. E. Armstrong, who is reported to sympathise with the view of King James I that tobacco "is the lively image and pattern of hell," has recently been investigating the carbonic-oxide content of tobacco smoke and the results of his "little experimental excursion" in the laboratories of the South Metropolitan Gas Co. are given in the issue of the *British Medical Journal* for June 24.

Four sorts of tobacco were smoked in a pipe or as cigarettes, which were attached to a gas-sampling bottle from which mercury was allowed to run out in "puffs," and the smoke was found to contain from 4·24 to 10·15 per cent. of carbonic oxide; the smoke from a cigar treated similarly contained 5·8 per cent., but the ratio of carbon dioxide to monoxide was much higher in the latter case. Determinations were then made by Gautier's method, viz., by estimating the monoxide by passing the purified gas over heated iodine pentoxide and titrating the liberated iodine. The percentage of carbonic oxide was found to vary between 0·6 and 0·875 in cigarette smoke, and between 0·7 and 1·14 in pipe smoke. Rapid smoking considerably increased the content of carbonic oxide.

Prof. Armstrong then resorted to natural smoking—by deputy—the fume from cigars of various qualities and ages being expelled from the mouth into a mercury receiver and then analysed. Under these conditions the average content of carbonic oxide was 4·7 per cent., compared with 2·6 per cent. in smoke obtained by mercury suction, and the ratio of carbon dioxide to monoxide was much lower. The results were little affected by make or quality; closeness of packing and rate of smoking appeared to be the determining factors. Although South Metropolitan gas was found to contain as much carbonic oxide as the smoke of an average cigar, it is not suggested that the one is an economical, or even a hygienic, substitute for the other.

What is a Chemical Engineer?

The Provisional Committee of the Institution of Chemical Engineers has provided a solution of this well-known problem. "The chemical engineer is a professional man experienced in the design, construction and operation of plant in which materials undergo chemical or physical change." This definition is commendably short, but is it sufficiently precise? Are those who design, construct and operate mining-plant or kitchen-ranges chemical engineers? Is conveying machinery within their province? And does "man" in this case include woman?

Artificial Silk in Italy

There are now five artificial-silk factories in Italy, and their total output is about 8 metric tons (? per day). All these plants are in Northern Italy, but a company which owns a factory in Venetia with a capacity of 2 tons, is erecting one new works in Rome and another in Naples. The viscose process of manufacture has entirely supplanted the expensive and dangerous alcohol process, and the necessary wood-pulp is imported from Norway. Whereas imports were formerly considerable, the Italian factories are now well able to meet any normal increase in the home demand, as well as to export considerable amounts. In 1921 the export was 588·8 t., of which 173·9 t. was shipped to the United States.—(*U.S. Com. Rep., May* 15, 1922.)

New Salt Deposit in Holland

Borings for minerals conducted on behalf of the State have revealed the presence of a deposit of salt at Corle, near Winterswijk. Previous borings in the same district had shown the existence of a deposit at great depths, but it was irregular and discontinuous. The new deposit was struck at a moderate depth—a point of great importance for eventual exploitation. The new deposit is very regular, and it is hoped that potash salts may also be found.—(*Chem. Ind., May* 29, 1922.)

The German Potash Industry

According to a report of the general meeting of the Burbach potash group, conditions in the potash industry improved considerably during the past year and sales during the first five months amounted to 561,000 tons of potash (K_2O), an increase of 60 per cent. over sales in the same period of the previous year. Sales of manufactured salts showed the largest increment, but the demand for crude salts was only moderate. Many potash works are now (June, 1922) unable to fill current orders for manufactured products, the demand having been stimulated by the liberal discounts granted to agriculture by the Potash Syndicate and the introduction of special railway rates. These increased summer sales will probably lead to still bigger sales in the autumn. So far it has been possible to keep inland prices low by charging higher export prices, and the attempt of the Government to levy a special tax on the receipts from exports is regarded as dangerous, for such a tax would inevitably result in an increase in inland prices.—(*Deutsche Bergwerks-Z., June* 23, 1922.)

Wages in the German Chemical Industry

Labour in the German chemical industry is classified under three heads, viz., general workers, technical workers (including laboratory workers, constructional engineers, chemists, and pharmacists), and office workers, each group being organised under a trade union. Of the 350,000 employees in the German chemical industry, 90 per cent. belongs to trade unions. Wages per hour paid to general workers in the Berlin district (where the highest rates prevail) at the end of 1921 were as follows:—Factory hands 8·50 mk., transport workers 8·96 mk. to 9·35 mk., boiler men and machinists 8·65 to 9 mk., labourers 8·70 to 9·10 mk., coppersmiths 9·30 mk.; apprentices 1·50 to 4 mk. The minimum rates are 33 per cent. less than those paid in the Berlin area. In addition, a family allowance of 14·4 mk. per week is made for dependents of the workers.

The average monthly wages of untrained technical workers at the end of 1921 varied from 1092 mk. in the Leipzig district to 1310 mk. in the Berlin district, and workers with technical education but no practical training were paid from 1495 mk. (Berlin) to 1890 mk. (Cologne), trained technical workers from 1650 mk. (Bavaria) to 2542 mk. (Cologne), and managers, industrial engineers from 2084 mk. (Posen, Silesia) to 2600 mk. (Berlin). The agreement controlling the labour conditions of technical and office workers in the Berlin district provides that employees shall be paid according to length of service at rates reaching a maximum in the eleventh year, that the working week shall be 46 hrs., that employees, when ill, shall be paid for 6 weeks and, after 8 years' service, for 13 weeks. A supplement of 100 mk. per month is paid for each dependent of the worker. The working hours per week vary from 45 in Central Germany to 46 in Bavaria and 48 in Leipzig (*cf.* J., 1922, 26 R).

In May, 1922, wages throughout the chemical industry were increased by 75 to 80 per cent. over those holding in January, in order to compensate for the depreciated value of the mark, and on May 26 the employers and unions agreed to fix wages during June at an average of 23 mk. per hr., 184 mk. per day, 1058 mk. per week, or 4585 mk. per month, the family bonus remaining unaltered. This represents an increase of 100 per cent., but it provides only an approximate evaluation of the wages now paid to each class of workers, as it is not known whether the increase has been evenly distributed among technical, office, and general workers.—(*U.S. Com. Rep., June* 19, 1922.)

Sugar Production in Czechoslovakia

It is estimated that the sugar-beet crop for the season 1921–22 was 3,475,000 metric tons, and that the yield of raw sugar was 640,000 t., of which 560,000 t. has been refined to white sugar. In 1920-21 the beet crop was 4,200,340 t., and the production of sugar 717,240 t. During the six months ended March 31, 1922, the consumption was 168,835 t. and exports 257,141 t., leaving 262,364 t. on hand at April 1, 1922. Trade in sugar is now unrestricted, but Government control of profits is continued because of the difference between the home and foreign prices. Prices of raw and refined sugar were fixed at 338 and 650 kronen per 100 kg., respectively, during the 1921–22 season, as compared with 79 kr. in 1914-15 (kr. = 10d. at par, now about 1·1d.).—(*U.S. Com. Rep., May* 22, 1922.)

Copper in 1921

The following statistics have been compiled by the Imperial Mineral Resources Bureau:—

			Long tons
United Kingdom	Imports	Bars, blocks, etc.	84,320
	Exports	Bars, blocks, etc.	10,885
Northern Rhodesia	Production	Finished copper	196
Southern Rhodesia	Production	Blister copper	2,750
	Exports	Bar, blister and ingots	3,016
Union of S. Africa	Production		141
		Metal content	92
	Imports	Bar, rod, ingot	20
	Exports	Ore and regulus	183
South-West Africa Protectorate	Production	Copper, lead-ore	72,643
	Exports	Copper-matte	1,414
Canada	Production		23,867
	Imports	Ore and concentrates	1,228
		Blocks, pigs or ingots	413
	Exports	Fine copper in ore, etc.	4,692
		Blister copper	14,767
		Pigs, bars, sheets, etc.	1,453
India	Imports	Unwrought copper	504
	Exports		77
Australia	Production		10,971
		Refined copper produced in Australia, and metal in blister, matte, ore, etc., exported	18,634
	Exports	Refined copper	12,082
		Copper in blister, matte, ore, etc.	34
Belgium	Imports		15,296
France	Imports	Ore and concentrates	6,459
		Cement, crude, ingots, anodes	48,029
	Exports	Ore and concentrates	1,492
		Cement, crude, ingots, anodes	3,779
Italy	Production	Ore	22,300
		Metal	97
Norway	Exports	Ore	561
		Crude and refined	1,016
Russia	Production	Ore	4,600
Belgian Congo	Production		29,978
Madagascar	Exports	Copper	4
United States	Production	Refinery production from domestic sources	268,300
		Refinery production from foreign sources	142,900
			411,200
	Imports	Ore, concentrates, matte, regulus, coarse, metal, cement, etc.	379,428
		Copper content thereof	45,893
		Unrefined, block, blister and converter copper	76,668
		Refined copper	30,915
	Exports	Ore, concentrates, matte and regulus	1,744
		Copper content thereof.	161
	Exports	Unrefined, block, blister and converter copper	67
Chile	Exports	Refined copper	266,124
		Bars	46,988
		Matte	319
Japan	Production	Ore	47,926
		Copper	52,304

PARLIAMENTARY NEWS

House of Commons

British Dyestuffs Corporation

Mr. Baldwin, replying to Major Barnes, said he was aware of the financial position of the Corporation, but no proposals had been made respecting the Government's holding in it.—(July 10.)

Sales of Coal to Germany

In answer to Lieut.-Com. Kenworthy, Mr. Bridgeman stated he had no information that British coal sold to Germany was being transferred to France as "reparation" coal. During the first half of 1922, 6,616,992 tons of British coal was exported to France and 2,882,655 t. to Germany.—(July 12.)

Applications for Patents

Sir W. Mitchell-Thomson informed Capt. W. Benn that the delay in dealing with applications for patents was largely due to arrears of work caused by war conditions and depletion of staff for military service. Since the war the number of applications had increased to an average of 35,000 yearly, as compared with 30,000 in 1913. Every effort was being made to return to normal conditions.—(July 14.)

Norwegian Cement

Replying to Mr. J. Wilson, Mr. Baldwin stated that the prices quoted during 1921 for bulk consignments of British cement were slightly below the average declared value of imported Norwegian cement. The price of British cement and the average value of imported Norwegian cement had both fallen during the present year, but continued to approximate closely. The Board of Trade had no power to ensure the continued consignment of Norwegian cement to this country.—(July 17.)

Railway Rates

In answer to Mr. Gilbert, Mr. Neal said that the railway companies in England and Wales had announced general reductions in railway rates for goods traffic from August 1. The rates were not fixed for any definite period, but the Federation of British Industries and the companies had agreed not to apply for a general alteration to come into force before July 31, 1923.—(July 17.)

Export Duties in African Colonies

Answering various questions, Mr. Churchill said that the duty on palm oil exported from Sierra Leone had been reduced to 20s. 10d. per ton, which was a little more than 4 per cent. of the price at Freetown at the end of May. Recently the export duties on palm oil and palm kernels in Dahomey were 49·5 francs. and 24·75 fr. per metric ton, respectively, the corresponding rates in Nigeria being £3 and £2 per ton and in Sierra Leone 20s. 10d. and £1 per ton. The export tax imposed on cotton from Uganda was designed to raise revenue for developing the cotton-growing districts; since the tax was applied the export had increased from 6300 tons in 1919 to 14,500 t. in 1921. The reason why it had not paid to export hides and skins from Nigeria was the fall in value of the hides from 1s. 3d. to 5d. or 6d. per lb. and not the export duty, which had been reduced from 2d. to ½d. per lb.

The export duty on cocoa in the Gold Coast had not prevented a continuous increase in the shipments of cocoa, but the possibility of a reduction would be considered.—(July 17, 18.)

Smoke Abatement Bill

Sir A. Mond informed Mr. Betterton that he hoped to introduce the Smoke Abatement Bill at an early date.—(July 18.)

Cocaine

In reply to Mr. Lyle, Mr. Shortt said that no cocaine was produced in this country and that no statistics of consumption or trade were kept.—(July 18.)

Measuring Instruments Bill

A Bill to extend the powers of the Board of Trade, to make regulations with respect to measuring instruments used for trade, and to amend the law with respect to instruments used in ascertaining wages, and for purposes connected therewith, was presented by Sir W. Mitchell-Thomson and read a first time on July 19.

Safeguarding of Industries Act

Refund of Duty.—A motion, moved by Mr. Kiley, to insert a new clause in the Finance Bill providing for the repayment of duty collected on scheduled articles that have afterwards been removed from the lists, was rejected by 208 to 95 votes. Sir R. Horne observed that the Act specifically excluded the possibility of claims for refund of duty, and in any case it would be impossible to discover the person who in the end had paid the duty, as the article was usually sold before the inquiry was held.—(July 12.)

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Dumping.—Since Part II came into force in August, 1921, less than 120 trades or branches of trades have communicated with the Board of Trade. Of 45 complaints relating to goods made in Germany, 13 were referred to committees; in 29 cases complainants failed to establish a *primâ facie* case or withdrew the complaints, or have been asked to supply further information; and 3 complaints are now being considered.—(July 10.)

Glass Bottles.—The Board of Trade is aware that, at the inquiry under Part II, a witness stated he supplied from his own factory 75 per cent. of the glass bottles used by the perfumery manufacturers in this country, and that the perfumery manufacturers deny this. No action need be taken as the Committee can call for further evidence if this is considered necessary.—(July 10.)

Questions in Parliament.—Approximately 300 questions relating to the Act have been addressed to the Board of Trade, and in addition a large number to the Treasury. No reliable estimate of the cost of these answers can be given.—(July 11.)

Procedure.—It is intended, when the reports of the Committees now sitting have been received, to review the position with a view to seeing what alterations, if any, can usefully be made in the procedure under the Act.—(July 17.)

Opal Glass Shades have been made in large quantities in the Birmingham and Stourbridge districts, but several factories have shut down owing to trade depression and the output is now small.—(July 17.)

Complaints.—Since October 1, 1921, no complaints under Part II of the Act have been received that goods are being dumped from Germany.—(July 17.)

Synthetic Perfumes.—The Board of Trade is aware that toilet soap containing synthetic perfumes and dyes is being imported duty free into England, whereas when imported separately these perfumes and dyes are either prohibited or duty is demanded on them. It is not intended to introduce legislation to admit these chemicals free of duty.—(July 17.)

Glassware.—The case for making an Order (under Pt. II) relating to German-made glassware has been established. The question of Czecho-slovakian glassware will be considered during the debate on the Act which must take place before the summer recess.

On June 5, 5010 glass-bottle makers, including 1336 labourers, were registered in Great Britain as unemployed, as compared with 4357 (including 1345 labourers) on December 2, 1921. Separate figures for machine workers are not available.—(July 17.)

Reports.—The reports of the Committees on scientific and optical instruments, glass bottles, and gas mantles, have not yet been received.—(July 17.)

REPORTS

FIFTY-EIGHTH ANNUAL REPORTS ON ALKALI, ETC. WORKS. 1921. *By the* CHIEF INSPECTORS. *Pp.* 32. *London: H.M. Stationery Office*, 1922. *Price* 1s.

Plants have been working under quite abnormal conditions during the year, and the work of the Inspectors has been unusually difficult. The number of complaints received regarding nuisances has not been large, and fifty per cent. of those received related to the refining of petroleum and tar-oil, the manufacture of fish manure and organic acids, and other works over which the Alkali Inspectors have no jurisdiction.

The total number of registered works in England, Wales and Ireland during 1921 was 1342, a decrease of 41 during the year. The number of separate processes of manufacture under inspection was 2150, a decrease of 91. The tabulated results of determinations of acid gases escaping show that reductions have been effected during the year in all classes of works.

Alkali Works.—In all districts the percentage condensation of muriatic acid gas was good. Alterations of plant at one works have resulted in a reduction of 50 per cent. of the acid escape. One of the complaints received was due to a temporary insufficiency of draught.

Cement Works.—Rotary kilns have now attained a length of over 240 ft., and have not, apparently, reached their final stage of development. Although black smoke is seldom seen, attention is directed to the necessity for careful control of combustion, as in one case hydrogen sulphide was emitted owing to a deficiency in the air-supply. In connexion with the recovery of potash salts, further investigation is needed upon details in each particular installation, and especially as regards the choice of filtering material.

Sulphuric Acid Works.—The demand for sulphuric acid has been comparatively small and has resulted in an accumulation of stocks of spent oxide. At a number of works where pyrites has hitherto been used, plant suitable for the burning of spent oxide has been installed. American sulphur, either alone or mixed with spent oxide, is also being used, thus eliminating the difficulty of dealing with the cupreous-pyrites residues and obtaining directly a practically non-arsenical acid. The best possible means of dust deposition should be adopted when burning oxide, particularly when mechanical furnaces are employed. Filtration presents difficulties and the passage of the gases through a large unpacked chamber, although most efficient, involves loss of heat. The provision of baffles in flues often results in little deposition of dust owing to the locally increased velocity. More attention should be paid to the use of sumps in flues, the introduction of secondary air after the burners, and the electrical deposition of dust. The provision of oxides of nitrogen for the chambers by means of the ammonia-oxidation process is extending. A further substitution of fans for steam jets for the purpose of draughting chamber sets is recorded. Attention is dircted to the need of maintaining the efficiency of scrubbers attached to concentration plants.

Chemical Manure Works.—The average acidity of the gases escaping from scrubbing towers was equivalent to 0·06 grain SO_3 per cb. ft., as compared with 0·2 grain in 1903. Condensing flues play an important part in removing noxious compounds, and should be particularly considered where newer types of mixing plants are installed. An efficient scrubbing plant mentioned consists of a number of unpacked tower-chambers, each fitted with high-pressure water sprays, followed by two closely-packed water scrubbers, the latter being of considerable importance.

Sulphate and Muriate of Ammonia Works.—Owing to the coal strike, the high price of sulphuric acid and the low value of sulphur in spent oxide, these manufactures have been carried on under adverse conditions. The total quantity of ammonia products (expressed in terms of sulphate containing 25·75% NH_3) manufactured in the United Kingdom amounted to 253,253 tons, as compared with 397,937 tons in 1920. Activity is being displayed in the production of sulphate in a dry and neutral condition and in the recovery of muriate at coke-oven works. The heap system of purifying the foul gases from sulphate plants is found to be more satisfactory than the use of box-purifiers.

The increasing difficulties in disposing of spent liquors from the distillation of ammoniacal liquor have been specially investigated. The liquor is usually passed through settling pits in order to remove suspended matter, but phenoloid and other offensive vapours are evolved with the steam rising from the hot liquor, and local authorities often object to deal with the remaining effluent. The total volume of spent liquor to be handled in gas-works' practice is about 4000 galls. per ton of sulphate, and larger volumes are involved in coke-oven practice. In an appendix to the Report, methods of analysis are described, and it is shown that an average sample of effluent from the settling pits of a gas-works' sulphate-plant contains phenols equivalent to 0·8—1·5 g. $C_6H_5.OH$ per litre, in addition to thiocyanate and thiosulphate (*cf.* J., Skirrow, 1908, 58, Fowler and others, 1911, 174, Frankland and Silvester, 1907, 231). Devil liquors also contain hydrogen sulphide and hydrocyanic acid, and, as they are much richer in phenols, the practicability of submitting them to special treatment should be considered. The spent liquor from the stills has a high oxygen-absorptive power and develops a brown coloration which can be discharged by the addition of acid. It was found that by bringing the liquor into contact with waste combustion gases at a temperature near the boiling-point, a large proportion of the phenols together with any residual ammonia and pyridine could be volatilised. Further, the alkalinity of the liquor can be neutralised by the acid in the waste gases. A large-scale experimental plant has been erected, and further trials are being made; it is anticipated that by this means a deodorised and almost colourless effluent suitable for admission to the sewers will be obtained.

Tinplate Flux Works.—The preliminary cold-water treatment of scruff is being more widely adopted and analyses of chimney gases show considerably improved results.

Tar Works.—Abnormal conditions in the manufacture of coal gas have affected the character of the tar at some works, and in one case increased amounts of foul gases were produced. At several works the escape pipes from pitch coolers were inefficiently sealed. The tar distilled in the United Kingdom during 1921 amounted to 1,013,245 tons and the pitch to 384,416 tons.

Report on Scottish Works.—During 1921 there were 167 registered works in Scotland which operated 319 scheduled processes. In no case did the results of the chemical tests exceed the statutory limits. The depressed state of trade in comparison with the previous year (*cf.* J., 1921, 279 R) is shown by the following data:—Pyrites and spent oxide burned 71,416 tons, phosphates and bones dissolved 51,796 tons, salts of ammonia made (expressed as sulphate) 62,343 tons, tar distilled 148,608 tons, pitch produced 58,833 tons.

The condensation of noxious gases in chemical manure works has been improved as a result of the provision of additional condensing flues and careful control of the exhaust-fan. A market is required for the snowlike deposit of hydrated silica obtained. In the newer types of dens the acid steam evolved from freshly-made superphosphate is a cause of irritation. An improved quality of ammonium sulphate is being made, and the larger size of individual crystals now demanded is being obtained with vacuum saturators. For the dehydration of tar for road-making, additional stills of the continuous pattern have been erected.

Third Annual Report of the Governors of the Imperial Mineral Resources Bureau. *Pp.* 72. *Published by the Bureau, 2, Queen Anne's Gate Buildings, London, S.W.* 1. 1922.

This report, covering the calendar year 1921, relates to changes in personnel, the collection and dissemination of information, the staff, the forthcoming British Empire Exhibition, the unification of mineral statistics, and financial matters. The greater part of the pamphlet is occupied by appendices, one of which, filling 36 pages, presents very valuable review of the principal mineral dustries of the British Empire and foreign untries for the year 1921; another explains the forts the Bureau is making to unify methods returning and recording mining and metalrgical statistics. In the latter connexion it is orthy of note that, with but very few exceptions, e Bureau has adopted the British statute ton of 240 lb. as the standard of weight and the £ sterling the standard of value. The ambiguity of the rms "production" and "consumption" is iscussed, and generally this part of the Report ill prove very useful to those who have to deal ith statistical information.

During the past year the Bureau has issued a rge number of publications, many of which have een in great request. The series on the mineral dustry during the period 1913—1919 is now early complete. A statistical summary of production, imports and exports of minerals from 1913 1920 was also published. The valuable work on he iron resources of the world is nearing completion (Pts. I to V have just been issued). olumes on the mining laws of the Transvaal and ritish Columbia will be published shortly. A pecial compilation on the laws and regulations overning the employment of persons in lead mines nd lead manufactories in all parts of the world, nd a model code of mining ordinance for Kenya olony, were issued during 1921.

In the interest of economy the paid staff of the ureau has been reduced from 46 to 36, and other rrangements have been made to effect a total aving of £4000 per annum. Grants amounted to 16,800, of which £10,000 was contributed by the mperial Government.

REPORT ON THE ECONOMIC SITUATION OF BELGIUM AT THE END OF 1921, REVISED TO MARCH, 1922.

By R. F. H. DUKE, *H.M. Commercial Secretary, Brussels. Department of Overseas Trade. Pp.* 134. *London: H.M. Stationery Office,* 1922. *Price* 3*s.* 6*d.*

Before the war Belgium possessed many flourishing industries—chiefly coal-mining, metallurgy, textiles, glass-making, industrial chemicals, cement, bricks—and a comparatively small national debt. The war destroyed all these industries except coal-mining, deprived Belgium of her export trade and the assistance of German capital, and increased the national debt enormously. Economic recovery has, however, been wonderfully rapid, and the formation of combines, particularly in the metal, glass, textile, cement and building-material industries, has enabled the manufacturers to develop the export trade and to resist the economic stagnation more successfully.

By the end of 1920, 27 out of the 54 blast furnaces which existed before the war had been relighted, and the output of iron and steel was over one-half that of 1913. During 1921, however, owing to the steady fall in prices of metallurgical products and severe foreign competition, production declined, and manufacturers restricted themselves to working up imported raw steel. At the end of the year only 14 blast furnaces were in operation, but subsequently the receipt of foreign orders improved the outlook. The zinc industry, which suffered little during the war, was short of raw material, and owing to the high cost of coal and labour, production declined from 84,252 tons in 1920 (41 per cent. of the output in 1913) to 66,470 t. in 1921. Reconstruction has not been so rapid in the lead industry, which is of lesser importance (*cf.* J., 1922, 266 R). The commercial agreement with Luxembourg (*cf.* J., 1922, 202 R) has been opposed on the ground that pig iron can be produced more cheaply in that country than in Belgium, which has to import the ore, and it has been proposed to form a Franco-Belgian-Luxembourg cartel to control the output of Alsace-Lorraine, Belgium and Luxembourg.

An approach to the pre-war level of prosperity was made in 1920 by all branches of the glass industry except that of table-glass, but in 1921 conditions were less favourable, labour and export difficulties proving serious, and attention was turned to the establishment of a special export sales-organisation. The chief producers are to participate in erecting a large glass factory to utilise the Foucault process in the Kaiping coal-mining district of China. Like other textile industries, the artificial-silk industry has suffered during the past year, but demand is now said to be in excess of supply; the export in 1921 was 153 t. and the daily output is now about 12 to 13 tons. The cement industry has been prosperous and the export trade considerable; the product has been improved by adopting the British standard specification, but packing is still faulty.

In the chemical industry the situation is not good, consumers are holding stocks, and the wage question and German competition are causing difficulties. The output of superphosphate fertiliser is still below the pre-war level of 230,000 t., but that of ultramarine has increased, so that sales of the British article have declined. The Fours à Coke Semet-Solvay and Piette (capital, 40 million francs), which is the chief manufacturer of coal-tar products in Belgium, has been working on only a small scale since the armistice. Many of the Belgian companies formerly under German influence have been acquired by the Compagnie Belge pour les Industries Chimiques (capital 50 mill. fr.), which is closely connected with French interests.

Among minor industries the match industry has been most successful since the war, both in the home and export trade. The paper industry, centred in the Ardennes and in Brabant, reduced production during 1920 on account of German competition. In 1920 the output of coal was 22·5 million t., compared with 18·5 mill. t. in 1919 and 22·8 mill. t. in 1913; production, however, is insufficient to meet the demand and importation is necessary. Developments are in progress in the coal-mining industry to improve materials, methods, etc.

Exports from Belgium in 1920 amounted to 10,548,593 t., valued at 8,708,082,000 fr., and 17,160,355 t., valued at 7,147,327,000 fr. in 1921, 15·5 and 17·6 per cent. by value being directed to the United Kingdom in the two years, respectively. The chief exports to the United Kingdom in 1921 were as follows (in 1000 fr.):—Copper, raw, 8497 iron and steel 61,301; lead, crude, 7121; lead 3107 zinc, crude, 15,030; zinc 9915; cement 15,010; basic slag 6055; superphosphate 11,994; chemicals 8478 vegetable oils (not olive or groundnut oils) 17,005 dyes and colours 7074; pottery 2056; glass 49,296 iron and steel 149,619. In 1920 the imports were 11,946,448 t. (11,171,467,000 fr.) and in 1921

17,511,863 t. (10,054,583,000 fr.), the percentage supplied by the United Kingdom being 17·2 and 11·17, by value, in these two years. Values (in 1000 fr.) of some of the principal imports from the United Kingdom in 1921 were:—Salt 1481; olive oil, groundnut oil 1707; edible fats 1908; non-edible fats 6670; vegetable oils 11,946; hides 28,744; ores 6857; copper, raw, 4454; copper 2800; tin, raw, 5069; coal 39,958; iron and steel, raw, 17,350; iron and steel 21,902; tar, tar oils, mineral oils 27,097; soap 1050; chemicals 17,249; dyes and colours 6811; paper 2644; pottery 3375. The fluctuating value of the franc has adversely affected British trade with Belgium. British goods still retain a reputation for superior quality, but if prices are not considerably reduced, better terms of credit given and more punctual deliveries made, trade will diminish.

The natural resources, trade and industry of the Belgian Congo are discussed and the opportunities for British enterprise outlined.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for July* 13 *and* 20)

TARIFF CUSTOMS EXCISE

Australia.—The operation of the duties on citric acid, chamois leather, metal cordage (not including aluminium cable) has been postponed until September 30. Negotiations are in progress with Canada and New Zealand for reciprocal tariff arrangements.

Belgium.—Export licences are now required only for sugar, syrups of all kinds other than pharmaceutical syrups, and molasses.

Chile.—It is proposed to apply an export duty on ores of copper and iron.

Egypt.—A list of import valuations for iron and steel goods is given in the issue for July 20.

France.—By a recent customs decision nickel pellets are admitted duty free.

French Colonies.—The export or re-export of opium, morphine, cocaine and their salts is prohibited. Opium and opium products directed to France or in transit through French Somaliland are not affected.

Germany.—Artificial honey, cocoa butter, cocoa products, and other food products no longer require an import licence. In future the surtax leviable when customs duties are paid in paper currency will be fixed weekly on the basis of the dollar exchange for the previous week.

Lithuania.—Export licences are now required for, *inter alia*, cast iron, brass, silver, gold, fuel, bones, hemp, explosives, and malt.

Mexico.—The export duty on beans has been reduced to 1 cent per kg. The internal taxes on petroleum and its derivatives have been modified.

Newfoundland.—A Commission has been appointed to revise the customs tariff.

Poland.—An export duty of 15 Polish marks per kg. has been imposed on crude mineral oil.

South Africa.—Special duties have been adopted to prevent dumping from countries with depreciated currencies. The Board of Trade and Industries recommends that certain materials used for manufacturing goods within the Union be admitted duty free. The duty on starch has been fixed at 1d. per lb. A Bill has been introduced to prohibit, regulate or restrict the importation of boots and shoes, and sugar.

Spain.—A customs duty of 85 pesetas per 100 kg. on sugar, glucose, liquid caramel and similar products and consumption duties of 45 pesetas per 100 kg. on sugar made in Spain and 22·50 pesetas per 100 kg. on glucose have now been enacted. The import duty may be reduced temporarily by 15 pesetas per 100 kg. if Spanish manufacturers raise their prices unduly. A schedule of modifications in the customs tariff is given in the issue for July 20.

Switzerland.—The temporary reduction of the export duty on scrap iron to 40 centimes per 100 kg. has been extended until further notice.

Tanganyika.—The export duty on hides and skins is suspended until December 31.

United States.—A copy of the Narcotic Drugs Import and Export Act may be consulted at the Department of Overseas Trade.

Yugoslavia.—A new scale of monopoly duties has been fixed for explosives.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W.1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

LOCALITY OF FIRM OR AGENT	MATERIALS	REFERENCE NUMBER
Argentina	Glass, glassware	225/6/F.G./M.C./A.
Australia	Heavy chemicals, fish oils ..	18
"	Explosives	412/20/7/3101*
"	China, pottery, glassware ..	412/20/7/3115*
"	Iron and steel, chemicals ..	412/20/7/3108*
Brazil	Paper	81
"	Chemicals, drugs, cement, crockery	82
Colombia	China, earthenware, stoneware	6260/F.L./M.C.
Costa Rica ..	Chemicals, drugs	83
Ecuador	Paints, oils, cement, earthenware	84
Egypt	Sheet zinc, zinc oxide ..	8610/F.E./E.C.
France	Tinplate	64
Holland	Heavy chemicals, pharmaceutical products, castor oil ..	35
"	Ammonium sulphate, superphosphate, etc.	36
"	Earthenware and fireclay goods	68
New Zealand ..	Paper	25
" " ..	Leather	62
Norway	Artificial leather	69
Portugal	Rubber, lubricating and fuel oils	71
Sweden	Hides, leather and tanning materials	41
Switzerland ..	Olive oil, groundnut oil, sugar	43
United States ..	Linseed oil, coke	78
Uruguay	Pottery, glass, glassware ..	225/54/F.G./M.C.

* Official Secretary, Australia House, Strand, W.C.2.

TRADE NOTES

BRITISH

Seychelles in 1920

Considerable progress was made during 1920 in the distillation of essential oils, the exports being valued at Rs. 420,104. Towards the end of the year the European demand for cinnamon-leaf oil practically ceased, the price fell from Rs. 12 to Rs. 4 per kg., and many distilleries had to close down. Only three tons of vanilla was exported, and the crop was the smallest on record. The vanilla vines suffer severely from a disease, which is now the object of investigation. The crop of coconuts reached the estimated total of 23,159,172 nuts, of which nearly 18 million was converted into copra; the increased crop, compared with 1919, was due to the enforced cleaning of the plantations. The manufacture of soap, for which much coconut oil is used, was discontinued owing to the difficulty of importing soda. Exports of rubber declined from 13·4 t. to 10·7 t.; progress was made in extending the coffee crop and in reafforestation; and the guano industry was restarted. Exports from the colony decreased in value by Rs. 389,422 to Rs. 1,711,955, owing to trade in copra re-attaining a normal level. Imports, valued at Rs. 1,716,408, increased, and a larger proportion than usual was derived from the United Kingdom.

FOREIGN

The New Bakelite Corporation

Following the legal action which resulted in the upholding of the Bakelite patents for the manufacture of phenolic condensation products, the Redmanol Chemical Products Co. has decided to combine with the General Bakelite Co. in order to prevent loss of goodwill, plant and organisation. The Condensite Co., controlled by the Redmanol Co., is also entering the new combine, which has been taken over by the Bakelite Corporation. The three companies will continue separately to manufacture and market their products, which supplement one another; thus galalith and "hexa" are made only by Redmanol, chlorine substitution products only by Condensite, and transparent material by Bakelite and Redmanol.—(*Chem. and Met. Eng.*, *June* 31, 1922.)

German Chemical Trade during May

H.M. Commercial Secretary at Berlin reports a slight improvement in the inland trade in coal-tar dyes. Foreign sales were satisfactory, and business remained at the level of the previous month in the Austrian Succession States, Holland and North Europe, but declined in Czechoslovakia, Finland and Belgium. Business was hampered in Northern Europe by offers of dyestuffs illegally exported from Germany, and by keen competition from many countries. The demand for pharmaceutical products increased, but that for chemicals continued to decline without, however, restricting full employment in the factories. Exportation was affected by fluctuations in the value of the mark and the world-market prices of certain chemicals were often reached and even exceeded. Supplies of raw materials improved, but soda had to be imported in bulk from France and Switzerland. Large orders for tinplate were placed in England and difficulties were experienced in obtaining supplies of packing paper, carboys, carbons, iron bars, etc.

Caustic Soda in Brazil

Owing to difficulties in obtaining supplies of caustic soda during the war, the Brazilian Government offered loans and concessions to encourage the manufacture in the country. This action resulted in the formation of the Cia. Brazileira de Productos Chimicos, which has erected a plant near Rio de Janeiro with a capacity of 5 metric tons of caustic soda solution (76°) and 10 t. of calcium chloride solution (35°) per 24 hrs. Since these products have been marketed imports of caustic soda have declined from 12,036 t., valued at 8,523,000 milreis, in 1920 to only 2899 t., valued at 2,567,000 milreis, in 1921 (milreis = 2s. 3d. at par, now 7·4d.). Although this heavy decrease was undoubtedly due largely to trade depression, the Brazilian demand for foreign caustic soda will probably be much restricted in future.—(*U.S. Com. Rep.*, *May* 22, 1922.)

REVIEWS

BASIC SLAGS AND ROCK PHOSPHATES. *By* GEORGE SCOTT ROBERTSON, *with a preface by* SIR EDWARD J. RUSSELL. *Cambridge Agricultural Monographs. Pp. xiv*+120. *Cambridge: The University Press*, 1922. *Price* 14*s. net.*

Much interest is being taken at the present time in the production of basic slags and in their value as fertilisers, and at the same time the not less important question of the manurial value of ground rock phosphates, and of the extent to which they can replace basic slags as fertilisers, is receiving much consideration. The monograph by Dr. Scott Robertson on basic slags and rock phosphates, which has been issued as one of the Cambridge Agricultural Monographs, appears therefore at a particularly appropriate time, and should be very useful to all agricultural teachers and agricultural chemists.

For a long time basic slag was not very popular with the British farmer. Whereas Germany, the largest producer, consumed at home nearly the whole of her millions of tons, it was not sufficiently appreciated in this country, in spite of the evidence obtained at Cockle Park and elsewhere, to prevent a considerable proportion of our relatively small production being exported. Under the stress of war necessities the British farmer at last learnt to appreciate basic slag, and during the years 1917 and 1918, though the home production was greater than ever before, it was all used at home. It was through experiments made with slag produced by the basic Bessemer process that the reputation of basic slag as a manure was established, and it seems almost tragic that when British farmers had at last learned to appreciate and use this fertiliser, changes in the steel industry have made it necessary again to undertake the whole process of determining by field experiments the value of basic slag relatively to other phosphatic manures. Most of the basic slag now on the market is not the same substance as the old Bessemer slag, from which it differs both in the phosphate percentage and in the solubility of its phosphate.

Closely related to the slag question is that of the fertilising value of ground rock phosphates, and this also has recently assumed new importance. The orthodox agricultural chemistry of the past taught that rock phosphates are of little or no value as manure until they are dissolved to form superphosphate. There have always been a few unorthodox persons who have maintained that ground rock phosphates have in themselves a high value, and during the past twenty years opinion has gradually been coming over to their side, as evidence has accumulated showing that, weight for weight of phosphate, nearly as good a result can in many cases be obtained from ground rock phosphate as from superphosphate, and that therefore, to a large extent at any rate, it is unnecessary and wasteful to use superphosphate.

Dr. Scott Robertson's little book is mainly taken up with a record of field experiments carried out on grassland in Essex with basic slags of different kinds, and with ground rock phosphates from North Africa, Florida and elsewhere. Sir E. J. Russell, the director of the Rothamsted Experiment Station, who is chairman of a Departmental Committee appointed to consider the question of the supply of basic slag, provides an introduction.

The opening historical statement and the review of previous experiments are short and might usefully be enlarged in a new edition. These sections are so incomplete that they hardly give a fair and balanced impression of the development of the use of slag and rock phosphates.

The really valuable part of the work is the account of Dr. Robertson's own experiments on grassland in Essex, which occupies by far the greater part of the book. These experiments were carried out on eight different farms on soils of three different types and are characterised by certain distinctive features. The improvement obtained is not measured merely by weighing the crops of hay, but careful botanical analyses were made, and the effect of the manure in changing and improving the kind of plants in the pasture is carefully discussed. The relation of the phosphatic dressings to the accumulation of nitrogen in the soil, and their effect on the soil bacteria, and on the soil acidity, moisture and temperature, are all critically examined in a scientific manner, and conclusions of much interest are drawn. The results in general show that rock phosphates "give results approximately equivalent to those secured from the high citric-soluble types of basic slag" and that whilst the low-soluble fluorspar basic slags have effected considerable improvement they "have undoubtedly proved to be less effective than either the high-soluble slags or the rock phosphates."

Dr. Robertson states his conclusions moderately, and the economic importance of the questions involved is so great that he might perhaps have been a little more emphatic in stating the conclusions at which he has arrived, even though they may sound unorthodox to those who hold that agriculture cannot prosper without basic slag.

The book has a good index and is illustrated with reproductions of a number of excellent photographs.

James Hendrick.

L'Azote. *By* L. Hackspill. *Pp.* xii+271. *Paris: Masson and Cie. and Gauthier Villar et Cie.,* 1922. *Price* 14 *francs net.*

This volume, which is one of a series of monographs included in the Encyclopédie Léauté, contains a well-written review of the principal processes of nitrogen fixation by an author who has had considerable opportunity for studying these in actual operation. The fourteen chapters contained in the book include a description of the technical manufacture of the more important nitrides and of calcium cyanamide, of the synthesis of ammonia, and of the fixation of nitrogen by the arc process. In addition, various operations subsidiary to the main process of fixation, such as the preparation of nitrogen and of hydrogen, the absorption and concentration of oxides of nitrogen and of nitric acid, and the formation of various ammonium salts are described; further, constructional details and the number of plants of various types known to be in operation are frequently given. In particular, the account of the Oppau and Merseburg synthetic-ammonia plants, including the methods employed in carrying out many of the subsidiary operations involved, is worthy of note. A special chapter is devoted to the use of abnormally high pressures by Claude, and further sections contain a general economic review of nitrogen fixation, of the utilisation of artificial nitrogenous manures, and of the production and consumption of nitrogen compounds in various countries.

On the whole, Prof. Hackspill is to be congratulated on the production of a very readable and well-arranged work, which appears to be exceptionally free from misstatements and from serious misprints. The statement on page 15 that nitrogen, on being activated by electric discharge at low pressures "devient lumineux pendant un certain temps, plus long si l'on refroidit, plus court si l'on chauffe" cannot, however, be accepted as completely accurate in view of Strutt's observation that an afterglow, which persisted at room temperature for slightly more than a minute, became extinguished in fifteen seconds at the temperature of liquid air. Similarly, misprints occur occasionally in the spelling of proper names. Thus, "Briegler" for "Brieglieb" (p. 17), "Scheffield" for "Sheffield" (p. 73), "Clause" for "Claude" (p. 84), and "Vant 'Hoff" for "Van't Hoff" (p. 156), in addition to other minor misprints, were noticed on reading through the volume, but small inaccuracies of this type do not detract from the general utility of the work, which forms a very acceptable addition to the literature of fixed nitrogen. The diagrams are excellent, particularly since many of them are marked with the actual dimensions of the plant illustrated, thus allowing a far more accurate conception of relative sizes to be obtained than is possible from purely diagrammatic sketches.

E. B. Maxted.

Principles of Leather Manufacture. *By* H. R. Procter. *Second edition. Pp. viii+688. London: E. and F. Spon, Ltd.,* 1922. *Price* 33*s. net.*

In 1903 Prof. Procter's "Principles of Leather Manufacture" replaced his still earlier "Text-Book of Tanning," published in 1885. The great advances made since then in the science and practice of leather manufacture have necessitated another edition, and the above volume replaces the first edition as the standard work on the subject and the final authority on all matters within its scope. The second edition contains 170 more pages than its predecessor, and its printing, illustrations and binding are worthy of its high position in technological literature. The general scheme of division into chapters adopted is the same as in the first edition, each chapter being expanded, several new ones added and an appendix inserted containing several original contributions by various authors.

Starting with a brief description of the living cell, the mechanism of putrefaction and fermentation under the influence of moulds, yeasts and bacteria is described. A chapter devoted to a full account of the antiseptics and disinfectants applicable to hides and skins is followed by a description of the origin and curing of the same, special reference being made to the cause and prevention of salt stains and the damage to hides caused by the warble fly. The chapter on the structure and growth of skin is illustrated by excellent photomicrographs by A. Seymour Jones and R. H. Marriott. The section dealing with physical chemistry as applied to the leather industry is greatly enlarged, special attention being given to the measurement and effects of variations of hydrion concentration and a chapter devoted to colloid solutions and the colloid state. A chapter on the chemistry of hide nearly completes the scientific as distinct from the practical part of the book. Henceforward the processes of leather manufacture are dealt with in the order in which they are carried out in the tannery, separate chapters being devoted to softening of hides and skins, depilation, deliming, bateing, puering and drenching, and pickling and depickling.

Of actual tanning processes, those by means of chrome, alum and iron are first considered, the two former in considerable detail. A very complete account of the vegetable tanning materials follows, occupying nearly 60 pages and containing many illustrations, and the tannage of sole leather with these materials is described, combination tannages being briefly dealt with. Accounts of the grinding and extraction of tanning materials and evaporation follow. The chemistry and analysis of oils and fats occupy 30 pages, and chapters on their use in leather manufacture are included. Dyes and mordants as used on leather, evaporation, heating and drying, maintenance of tanneries and disposal of waste products are treated in detail in the last four chapters.

In the appendix, full extracts, with a number of tables and diagrams, from the papers by the author and Wilson on the gelatin equilibrium are given. M. C. Lamb contributes a list of dyes suitable for use on chrome and vegetable-tanned leather, and papers by Atkin and Thompson on the determination and control of acidity in tan-liquors, and by W. R. and J. Atkin on the caustic alkalinity of lime liquors, are included.

Many practical books consist of a monotonous catalogue of processes, good, bad, and indifferent, of the majority of which it is extremely unlikely that the author has any personal knowledge. On the other hand, scientific teaching requires to be presented to the average tanner in a very clear way if [illegible] to listen to it. Prof. Procter, as a practical tanner, can give the manufacturer much valuable advice, and as an eminent scientist his gift of lucid explanation is such that his exposition of the science and theory of the industry can be profitably studied both by the non-practical man unacquainted with the industry and by the manufacturer desirous of understanding more of the principles underlying his processes.

Douglas J. Law.

PUBLICATIONS RECEIVED

Catalytic Action. *By* K. G. Falk. *Pp.* 172. *New York: Chemical Catalog Co., Inc.*, 1922. *Price* $2.50.

An Inorganic Chemistry. *By* Prof. H. G. Denham. *Pp.* 683. *London: Edward Arnold and Co.*, 1922. *Price* 12*s.* 6*d.*

Trattato di Chimica Analitica Applicata, Vol. II. *By* Prof. G. V. Villavecchia. *Second edition, revised and enlarged. Pp.* 884. *Milan: U. Hoepli*, 1922. *Price, paper*, 58 *lire.*

First Report of the Adhesives Research Committee. *Department of Scientific and Industrial Research. Pp.* 129. *London: H.M. Stationery Office*, 1922. *Price* 4*s.*

Journal of the Institute of Metals, Vol. XXVII, No. 1, 1922. *Pp.* 621. *Published by the Institute*, 36, *Victoria Street, London, S.W.* 1, 1922. *Price* 31*s.* 6*d.*

Iron Ore. Summary of Information as to the Present and Prospective Iron-Ore Supplies of the World. *Imperial Mineral Resources Bureau. London: H.M. Stationery Office*, 1922:—

Part I.—United Kingdom. *Pp.* 237. *Price* 6*s.*

Part II.—British Africa. *Pp.* 76. *Price* 3*s.*

Part III.—British America. *Pp.* 115. *Price* 3*s.* 6*d.*

Part IV.—British Asia. *Pp.* 65. *Price* 2*s.* 6*d.*

Part V.—Australia and New Zealand. *Pp.* 106. *Price* 4*s.*

Symposium on Impact Testing of Materials. *Held by the American Society for Testing Materials on June* 28, 1922. *Pp.* 107.

Barium and Strontium in Canada. *By* H. S. Spence. *Department of Mines, Mines Branch, Canada. Pp.* 100. *Ottawa: Government Printing Bureau*, 1922.

Bulletins of Indian Industries and Labour. *Calcutta: Superintendent Government Printing, India*, 1922:—

Notes on Zinc and Lead. *By* Dr. J. Coggin Brown. *Bulletin No.* 19. *Pp.* 80. *Price* 14 *annas.*

Notes on Asbestos. *By* Dr. J. Coggin Brown. *Bulletin No.* 20. *Pp.* 31. *Price* 6 *annas.*

Paper and Paper-Pulp Production in the Madras Presidency. *By* Dr. F. Marsden. *No.* 24. *Pp.* 46. *Price* 8 *annas.*

Gilt Wire and Tinsel Industry. *By* V. N. Mehta. *No.* 25. *Pp.* 35. *Price* 6 *annas.*

Ninth Annual Report on the Industrial Fellowships of the Mellon Institute, 1921–22. *By* E. R. Weidlein. *The Mellon Institute, Pittsburgh, Pennsylvania*, 1922.

Publications of the United States Geological Survey. *Department of the Interior. Washington: Government Printing Office.* 1922:—

Quicksilver in 1920. *By* F. L. Ransome.

Mica in 1920. *By* B. H. Stoddard.

Cadmium in 1921. *By* C. E. Siebenthal *and* A. Stoll.

Publications of the United States Bureau of Mines. *Department of the Interior. Washington: Government Printing Office*, 1922:—

Evaporation Loss of Petroleum in the Mid-Continent Field. *By* J. H. Wiggins. *Price* 20 *cents.*

REVIEW

Vol. XLII] AUGUST 15, 1922 [No. 15

THE TRAINING OF THE CHEMICAL ENGINEER*

R. F. RUTTAN

THE great field for the development of stable chemical industries in Canada is the utilisation of those natural resources which we possess in greater quantity, and more conveniently situated, than other countries. This need not call for original research but rather for adaptation to our conditions, of methods, principles and processes already known and well tried elsewhere. This is obviously the function of the chemical engineer, and it is from the young chemical engineer that we may expect the kind of industrial research which the country needs at present.

The scientific army of Great Britain has always consisted of a brilliant group of staff officers, but before the war England had not learned how to make the most of her mediocre ability. She did not recognise that without the scientific rank and file it would be impossible to staff the industrial research laboratories so as to compete with the more elaborate organisations of Germany and America. The English idea was that the two professions should be kept separate, each specially trained for its field of work, and that a chemical job should be done by a chemist and an engineering task by an engineer. The two, it was thought, should not be combined because the two subjects were too big for one man, save in a few exceptional cases. This is certainly true when the course of training does not exceed three years.

I think that most of the leaders in chemical industry in England are now willing to concede that the engineer should be taught sufficient chemistry to be able to appreciate the chemist's point of view, and that the chemist should know enough of engineering to realise that he can safely leave the practical application of the processes he devises in the laboratory to the engineer thus trained. The principle of "one man, one job," is thoroughly English, but it may be carried too far. One cannot overlook the important rôle played in the chemical industries of America and Germany by a class of scientific men who are neither highly-trained engineers nor highly-trained chemists, but who are recognised as a class, and many of whom have a great deal more in them than a knowledge of chemistry and of engineering.

It has been pointed out that as the engineer and the chemist become more highly trained and specialised, their paths become more divergent, and their points of view irreconcilable; in short, the experience of many heads of works is that the two types are largely incompatible. A works chemist defined the average engineer as "an empyric who has been trained on cotton waste and engine-oil"; and a works chemist has been described by an engineer as "an organic body more liable than any other of similar nature to spontaneous explosions." Chemists and engineers have also been called the physicians and surgeons of industry. On this analogy the chemical engineer would represent the general practitioner of the chemical industries; like the physician, his chemical knowledge enables him to see below the surface, to diagnose from physical signs unseen changes and conditions, and from his experience to find a remedy for any abnormal reaction. Just as there is a limited number of unseen organs in the human body to be studied and observed, so in a chemical works there is a limited number of operations, more or less invisible, going on in chemical units, each with its clinical thermometer, pressure-indicator, etc. attached to give early symptoms of any departure from the normal. The engineer in charge, like the surgeon, has to deal with the adjustment, repair and alterations of the anatomical units, the works, the accessible outward portions. Just as minor surgery constitutes a large part of the activities of the general practitioner, so frequent minor adjustments, alterations, improvements and repairs skilfully carried out form the larger part of the duties of the chemical engineer. Like the general practitioner, the chemical engineer should know his limitations and, when necessary, consult the specialist, the electrical or hydraulic engineer, or the chemist.

No analogy, however, should be carried too far, but it is worthy of note that the best specialists in any field of medicine or surgery are those who have spent years as general practitioners. Therefore knowledge of the general practice of chemistry and engineering in works is a very sound basis on which to build expert knowledge in either branch of science.

---

* The substance of an address delivered at a joint meeting of the Chemical Engineering Group and the Chemical Industry Club in the Savoy Hotel, London, on June 28, 1922.

During the past few years there has been a very prolific discussion regarding the best course of training for the chemical engineer. It has become generally recognised, on both sides of the Atlantic, that progress in industrial chemistry is based upon both engineering and chemistry, and that the Universities have failed to impart just the right type of education. This is due to the fact that the Universities are unable to teach the control of chemical reactions and the handling of materials on a sufficiently large scale. The best that can possibly be expected of the University in a course of four years is to give a broad and scientific foundation. After having once entered upon the work of his profession it is only in very exceptional cases that a man returns to the University for further training in research. Admitting the unsatisfactory and incomplete training which is now being given, the time seems ripe to consider some plan which will provide better-trained chemical engineers. The plan which, in my opinion, gives promise of meeting these requirements, is an adaptation of one which has been developed, and is now being tried, by the Massachusetts Institute of Technology, Boston. This unique scheme of education, which was evolved by a committee of engineers (of which Mr. A. D. Little was chairman) appointed by the Institute, has up to the present time completely realised the expectations of those who introduced it.

We recognise that chemical processes, whether on the laboratory or the factory scale, consist of a series of collected " unit " actions, such as pulverising, mixing, heating, roasting, absorbing, precipitating, condensing, crystallising, filtering, and electrolysing. The number of these basic unit operations is not very large, and only a few of them are to be seen in any particular works. To afford an insight into the real problems requiring industrial chemical research, the Institute mentioned established five or six chemical engineering and research stations in direct contact with important industries. These were selected with a view to bringing to the attention of the engineering student the largest possible number of the unit operations of which chemical processes are generally composed. The stations have a threefold function : (*a*) practical instruction in chemical engineering ; (*b*) instruction of ambitious foremen and others in the works in the fundamental principles governing their operations ; and (*c*) advancement of industrial research in special industries. The equipment of each station consists of a small building of one storey which contains a small reference library and a very complete collection of photographs and drawings of apparatus and machinery utilised in the local industry, but not installed in the locality ; a conference and lecture-room to accommodate fifteen or twenty people ; a small laboratory with benches for the same number an office for the station director ; and a laboratory for specialised industrial research, with space and equipment for five graduate research assistants. The cost of such an equipment would be from 10 to 20 thousand dollars in different industries.

According to the arrangements at the Institute the students leave the University about the middle of their fourth year, and spend the period from January to September in moving from station to station, spending about six weeks at each. An instructor is in charge of each station, and maintains the same strict discipline among the students as is found at the University. Each day's work is carefully planned, and daily lectures on different stages of the process form a part of the system.

The five-year course is designed to fulfil the following objects :—(1) To acquire a first-hand knowledge of the processes, plant and machines in the equipment. (2) To study the chemical control of industrial processes through the laboratory, and to acquire ability in the interpretation of laboratory data in terms of factory practice. (3) To obtain a general knowledge of modern methods of factory management and control, together with methods of apportioning cost of manufacture. (4) To obtain the wider viewpoint which comes from contact with those who are employed to superintend or carry out factory operations, and to acquire the degree of confidence in handling industrial processes and large-sized apparatus which comes from actual participation in the work of the plant. (5) To acquire that inspiration for further work in science and research which intimate contact with large progressive industries inevitably affords. On returning to the Institute to complete his fifth year, the student follows a course of advanced lectures and laboratory work, the value of which he will appreciate as the result of his experience in the works. The above description is the substance of the report of the committee presided over by Mr. A. D. Little.

This, in outline, is the object and method of this new plan of educating chemical engineers. It is our purpose to adopt a modified form of it in Canada, and this will require co-operation among the engineering faculties in Canadian Universities on the one hand, and a successful appeal to the captains of Canadian industry on the other. The Universities must agree upon the necessity for a five-year course in chemical engineering, and be convinced that one year spent chiefly in works' training is the best way of employing the students' time. Success or failure will depend very largely upon the manufacturers ; without their cordial co-operation and assistance the plan is obviously doomed to failure. In the United States every industry invited gladly accepted the opportunity of having a station in the works. The Honorary Advisory Council for Scientific and Industrial Research has appointed a committee to look into this question and to formulate a plan fo putting it into effect next year. It seems to me a very obvious and effective method of bringing into closer relation the Universities and the industries of Canada, enabling the former to ascertain the important industrial problems of the country, and giving the industries an opportunity of utilising in part the teaching and research powers of the Universities. Not only would this scheme give our students in chemical engineering a range of experience impossible to obtain otherwise, but the stations could offer special courses in the technology of their industry to superintendents, foremen, etc., thus forming a sort of university extension in chemical industry. The plan lends itself with peculiar effectiveness to the development of industrial research at each station. The director in charge of the station would obviously be a well-trained chemist or chemical engineer who has specialised, or intends to specialise, along the lines of the particular industry or industries with which he is connected.

The application of this scheme of training to Canadian conditions will not be easy. In the first place, the total number of graduates in chemical engineering and chemistry in Canada is less than is annually turned out by the Institute of Technology; hence the field from which we can select is smaller. The average student at the Institute is financially better able to spend the extra year, with its additional tuition fees and travelling expenses, than is our Canadian student. Again, few industries are on a scale comparable with many in the United States. But these difficulties are not insuperable. There is little doubt that industrial chemistry is offering such a future to our technically-trained graduates that chemical engineering is rapidly becoming the most attractive career for the engineering student, and the required number will soon be available. If the universities gave the Bachelor degree at the end of four years and a Master's degree in Science after five years; if the fees were made as low as possible and substantial Government assistance be given to these training centres, the obvious value of this practical training would soon create a competition among the students for the privilege of being admitted to the course.

The station in each centre would become the scientific bureau of information and research for the local industries, and would go far to introduce an atmosphere of science into those industries in which chemistry plays a part.

Finally, I feel strongly that the chemical engineer so trained is just the type of man to develop our industries. He would be a University man familiar with the engineering problems presented by chemical industries, one whose capacity for initiative and for attacking scientifically an industrial problem would be many times that of the present science graduate, however good his university training may have been.

CONSTRUCTIVE INDUSTRIAL HYGIENE IN THE INDIARUBBER INDUSTRY

C. A. KLEIN

EARLY in 1921 the Home Secretary, under Section 79 of the Factory Act of 1901, certified as dangerous the following processes incidental to the manufacture of indiarubber and indiarubber goods :—

(*a*) Vulcanising by means of the cold cure process or by any other process involving the use of carbon bisulphide, sulphur chloride, carbon-chlorine compounds or benzol (pure or commercial);

(*b*) Any process involving the use of lead or compounds of lead.

This certification by the Home Secretary is a necessary preliminary under the Act when it is intended to institute regulations for the hygienic control of an industrial process.

Shortly after the certification of the above processes as dangerous, the Secretary of State issued draft regulations which it was proposed to institute in connexion with these processes and, as prescribed, the draft regulations were submitted to those concerned and interested in the matter. After mutual criticism and discussion, a final form was agreed and Statutory Rules and Orders, dated March 31, 1922, now known as the "Indiarubber Regulations, 1922," came into operation on May 1 of this year.

The regulations divide the above-named processes into two kinds, viz., "fume processes"—*i.e.*, those referred to under (*a*) as above—and "lead processes," or those described under heading (*b*). The regulations for the two types of processes are almost entirely distinct, but few having dual reference.

In the regulations dealing with "fume processes," the essential feature is protection against the injurious effects of the vapours of volatile solvents used in indiarubber manufacture, the provisions being for minimum age of employment, limitation of hours worked, prohibition of the use of such processes in the open air, the application of exhaust draught or (when only benzene—pure or commercial benzol—is used) of efficient ventilation, the adoption of means to minimise the amount of vapour entering the air, messroom, medical examination at prescribed intervals, maintenance of health register, and rules for the re-employment of persons suspended by the certifying factory surgeon.

These new regulations supersede the Special Rules in operation since May 1, 1898, for "The vulcanising of indiarubber by means of bisulphide of carbon," and are more comprehensive and applicable to processes in which other volatile products are used.

The inclusion of liquids containing benzene and the carbon-chlorine compounds, indicates the increased employment or introduction of such compounds in the rubber industry and implies that the toxicity of the vapours of these compounds has been definitely established by practical experience. The toxic properties of the vapours of such bodies have been known for some time and the new regulations will cause little surprise—in the opinion of some, they were long overdue.

There has recently been much discussion as to the toxic effects produced by the vapours of the volatile thinners used in painting operations, and, as certain of the volatile thinners are common to the paint and rubber industries, the recognition of these vapours as dangerous in the rubber industry has an important bearing on the question under discussion. It has been suggested that the conditions obtaining in the two trades are not comparable, but as yet no evidence has been brought forward in support of this contention. The question at issue, though complicated, as are all questions involving the resistance of the human body, must be studied in its broadest aspect, for in no line of inquiry is the old saying that "one man's meat is another's poison" better illustrated. Personal idiosyncrasy plays a large part in these matters and until the subject has been carefully studied, it would appear as if Rolands and Olivers can be produced in about equal numbers, and the true position will not be known until the many and varying factors involved have been carefully considered.

The regulations for "lead processes" closely follow in principle those which in recent years have become standard in this country for all processes involving exposure to lead compounds, and provide for a minimum age of worker, exclusion of any female under 18 years of age from any lead process, application of exhaust-draught for the removal of lead dust at (or as near as possible to) its point of origin, mess-rooms, regular supply of clean overalls, accommodation for clothing put off during working hours, washing facilities, medical examination, maintenance of health register, rules as to the re-employment of workers after suspension by the certifying surgeon, and finally, facilities for the sampling of materials by Government inspectors.

The final requirement, which refers to the sampling of materials used, follows the practice which has been in vogue for some years in connexion with the use of lead compounds in the manufacture of pottery, and has been recently incorporated in the Women and Young Persons (Employment in Lead Processes) Act, 1920. In the latter case, as in the Indiarubber Regulations, the provision is made in order to afford samples, from the examination of which the process is to be classified as a 'lead process' or otherwise.

The test employed is the Thorpe solubility test by which the solubility (expressed in terms of PbO) of the material in 0·25 per cent. hydrochloric acid, is determined: one gram of the material being shaken for one hour with one litre of acid at common temperature and afterwards allowed to stand for one hour before the solubility is determined. The basis for the classification of operations prior to that of incorporation, is the solubility of the dry material, and, as it has been found that the test cannot be applied to mixtures containing rubber, the incorporation processes are classified on the basis of the solubility of the mixed mass as calculated from the solubility of the dry material and the quantity of the same in the mixture. Materials having solubilities not exceeding 5% when determined by such methods, are regarded as innocuous and processes involving their manipulation are not "lead processes": consequently, the provisions of the Regulations do not apply thereto.

The Lead Regulations, although new to the indiarubber industry, have been in operation in other industries for many years, and embody the principles which experience has shown to be of fundamental importance.

It does not appear to be known, except by those who have immediate interest in the subject, that this country was the pioneer in the study and control of industrial lead poisoning and that the progress made is regarded as a unique demonstration of the successful application of the science of industrial hygiene—a science which, to-day, is making rapid strides in spite of its comparative infancy. In Great Britain there were over 1000 cases of industrial lead poisoning in the year 1900. To-day, the annual figure is about 200, and this remarkable improvement has been effected without any serious interference with the progress of industry.

During the last twenty years, lead and its compounds have been more largely used than hitherto, whilst, as has been shown, the incidence of poisoning has fallen sharply. This progress is due to sympathetic co-operation between the officials of the Home Office, the employees, and the manufacturers. In no single case has it been deemed necessary to prohibit the use of compounds of lead, despite the occasional outbursts of certain well-meaning but uninformed and ill-advised amateurs who have clamoured for prohibition as the only panacea, heedless of any consideration of the economic aspects. Nothing is more conducive to lasting progress in industrial hygiene than harmonious co-operation of employers, employees and Government Departments: fortunately, it i in this way that English industrial hygien is proceeding.

It is not here suggested that the limit o improvement in respect to industrial lea poisoning has been reached, for there is clea evidence to show that further reductions ar possible, and there is little doubt that thes reductions will be made in due course. Th whole of the accumulated evidence goes t show that the problem of industrial lea poisoning is essentially one of dust, or to use the words of Dr. Legge* (H.M. Medical Inspector of Factories):—

"On the practical side little more is to be learned as to how lead poisoning is caused, and it can be taken as axiomatic that all risk lies in the inhalation of dust or fume. These removed or prevented, there would be no lead poisoning."

Nothing could be more definite or helpful than such a conclusion and the direction in which efforts must be concentrated is clearly defined—a position which is in striking contrast with that obtaining some few years ago when, at frequent intervals, those handling lead compounds were scared by the publication of alleged discoveries and alarmist theories as to sources of poisoning which proved costly to investigate and were invariably found to exist only in the imagination of their authors.

The lead compounds used in the rubber industry are litharge, and to a smaller extent, white lead, red lead, and basic sulphate of lead. These products are used in the dry form in mixture with other powders and are incorporated in rubber on slowly-revolving, heated "mixing" rolls. The dry powders are distributed by hand over the rubber as it passes through the heated rolls, and the operation is continued until all the material has been added and is thoroughly incorporated.

The cases of lead poisoning arising in this industry occur among those engaged in weighing out dry lead compounds and, to a much greater extent, among workers employed at the incorporating rolls. In both cases the danger is clearly attributable to dust, aggravated in the operation of incorporation by the current of hot air which rises from the rolls, carrying with it a certain quantity of lead dust. As an example, Legge and Goadby† instance an ndiarubber factory for which the records of poisoning are available before and after application of exhaust ventilation over the heated "mixing" rolls. Before the alteration was made, out of fourteen men employed thereon, ten showed a blue line, five were markedly anæmic, one had weakness of the wrist and two weakness of grasp. In a period of ten years after the application of exhaust ventilation, only one case had been reported.

The total quantity of lead compounds used n the indiarubber industry is very considerable, but the distribution of cases of poisoning bears no sensible relation to the weight distribution of the raw materials. In this industry, as in others, it is found that controlled workers may use large quantities of lead compounds without ll-effects, whilst in the hands of careless workers, or when used in unprotected apparatus, small quantities of lead compounds may give rise to a large number of poisoning cases.

There is a growing tendency in the lead industry to centralise the dangerous processes so that they can be operated by a small number of workers producing materials which are much less toxic than their separate constituents. It is obvious that this method is the only scientific and rational solution of the problem, and its application where possible should need no advocacy.

As an instance of what has already been successfully done, mention may be made of low-solubility lead silicate which is now used in large quantities in pottery work. This product, which contains approximately 65 per cent. lead oxide, combined with 35 per cent. silica, has a solubility of less than 5 per cent. when determined by the Thorpe solubility test, and can be used by the potter with comparative safety, being much less soluble than white lead, litharge, red lead or even the lead silicates formerly used. In this case, it has been possible to render the lead comparatively innocuous by chemical means, but there are industries in which this is not desirable and therefore alternative means have had to be found.

In certain industries, it was formerly the practice to purchase dry lead compounds for use in operations where they would be ultimately wetted by water, and, owing to the dust created in the handling of these dry compounds, an unnecessary amount of lead poisoning occurred: this has since been obviated by substituting water pastes for the dry compounds, thus overcoming the risk of poisoning through dust in the production of the lead material and its subsequent use.

The Indiarubber Regulations of 1922 have given an impetus to progress in another direction, and mixtures of pure rubber with various lead compounds have recently been put on to the market. The mixtures, which consist of 80 parts of lead compound incorporated with 20 parts of pure rubber, are sold in the form of thin sheets which are homogeneous in composition, and are used in the incorporating rolls in the place of dry lead compounds. In practice, it has been found that the mixture incorporates with the other ingredients quite satisfactorily on the rolls and a demand for the product has been established. The material is produced in lead factories where there are already in operation the most up-to-date methods of hygienic control under the supervision of those daily concerned with the handling of lead products in large quantities. It is obvious that no lead dust can be created by the indiarubber manufacturer in the handling of this mixture and that it is entirely free of danger. The Factory Department of the Home Office has given the matter serious consideration and has decided that the mixtures are neither "dry compounds of lead" nor "dry mixtures containing dry compounds of lead," and therefore, that any process in which the mixtures are used, is not a " lead process " to which the Indiarubber Regulations, 1922, will apply.

---

* Annual Report, Chief Inspector of Factories, 1918. Cmd. 40, p. 66.

† Legge & Goadby. Lead Poisoning and Lead Absorption. Arnold: London, 1912, p. 201.

By substituting this material for raw lead compounds, the rubber manufacturer will not only be free of control in respect to the use of lead compounds, but will at the same time, have the satisfaction of knowing that his work-people are handling a material which cannot, in any normal circumstances, exert an injurious influence on their health. There would appear to be no reason why the material should not be generally used in the indiarubber trade to the exclusion of raw lead compounds, but in particular, it seems to be eminently suitable for small manufacturers whose use of lead compounds is necessarily limited, and to whom the installation of apparatus and control demanded by the new regulations might be somewhat onerous. The future progress of the material will be watched with great interest because it is a fresh advance in modern industrial hygiene, the aim of which should be, not the destruction of industry, but its maintenance coincident with improvements in the hygienic conditions of employment.

THE THIRD INTERNATIONAL CHEMICAL CONFERENCE

THE Third International Conference of Pure and Applied Chemistry was held in Lyon from June 27 to July 1, Prof. C. Moureu (France) again presiding (*cf.* J., 1921, 267 R). The 100 to 120 representative chemists who attended were delegates from the twenty-four countries composing the Union. The delegates from the Federal Council of Pure and Applied Chemistry, the English section of the Union, were Sir W. J. Pope, Dr. T. H. Hewitt, Prof. T. M. Lowry, Dr. S. Miall and Dr. E. Mond. Canada was represented by Mr. A. T. Charron and the United States by Dr. C. L. Parsons, Prof. E. Barlow, R. B. Moore, and L. W. Washburn.

The Union discussed a large number of questions of interest to the chemical community as a whole and with the aid of its numerous committees came to a number of conclusions which will be submitted to the chemical organisations of the countries which compose the Union. A few of the conclusions thus arrived at are summarised below.

Nomenclature.—The question of introducing such unifications and conventions into the methods of naming and describing chemical substances as will facilitate the production of indexes in the chief languages which will be interchangeable as far as possible was discussed at length. On the motion of Sir W. Pope, it was decided that all questions of chemical nomenclature should be submitted for consideration to the editorial staffs of the chief chemical journals and that the work of the Committee should be restricted to the discussion and criticism of the reports received from the editorial staffs. A Committee consisting of Messrs. Greenaway, Marquis and Patterson was appointed to prepare a complete system of nomenclature that could be used by all the journals devoted to chemical science and technology. It was decided to publish the report of the Committee on biochemical nomenclature.

Bibliographical Contractions.—It was recommended that the abbreviations of the titles of periodicals used by " Chemical Abstracts " should be adopted and that a title not printed in Roman type should not be translated but transcribed in the manner proposed by the periodical itself. In accordance with the wish of the National Research Council of Japan the proposal to abbreviate the word " Japanese " to " Jp " and not " Jap " was accepted. Further resolutions bore on the establishment of central bureaux of bibliographical documentation and the use of the decimal system of the International Institute of Bibliography for classifying papers on chemical subjects.

Physico-Chemical Standards.—The work done by this Committee related chiefly to the provision of a further scientific worker for the staff of the Bureau of Physico-Chemical Standards, hitherto supported entirely by contributions from Belgium.

Research Chemicals.—To avoid delay in obtaining practical results the Committee has restricted its work to accurate descriptions of the qualities required in common analytical reagents; the descriptions are to be published in an international codex. When this task has been accomplished attention will be paid to chemicals used for purposes other than analysis. In addition to a resolution aiming at facilitating the work of the national delegates on the Committee, it was proposed that, in the volumetric estimation of the halogens in seawater, pure sodium chloride should be used as a standard in preference to standard seawater.

Technical and Industrial Products.—This Committee pointed out the utility of lists of manufacturers of chemical products and suggested that the example set by Great Britain in this respect should be followed by the other adherent States. The lists should be kept in Paris at the central bureau, but to avoid excessive centralisation, a delegate in each country should be appointed to receive copies of all the catalogues and documents sent to the Bureau.

Thermochemical Standard.—Benzoic acid was recommended for use in standardising calorimeters, the heat of combustion of 1 g. weighed in air being fixed temporarily at 6324·15 cal., *i.e.*, 6319·15 cals. per g. *in vacuo*. The standard acid, prepared by the Bureau of Standards, Washington, can be obtained from the Institut International d'Etalons Physico-chimiques at Brussels. Authors who publish dat on the heats of combustion are asked to quote th figure they have adopted for the heat of combustio of the benzoic acid used in standardising the calorimeter and, as far as possible, to give their result in absolute units.

The report of the Committee on tables of constants, proposing the establishment of an international fund for its work, was adopted and pr gress was made in discussing the possibility devising an international patent scheme. It anticipated that the Union will be able to issue i various tables of constants of the elements, dealin with isotopes, radioactivity and atomic weight for 1923 at the end of the present year. Repor presented by the Committees on food preservatio fuels, ceramics and industrial hygiene were al approved.

During the past three years the Union has necessarily been occupied largely with settling the details of its organisation and with organising formal matters of international interest, such as the production of tables of constants of the elements. It is felt that the time has now come when the programme of the annual meeting may profitably include the discussion of scientific and technological problems of broad chemical interest, and a beginning was made at Lyon with addresses by Prof. L. Vignon, on the early history of dyestuff manufacture in Lyon, and by Prof Perrin, on the discontinuity of matter. It is proposed that henceforth a series of addresses, devoted to broad chemical problems, not matters of detail, shall be presented for discussion at each annual meeting.

The following officers of the Union were elected for a period of three years:—President: Sir William Pope; Vice-Presidents: Prof. W. D. Bancroft, Ithaca; Prof. E. Billmann, Copenhagen; Prof. E. Paterno, Rome; Prof. E. Votocek, Poland; General Secretary, Jean Gerard, Paris. At the conclusion of the Conference it was decided to hold the Fourth International Chemical Conference in Cambridge, England, from June 17 to 23, 1923.

The Committee at Lyon created an admirable organisation for facilitating the work and promoting the comfort of the delegates; numerous visits to works of a most interesting and instructive character were arranged and the delegates were entertained most hospitably at many social functions. The proceedings terminated with a banquet offered by the Chamber of Commerce of Lyon.

At the close of the Conference, many delegates left by special train for Marseilles to attend the opening of the second congress held by the Société de Chimie Industrielle.

MEETINGS OF OTHER SOCIETIES

BRITISH PHARMACEUTICAL CONFERENCE

The fifty-ninth annual meeting was held in University College, Nottingham, from July 24 to July 27 under the presidency of Prof. H. G. Greenish, who delivered an address upon "Pharmacognosy and the Pharmaceutical Curriculum." Pharmacognosy, he said, was a field of knowledge that the pharmacist was peculiarly fitted to cultivate provided he had received a sound scientific training. The training in pharmacognosy should be of a more general and practical nature than was at present often the case, and should include the determination of diagnostic characters by means of the lens or microscope or by qualitative chemical tests. A detailed syllabus, however, was disadvantageous as it restricted freedom of thought and the development of that spirit of inquiry which was essential to progress. In the advanced course of instruction and in the Major examination, more stress should be laid upon the identification of powdered drugs, the analysis of mixed powders and the assay of drugs by chemical methods. Opportunity for postgraduate work was very necessary and every inducement should be offered to the student to undertake it. The Universities of Manchester and Glasgow had accepted pharmaceutical subjects as part of the examination for the degree of Bachelor of Science, and if the University of London could be induced to do the same a considerable step forward would be made. The student who had attended advanced courses of instruction could take the degree of B.Sc., and then proceed without difficulty to the degree of Doctor of Philosophy, the requirement of the University of London being broadly two further academic years of study and the presentation of a thesis on an approved subject. The field of pharmacognosy was so wide and the problems awaiting solution so diversified in their nature that there would be no difficulty in selecting subjects suited to the varied abilities of the students. Great assistance would be rendered in this work by the establishment of an experimental station similar to the Pharmaceutical Experimental Station of the University of Wisconsin at which the material necessary for investigation could be grown and experiments carried out. The determination of the Pharmaceutical Society to foster its scientific work more in the future was one of the most hopeful signs for the future of pharmacy, and would assist the Society in establishing its position as a learned society.

In a paper entitled "A Contribution to the Study of Strophanthus" Dr. K. Saaman described a variety of strophanthus—*Strophanthus preussii*—from Southern Nigeria, and showed that whereas this drug acts powerfully on the heart, it has a comparatively negligible action on the blood vessels.

Mr. T. E. Wallis contributed a paper on "Some Characteristics of Wheat Starch." Since wheat starch closely resembles barley starch it is difficult to identify either starch in mixtures of the two. The author's experiments indicate that wheat starch can be identified by measuring the diameter of the largest grains, which vary in diameter from 15 to 45 microns, reaching a maximum of about 50 microns, whereas those of barley never exceed 40 microns, so that if the starch contains any number of grains measuring 40 microns and over the presence of wheat starch is established.

Prof. Greenish and Miss C. E. Pearson presented "A Note on the Occurrence of Santonin," in which they reported upon the examination of several species of *Artemisia* suggested as possible sources of santonin. *Artemisia brevifolia* from Gurez was found to contain about 1 per cent. of santonin, but a sample of "estafiate" sent from Mexico consisting of two distinct species of *Artemisia* (*A. mexicana*, Willd, and *A. redolens*, Willd.) and samples of *A. Abrotanum*, *Linn.*, and *A. vulgaris*, Linn. contained none.

A paper on "The Extraction of Quinine and Strychnine from Solutions of Varying Hydrogen Ion Concentration" was read by Mr. N. Evers, who described a method for separating strychnine from quinine based upon the fact that strychnine may be completely removed from a twice normal solution of hydrochloric acid by chloroform, whereas quinine is only removed to a very slight extent. The determination of Easton's syrup requires much less time with this than with other methods.

A detailed study of "The Rapid Estimation of Quinine Salts in Tablets" was presented by Messrs. S. G. Liversedge and F. W. Andrews, Mr. C. W. Gosling described in detail the Michell viscometer, and other contributions included:—"A Further Note on the Ether-Solubility of Scammony Resin," by H. Deane and W. E. Edmonton; "A Note on Acetum Scillae" by J. H. Franklin and G. G. Hammond; "A Note on a Ferrocyanide Coloration of Tincture of Chloroform and Morphine B.P. 1885," and "A Note on Cherry-Laurel Water," both by C. M. Caines.

BRITISH ENGINEERING STANDARDS ASSOCIATION

The fourth annual meeting was held on July 13 in the Institution of Civil Engineers. The Chairman, Sir A. Denny, in presenting the annual report said that nearly 2000 engineers now gave their time and experience to the Association. During the past year 72 new and revised specifications were issued and 39,000 publications sold, in addition to a large number of aircraft specifications distributed for the Air Ministry. Expenses totalled £17,000, of which industry, despite trade depression, contributed £9300, the remainder coming from the Government, the India Office, and the Governments of the Dominions overseas. After reviewing the work of the various sections of the Association Sir A. Denny asked for more financial support from industry so that the Association could carry out work in hand and increase its activities in the future.

CORRESPONDENCE

THE CHEMIST AND THE MANUFACTURER

Sir,—The following random thoughts have been evoked by reading an article in the *Journal of Industrial and Engineering Chemistry* (Eller, June, 1922, p. 544), headed "Can the College do anything for Industry?" and dealing with the ever-green question of training the industrial chemist.

What is the ideal industrial chemist? Ask the professor. Ask the works manager. Widely divergent definitions would be advanced according to the standpoint of the one defining. The definition depends on the view taken as to the needs of industry. The professor's slogan is "Science," and the manufacturer's counter-cry is "Profits." It is left to the ideal industrial chemist to provide a common standing ground.

To the unbiassed, broad-seeing observer one of the wheels of industry's chariot must be chemical knowledge, and such wheels in the form of good, all-round chemists are to be obtained from the professorial wheel-wright. The owner of the chariot, that is the manufacturer, must, however, do his own fitting, and there must be a trial run to rub the bearings smooth. Reduction in running-costs must not be expected immediately.

A cause of disappointment may be that the manufacturer is not clear as to what he wants from his chemist. He appoints a chemist perhaps as he tries a new, much-advertised machine. He finds that the working is not quite so automatic as the advertisements claimed. It should be realised that the young graduate, although full of new knowledge and enthusiasm, inevitably requires some initial leading in the ways of industry. Failing a co-operative and sympathetic attitude from the employer, there is very quickly an over-heated bearing, the chariot moves but slowly and science is condemned wholesale.

Narrowness of view is by no means confined to the employer of chemists. The University professor is, of course, essentially limited in outlook—at least according to the man of the industrial world. Goggled eyes are indispensable in his make-up in the caricatures; and he justifies the world's opinion when his students are let loose on the arid, stony plain of chemical manufacture, with the idea that the few short years of cloistered chemical study, and the possession of the coveted alphabetical handle to the name, are all that is necessary to cause the plain to bloom and blossom wherever they may go. No, it would be a move towards the ideal co-operation of manufacturer and chemist if the latter came from the University with the smallest opinion of his acquisitions, and the realisation that the first step in growing flowers of the industry and science strain is to clear the ground of stones. The stones are the manufacturer's doubt, distrust and lack of sympathy with the aspirations of science. Can these be removed? Doubtless it is generally a long and tiring process, but possibly judged worth while by those fortunate ones who have now arrived at the flower-gathering season.

In conclusion, the moral now appears. Manufacturers, tell your chemist clearly what you want of him, and use him to the full extent of his abilities. Universities, broaden your teaching and outlook, scrap the goggles. It might then be found that the college *was* doing something for industry.—I am, Sir, etc.,

Alan A. Drummond.

Iver, Bucks.
July 25.

PERSONALIA

Dr. M. O. Forster has been appointed director of the Indian Institute of Science, Bangalore, and will take up his new duties early in November.

Mr. J. F. Smith has been appointed director of research to the Commercial Solvents Corporation, United States.

Dr. G. Senter has been selected by the University of London Graduates' Association as candidate for the vacancy in the representation of science graduates on the Senate of the University of London.

Dr. T. M. Legge, of the Home Office, and Dr. S. Miall have been appointed the British representatives on the advisory committee on industrial hygiene of the International Labour Office.

The Trustees of the Beit Scientific Research Fellowships have re-elected Mr. H. L. Riley and Mr. W. A. P. Challenor to fellowships for the year 1922–23 and elected Mr. H. W. Buxton to a fellowship for the same period. The fellowships are tenable at the Imperial College of Science.

The Italian Ministry of Industry has appointed Professors M. G. Levi, Nasini, Parravano, and Scarpa to be members of the permanent Committee for the Italian Chemical Industry (*cf.* J., 1922, 9 R). Prof. G. Varino has been appointed president of the Royal Technical Institute in Mantua.

Dr. P. Riebensahm has accepted the post of professor in charge of the metallurgical institute of the Berlin Technical *Hochschule*; Dr. H. Meerwein has succeeded Prof. H. Klinger in the chair of chemistry in Königsberg University; Prof. Wilke-Dörfurt has accepted the professorship of pure and technical chemistry in the Stuttgart Technical *Hochschule*; and Prof. E. Terres, of Stettin, has been awarded the prize of the German Bunsen-Gesellschaft for his researches in inorganic chemical technology, carried out in the Karlsruhe Technical *Hochschule* and published during 1920–21.

* * *

All will regret the death, at the age of 75, of Dr. A. Graham Bell, the inventor of the telephone.

Dr. Jokichi Takamine, a prominent Japanese chemist, has died at the age of sixty-seven.

The death is announced of Prof. F. Hofmeister, formerly professor of physiological chemistry in Strasbourg University.

The following deaths are announced from Germany:—Prof. H. Rubens, director of the Institute of Physics of Berlin University; Dr. K. Schaefer, professor of chemistry at Leipzig University; and R. Nöllenburg, founder of the Deutschen-Erdöl-A.-G.

NEWS AND NOTES

FRANCE

Industrial Notes

Chemical Industry.—The Deguide process for recovering sugar from beet molasses by means of baryta (*cf.* J., 1922, 244 R) promises to become increasingly important, as it is now proposed to utilise the baryta for defecating the raw beet-juice. In this way it will be possible to recover all the potassium and nitrogen compounds that pass into the extracted juice in the diffusion process. Apart from their monetary value, these salts constitute ideal fertilisers for the sugar beet, and their recovery might lead to an extension of beet-growing in France. The Société des Produits Azotés is now producing a new fertiliser, "phosphazote," which consists of superphosphate of lime and urea, the latter being obtained by hydrolysing cyanamide. Urea contains nearly 45 per cent. of nitrogen, compared with 15·5 per cent. in sodium nitrate, 20 per cent. in ammonium sulphate, and 35 per cent. in ammonium nitrate. According to MM. Matignon and Fréjacques, urea can be produced either continuously or discontinuously by heating ammonium carbamate in an autoclave to 150° C.; when the temperature has fallen to between 60° and 100° C., the resulting carbon dioxide and ammonia are drawn off and utilised again. Treated in this way 100 kg. of carbamate is said to yield 35 kg. of very pure urea that requires no further treatment.

Metallurgy.—The effect of the sudden depreciation of the mark has already been felt in the metallurgical market: French exports have diminished, and although Germany has great needs but cannot buy, she is once again in an ideal position for exportation. The French consumption of iron ore is satisfactory and the exports are directed mainly to Belgium and Luxembourg; Germany is now getting her supplies from Sweden as far as possible. Great attention is being paid by the industrial world to "reparations" and inter-Allied debts. The only hope of a solution seems to lie in the application of the Wiesbaden agreement and of its extension, the Le Trocquer scheme, which proposes payment in kind and the use of German labour and raw material to carry out important public works in France. Of these schemes the chief are the harnessing of the Rhône, the Truyère and the middle Dordogne, the construction of a tunnel between St. Maurice and Wesserling, and of a canal to connect the Sarre, Moselle, Meuse and Meuse-Scheldt. Apparently, the great French metallurgical companies are not hostile to this solution, but wish to find how their own interests would be affected before approving it. Meanwhile the industry has to face the problem of increased costs due to the rise in price of metallurgical coke. At the end of June the price of metallurgical coke was 90 francs per metric ton, but rose to 93 fr. in July and will probably reach 97 fr., whereas selling prices of metallurgical products are falling steadily. If the cost of labour and transport also increase the industry will be forced to sell at a loss and a repetition of the financial crisis of last year will have to be faced. One impediment to a solution is that, in certain regions, labour is not only scarce but expensive, and, in addition, a reduction in railway rates is badly needed. The question of an agreement between the chief metallurgical firms in Allied countries is still in suspense, the chief obstacle to a decision being the attitude of the Belgian producers. In the meantime the Union Financière and the Union Métallurgique have decided to co-operate in exporting metallurgical products and action will probably be taken when business is resumed after the holidays.

AUSTRALIA

Copper Mining in Papua

Negotiations between the Commonwealth Government and the New Guinea Copper Mines, Ltd., are stated to be practically complete for the purchase by the former of the company's jetty and the railway connecting the Dubuna mine with the coast. The company, which will undertake to raise £100,000 for developing this mine, will connect the Laloki mine with the coast by an aerial ropeway and instal smelters at Bootless Inlet. As the ore contains 40 per cent. of iron and 40 per cent. of sulphur, it may eventually be shipped to Australia for use as a flux for siliceous ores. When the copper smelters on the mainland can take delivery, about 3000 tons of ore per month will be shipped.—(*Ind. Austral.*, *May* 4, 1922.)

The New Guinea Copper Mines, Ltd., was formed to take over the property of the Laloki (Papua) Copper Mines Co., situated near Sapphire Creek, not far from Port Moresby. The ore developed down to the 200-ft. level in the Laloki and Dubuna mines is estimated at 300,000 t., averaging 4·8 to 5 per cent. copper, 42 per cent. sulphur, and 2½ dwt. gold and 10 dwt. silver per ton. At 100 ft. below the 200-ft. level the ore averages 7 per cent. copper and there is evidence of the existence of other valuable ore-bodies. A smelting-plant with a capacity of 300 t. of blister copper per month is being erected and as the ore is pyritic contracts have been made to sell it to manufacturers of sulphuric acid.—(*Mining Mag.*, *July*, 1922.)

CANADA

The Asbestos Industry

The recent agitation for the provincial Government of Quebec to impose an embargo upon the export of raw asbestos has apparently died a natural death. The United States is the largest consumer of raw asbestos, which enters that country duty free, but there is a prohibitive tariff on manufactured asbestos products. The falling off in the demand for asbestos is reflected by the restricted mining operations in the Eastern Townships of Quebec. The prices of fibre have dropped from 25 to 60 per cent., and the competition from South Africa has cut into the sale of Canadian fibre in Europe. The South African mines have a much lower wage-scale. Russian fibre is also appearing on the market. Under present and prospective trade conditions some of the lower-grade mines may have to close, and the industry as a whole will have to be prepared to meet the competitive conditions of ten years ago. This should not offer great difficulty as both mining and milling methods have been improved since that period and, with competent management, Canada should retain the firm grip which it has had upon the asbestos trade.

The Alcohol Industry

Notwithstanding restrictive legislation the distilleries of Canada apparently are not idle. According to the report of the Dominion Bureau of Statistics for 1920, there were four distilleries in operation during that year, viz., two in Ontario and one each in Quebec and British Columbia. Invested capital amounted to $11,773,046, salaries $84,345, wages $292,363, fuel costs $144,304, materials cost $1,210,633, and the value of products was $2,815,359. Exports of distilled liquor in 1919 were valued at $3,809,298, consisting of 1,455,707 galls., whilst in 1920 exports were 1,332,365 galls., valued at $3,042,307. Imports of distilled liquor in 1919 amounted to $426,201 and $2,815,359 in 1920. In the latter year 2,223,428 galls. of non-potable alcohol, valued at $1,595,584, was imported, compared with 651,396 galls., valued at $227,988, in 1919. The production of distilled liquors in 1920 showed an increased value of $2,389,158 over the preceding year. Both potable and non-potable alcohol show a greater output in 1920; potable spirits increased in quantity from 95,226 to 1,084,213 proof galls., whilst non-potable alcohol manufactured in 1920 amounted to 2,223,438, as against 651,396 proof galls. in 1919.

Miscellanea

The Duffee Soap Co. is to erect a factory at Streetville, Ont., for the manufacture of soaps, and the B. and I. Laboratories Co. a plant for the manufacture of washing powders in Hull, Que.

The National Silk Dyeing Co., of Paterson, N.J., has purchased 13 acres of land at Drummondville, Que., for the erection of its Canadian plant.

The Quebec Legislature has passed a Bill empowering the interests which control the supply of electric power to Montreal to develop the great water-power at Carillon Rapids upon the Ottawa River, between Ottawa and Montreal. The associated companies (Montreal Railway, Heat, Light and Power Co. and Quebec Railway, Light, Heat and Power Co.) now control immense hydro-electric properties in the province and developments are awaited with much interest.

UNITED STATES

Zinc Production in 1921

The output of zinc in the United States in 1921 was 218,073 tons, valued at $21,807,000, compared with 484,748 t., valued at $78,529,000, in the previous year; consumption fell from 323,043 t. to 203,600 t., and the number of retorts in operation at the end of the year was 42,400, a decrease of 13,600. The output of rolled zinc diminished by nearly one-half. Imports, which have been negligible since 1915, increased very considerably.—(*Schweiz. Chem.-Z., May* 30, 1922.)

The Dye Embargo

During the discussion in committee on the tariff Bill, the Senate rejected the clause extending the embargo on dyestuffs for one year after the Bill becomes law. This rejection is believed by representatives of the dye and chemical industries to be due to the Government's action in demanding the return of the German patents sold by the Alien Property Custodian to the Chemical Foundation (*cf.* J., 1922, 311 R). An attempt will be made, however, to reverse the decision when the Bill comes before the Senate proper after the committee stage is passed.—(*Oil, Paint and Drug Rep., July* 24, 1922.)

BRITISH INDIA

Glue Manufacture in Madras

The manufacture of glue on a commercial scale has been started at the experimental glue factory in Madras, and the output is about 2 cwt. per day of excellent glue, priced at 55 rupees per cwt. at the factory. Glue of special quality can be manufactured to meet specific requirements.

Preparation of Odourless Spirit

Ordinary rectified spirit possesses, besides the smell of alcohol, an odour characteristic of the raw material used in its manufacture. As spirit possessing this extraneous odour is objectionable for use in preparing perfumery, Prof. A. C. Sircar and S. C. Deb have worked out three methods for deodorising rectified spirit obtained from *mahua* flowers or molasses. The methods used were, briefly, as follows:—(1) Four c.c. of a solution of 12 g. of potassium permanganate in 100 c.c. of water was added to 1 litre of the spirit and the mixture kept for two days. The alcohol was decanted from the black precipitate that had formed, kept over quicklime overnight, and then distilled. Recovery of alcohol was about 85 to 90 per cent. by volume, and the sample had a sp. gr. of 0·788 at 33° C.; a sample of odourless ("silent") spirit had a sp. gr. of 0·794. (2) One litre of alcohol to which 10 g. of caustic potash had been added was kept overnight, boiled under a reflux condenser for 1 hr. next day, then distilled, kept overnight over quicklime, and finally re-distilled. The recovery was about 88 per cent. by volume. (3) A 250 c.c. sample was filtered 8 times through 4 g. of porous charcoal made from flax stems, and then through 4 g. of purified animal charcoal. The specific gravity of the product was 0·82. Samples were examined by the Industrial Chemist to the United Provinces and found to satisfy the requirements of a "silent" spirit and to compare favourably with foreign samples.—(*J. Ind. Indust., May*, 1922.)

GENERAL

The Rubber Research Association

The new laboratories of the Research Association of British Rubber and Tyre Manufacturers at Croydon were opened on July 26 by Lord Colwyn in the presence of a representative gathering. Lord Colwyn, in declaring the laboratories open, observed that the ability of the industry to compete in the world's markets depended largely upon research, and Mr. A. Johnston, of the North British Rubber Co., who presided, said that although the value of the world's output of rubber goods was £350,000,000, the industry might still be regarded as in its infancy; he was confident that both the producing and manufacturing branches of the industry would soon regain their former prosperity. The new laboratories, which are under the charge of Mr. B. D. Porritt, contain, in addition to administrative offices and a library, laboratories for physical, chemical and special work, a miniature factory equipped with machinery for preparing and vulcanising rubber, a mechanical testing-room, a workshop, etc. The site is conveniently situated and there is ample space for future extensions.

Consumption of Rubber

The excess of imports over exports of rubber in the chief consuming countries was as follows in 1913, 1920 and 1921:—

	1913	1920	1921
		Metric tons	
United States ..	53,092	264,962	191,700
England	27,315	61,398	45,514
Germany	16,525	12,095	20,756
France	5,751	16,031	15,064
Japan	1,265	5,858	22,500
Canada	2,116	12,035	9,000
Italy	2,546	6,222	5,000
Belgium	3,588	3,500	3,000
Sweden	1,039	1,592	826
Norway	338	245	193
Denmark	130	508	258

As is well known, the United States is the greatest user of raw rubber, and of the goods manufactured therewith about 70 per cent. consists of tyres, 14 per cent. of footwear, 10 per cent. of technical products and 6 per cent. of miscellaneous goods. The demand from Russia, which was about 11,600 t. in 1913, fell to only 500 t. in 1920. Imports of raw rubber into Germany during the 10 months ended February, 1922, exceeded the total imports in 1913.

Standard Dimensions of Iron Pipe Fittings

The British Engineering Standards Association has issued two new reports, No. 143, and No. 154, which set out the British standard dimensions for malleable and soft cast-iron pipe fittings of nominal sizes from ⅛ in. to 4 in. and suitable for steam, water and gas. Both of the reports contain details of special sizes of reducing fittings, definitions of screw threads, methods of specifying outlets, and tables of dimensions of standard equal and reducing fittings as well as special tables for ascertaining the centre-to-face dimensions of reducing fittings. Type drawings of the fittings are given, in addition to a diagram illustrating the method of setting out curves for reducing fittings. Report No. 143 is limited to fittings (bends, elbows, tees and crosses) designed for use where the maximum "delivery head" is needed and where the frictional resistance has to be considered, whereas No. 154 is devoted to all fittings in general use. The reports, priced at 1s. each, may be obtained from the offices of the Association, 28, Victoria Street, London, S.W. 1.

Silver and Tin in 1921

The following statistics of production, imports and exports have been compiled by the Imperial Mineral Resources Bureau:—

SILVER

			Fine oz.
United Kingdom	Imports	Silver bullion, unrefined	5,787,244
		Silver bullion, refined	40,245,164
		Silver coin, of legal tender in U.K. (Face, or currency value) ..	(£1,525,520)
		Silver coin, not cf legal tender in U.K. (Value of commodity) ..	(£1,303,454)
Northern Rhodesia	Production		8,866·71
Southern Rhodesia	Production		152,988·80
Union of S. Africa	Production	Silver in gold bullion ..	821,037·48
		Silver in other minerals	9,291·616
Canada ..	Production	Silver	13,134,926
	Exports	Silver in ore, concentrates, etc.	1,537,980
		Bullion	7,258,954
India ..	Imports		55,919,954
Australia ..	Production	In lead and zinc concentrates, in other ores and concentrates treated in Australia or exported and in gold bullion treated at Australian mints	8,326,006
		Refined silver produced in Australia, and metal in unrefined products, ore and concentrates exported	5,304,950
	Exports	Bar, ingot and sheet ..	2,711,729
		Silver contained in matte	58,860
		Silver contained in ores and concentrates ..	667,261
France ..	Imports	Beaten, drawn, rolled and thread	89,184
		Crude, in ingots ..	3,994,187·40
		Coin	368,889·10
	Exports	Beaten, drawn, rolled and thread	1,303,489·60
		Crude, in ingots ..	6,876,756·40
		Coin	1,626,693·55
Italy ..	Production	Ore	(0 long tons)
		Silver	199,330
Mexico ..	Production		64,465,347·45
United States	Production		50,364,389

TIN

			Long tons.
United Kingdom	Production	Cornwall only	700
	Imports		20,967
	Exports		9,900
Nigeria ..	Production	Ore	12,423
Southern Rhodesia	Production		4
Union of S. Africa	Production		1,408
		Metallic content ..	920
	Imports		124
	Exports		1,678
S.W. Africa Prot'c'te	Production	Ore	156
Swaziland	Production	Cassiterite	383
Federated Malay Sts.	Exports	Tin and tin contained in ore	34,489
India ..	Imports		2,656
	Exports	Ore	81
Australia ..	Production		2,650
		Refined tin produced in Australia, and metal in ore and concentrates exported	2,990
	Exports	Refined tin	1,704
		Tin in ore and concentrates exported ..	5
Belgium ..	Imports		1,731
France ..	Imports	Ore	358
		Metal	6,998
	Exports	Ore	27
		Metal	506
Germany ..	Imports	Ore	2,273
Norway ..	Imports	Crude metal	130
United States	Imports	Ore and oxide	13,696
		Bars, blocks, pig or granulated	24,197
	Exports	Pigs, bars, etc. ..	1,031
Bolivia ..	West Coast shipments	Ore	17,414
China ..	Production		8,500
Banka ..	Production		12,125
Billiton and Singkep	Production		7,000

Beet-Sugar Production in Europe

According to the Sugar Statistics Bureau Licht, of Magdeburg, the European production of beet sugar in the seasons 1920–21 and 1921–22 was as follows:—

	1920-21	1921-22
	Metric tons	
Germany	1,109,119	1,320,000
Czechoslovakia	713,165	650,000
France	336,960	300,000
Holland	317,196	335,000
Belgium	242,589	300,000
Austria	14,000	16,000
Hungary	33,000	52,000
Denmark	137,000	145,000
Sweden	182,458	253,000
Italy	138,000	230,000
Spain	238,000	118,000
Poland	171,000	205,000
Other countries	160,000	180,000
Total	3,792,487	4,104,000

The German beet-sugar industry is rapidly recovering, and it is anticipated that production for next season will increase by 500,000 metric tons. Beet cultivation in Holland and Belgium is increasing, Italy has changed from an importing to an exporting country, but the output of Czechoslovakia has fallen off and Poland can do little more than supply its own needs. As a result of the war France possessed only 80 beet-sugar factories at the beginning of the 1920–21 season, compared with 206 in 1913, and imports have risen from 115,057 t. in 1913 to 626,337 t. in 1920, the home consumption of refined sugar in a normal year exceeding 700,000 t. Many of the factories now under restoration are being equipped with modern plant; so that costs of production will eventually be lowered and the French sugar market strengthened. Apparently nothing has been done to restore the Russian beet-sugar industry; but the factories are believed to be intact.—(*U.S. Com. Rep., Apr.* 10, 1922.)

REPORTS

Annual Report of the Chief Inspector of Factories and Workshops, 1921. *Pp.* 131. *London: H.M. Stationery Office*, 1922. *Cmd.* 1705. *Price* 3*s. net.*

As the industrial situation throughout the past year has not encouraged trade developments, those developments which did take place are of particular interest. They include the introduction of a new type of gas-producing plant which yields an output equal to that of four ordinary producers but with reduced expenditure upon coal and labour, the erection of new steel rolling-mill plant and electric furnaces in Sheffield, and the production of a stainless steel which is ductile and can be worked cold into articles of intricate shape. The introduction of an untarnishable metal resembling electro-plate and described as synthetic silver-nickel is also mentioned. Grinding operations in the cutlery trade have also been greatly improved and new factories have been erected for the manufacture of plate-glass, matches, formic acid, hydrogen peroxide, lanoline from wool grease, and cement, and for refining edible oils. The only trades which have been fully occupied are those connected with the manufacture of food, confectionery, hosiery and high-class cloth. Of late, however, manufacturers have reported that, with orders for both home and foreign markets coming in, the outlook is brighter. Further progress has been made in the standardisation of safety precautions in certain industries. The Inspectors in the Engineering Branch have conducted special inquiries in connexion with the draft codes of regulations for chemical works, the manufacture of aerated waters, india rubber, and electric accumulators, and the handling of hides and skins. Other inquiries have related to the dangers incident to repairs to oil-tank steamers, the competency of certain persons to examine steam boilers, and explosions due to dust, metallic powders, and volatile substances. Revised pamphlets describing the dangers from carbon-monoxide poisoning and from the use of acetylene have been issued. Amongst new Orders and Regulations made during the year are those relating to the manufacture of lead compounds, aerated waters, and celluloid. The Departmental Committee on the Prevention of Anthrax has reported that the process devised for disinfecting wool is also suitable for disinfecting horsehair. Another committee is re-examining the question of the danger of the use of lead paints.

The number of registered factories during 1921 was 142,749, an increase of 2685 over the previous year; the number of workshops was 156,123, 4944 fewer than in 1920. The number of reported accidents was 92,565, of which 951 were fatal. The remarkable decrease in the number of accidents reported is almost entirely due to inactivity in industry. The statistics reveal a striking proportion of accidents due to "falling bodies" and to "persons falling." Detailed descriptions are given of a number of accidents arising from mechanical appliances and additional precautions suggested. Two dust explosions resulted in accidents during the year, one of metallic aluminium powder in a rotary sieving machine and the other of dust in the hopper under the rolls of a malt mill. Both were probably caused by sparks from foreign bodies admitted to the mechanism. A fatal accident resulted from the explosion of a mixture of copper oxide and a powdered aluminium alloy containing copper and zinc. The ignition was started by sparks falling from a crucible, and the violence of the explosion may have been due to the presence of ammonium nitrate as an impurity in the powder or to overheating in a preparatory drying process. In the chapters on Dangerous Trades, Health and Sanitation, and Welfare, reference is repeatedly made to the importance of cleanliness and of efficient ventilation.

During the year there were 230 cases of lead poisoning, 1 of arsenic poisoning, 1 of toxic jaundice caused by arseniuretted hydrogen, 32 of epitheliomatous ulceration, 29 of chrome ulceration, and 25 of anthrax. No cases of phosphorus or mercury poisoning were reported. In connexion with lead poisoning attention is directed to the risks run in cutting up painted steel plates by means of the oxy-acetylene flame on account of the volatilisation of lead. Men employed in cutting up galvanised plates were found to be suffering from "brassfounder's ague" due to the presence of zinc oxide in the fume evolved. There were 77 cases of carbon-monoxide poisoning; in the treatment of these cases there is still difficulty in making rescuers understand the importance of rest. The results are recorded of medical investigations of illness caused by naphtha fumes, aniline, and paranitraniline. Three of the cases of epitheliomatous ulceration among tar workers occurred in stokers exposed to fumes on the top of gas-producer plants to which coal was being charged.

The report includes separate chapters of general interest devoted to the Generation and Use of Electricity, Employment, Truck, Underground Workrooms, and Conditions in the Glass Industry.

Report on the Commercial and Financial Situation in Bulgaria, Dated January, 1922. *By* F. J. R. Rodd, *Late H.M. Commercial Secretary, Sofia. Department of Overseas Trade. Pp.* 13. *London: H.M. Stationery Office,* 1922. *Price* 6*d.*

It is anticipated that when statistics of the trade of Bulgaria during 1921 become available they will show an adverse trade balance, as they have done since 1908, except in the war years 1915, 1916, and 1917. The Bulgarian Government has been unable to negotiate either a foreign or an internal loan since the armistice, and the financial position is accordingly poor. Conditions have been unfavourable to importers of foreign goods, especially from countries with an appreciated currency. Thus Czech, German and Italian firms have secured much business and the contract for supplying copper sulphate to the Agricultural Bank, which had always been given to a British firm, has gone to Italy. There is little hope of improving the Bulgarian market for British goods, but a certain volume of trade, especially through Government contracts, will continue. Exports were fairly satisfactory, and would have been better but for the restrictions on exports of grain and timber. The rose-oil crop was good, and although the tobacco crop was 40 per cent. below the 1920 harvest, export was satisfactory. No important industrial developments have taken place, and the mineral resources remain entirely undeveloped, the only output of importance coming from the State coal mines, which produced 732,671 tons in 1920 and 397,496 t. during the first half of 1921. The few Bulgarian industries have not done well, largely owing to excessive taxation and to Government intervention.

Report on the Commercial and Industrial Situation of Hungary, Dated March, 1922. *By* R. J. E. Humphreys, *H.M. Commercial Secretary, Budapest. Department of Overseas Trade. Pp.* 38. *London: H.M. Stationery Office,* 1922. *Price* 1*s.*

Although Hungary is handicapped by heavy debts, an adverse trade balance and a greatly depreciated and unstable currency, it has passed through the critical period of 1921 remarkably well and much improvement is observable in comparison with 1920. Owing to the drought, the fodder, beet and potato crops were poor, but the cereal crops were above the average and high export prices were realised. Of the industries based on agriculture, the milling industry, able to grind 750,000 tons of cereals annually, worked well below capacity, and although the 16 beet-sugar factories can produce 245,000 t. of sugar per annum, the poor harvest made it necessary to import sugar from Czechoslovakia. Alcohol is now being exported, the production exceeding the demand. Coal-mining, which follows agriculture in order of importance, made progress in 1921 and only 650,000 t. out of the 6,756,622 t. consumed had to be imported; with one exception (Pecs), the Hungarian mines produce only brown coal, so that some importation is essential. Mining other than coal-mining does not exist in Hungary, and all the iron ore required in the large iron and steel industry is imported; this industry is now stagnant and development is unlikely until iron ore can be imported freely (*cf.* J., 1921, 279 R). A revival in the leather industry is expected and several new factories are being built.

Imports during 1921 amounted to 2,330,000 metric tons, an increase of 300 per cent. over the previous year, and included over 72 per cent. of manufactured articles, the chief of which were valued as follows (million korona):—Mineral oil, refined, 664·7; pharmaceutical articles, perfumes, 97·4; candles, soap, 44·8; fuel 180·4; chemicals 383·3; glassware 511·5; stoneware 202·3. The value of the korona, 10d. at par, fluctuated between 0·28d. and 0·8d. in 1921. The imports came, as in pre-war times, mainly from Austria, Czechoslovakia and Germany, and only to a small extent (about £300,000 worth) from Great Britain, although British goods are included in the imports from Austria. All kinds of manufactures—textiles, leather, iron and steel, glassware—are required by Hungary, but trade cannot be re-established so long as the Succession States adhere to their policy of restrictions and until transport is greatly improved. Exports, amounting to 840,000 t., or 60 per cent. more than in 1920, consisted almost entirely of agricultural products.

Report on Economic Conditions in Rumania, Revised to April, 1922. *By* A. Adams, *H.M. Commercial Secretary, Bucarest. Department of Overseas Trade. Pp.* 62. *London: H.M. Stationery Office,* 1922. *Price* 2*s.*

The industrial situation of Rumania has changed very little since the last report was issued (*cf.* J., 1921, 412 R), but a new customs tariff has been introduced which aims at protecting local industries. Cereal crops suffered from drought during 1921 and the yields of wheat and maize were low; probably wheat growing will diminish because the land has been subdivided among peasant owners. Apart from agriculture, petroleum production is the chief industry, the output in 1921 amounting to 1,163,780 tons from 690 wells, as compared with 1,034,123 t. in 1920 and 1,885,225 t. in 1913. About 70 per cent. of the output is sold locally at very low prices and as the depreciated exchange neutralises the benefit of high export prices, the development of the industry is handicapped by lack of capital. Production is not likely to increase owing to deficiencies in transport by both pipe-line and rail and to heavy export duties. A detailed account of the petroleum industry is given in an appendix.

Coal is mined chiefly in the Lower Carpathians and the output, now about 150,000 t. per month, is not large. About 350,000 t. of industrial coal and coke was imported before the war, principally from the United Kingdom, but importation has now practically ceased and the consumption of fuel oil is increasing as a consequence. In view of the application of protective duties, it is suggested that British manufacturers should start producing in the country. There are nearly 18 million inhabitants and the purchasing power of the population already shows signs of increasing. Detailed statistics of

Rumanian trade during 1921 are not available, but it is probable that there was a large adverse trade balance. During the year United Kingdom exports of manufactures to Rumania were valued at £5,432,855 and imports from Rumania at £3,359,386. The export trade of Rumania is hampered by transport deficiencies and the import trade by wide fluctuations in the value of the currency.

PARLIAMENTARY NEWS

House of Commons

Trusts and Combines

Sir W. Mitchell-Thomson, replying to Mr. Waterson, said that the subject of trusts and combines was still under consideration, but no undertaking to introduce legislation could be given.—(July 20.)

Cocaine

In a written answer Mr. Shortt informed Dr. McDonald that licensed importers of cocaine had to keep records of their sales for inspection. The records did not show how the drug was distributed, as it might pass through several hands before being used.—(July 24.)

Poison Gas

The Prime Minister informed Mr. L. Malone that the United States War Department had discontinued the manufacture of poison gas for equipping the U.S. Army for gas warfare, but Congress had sanctioned the continuation of research and experimental work on poison gas. The proposed expenditure on preparing gas-warfare in this country in 1922-23 was £169,700, which covered research on protective measures against gas attack. Except small quantities for the research work, no poison gas had been manufactured in this country since the Armistice.—(July 24.)

Replying to Mr. Foot, Sir R. Sanders said that eight full-time and four part-time employees were engaged in the preparation of, or research on, poison gas, at an estimated total cost of £8000, not including the staff and expenditure for research on protection against gas attack.—(Aug. 4.)

Duty on Nigerian Palm Kernels

Answering Dr. Murray, Mr. Churchill said that the average price of palm kernels in Lagos was about £11 per ton in May and the export duty £2 per ton, *i.e.*, about 18 per cent. of the average price at that time.—(July 25.)

British Dyestuffs Corporation

In answer to Rear-Admiral Adair, Sir W. Mitchell-Thomson said that he had seen an article on the dyestuff situation by Prof. H. E. Armstrong, suggesting that the Government should either withdraw its control of the Corporation or insist that the business should be managed by persons with technical qualifications. The Corporation was not controlled by the Government, whose interest in it was limited to a large holding of shares; he did not think it expedient to withdraw that interest. The proceedings at the last annual meeting showed that the directors were supported by the majority of the shareholders, and particularly those representing the important consuming interests.—(July 26.)

Coal Exports to the United States

Replying to Mr. W. Thorne, Mr. Bridgeman said that orders from the United States had caused an increase in the price of certain grades of coal and an appreciation of certain colliery shares, but he was not aware of any contract placed in South Wales by the American Shipping Board; neither did the orders from the United States amount to nearly as much as 500,000 tons.—(July 27.)

Benzol Production in the United Kingdom

Sir P. Lloyd-Greame observed, in answer to Mr. Kiley, that the quantity of benzol produced by members of the National Benzol Association during 1921 was estimated at 9 million gallons, whereas non-members produced about one-quarter of that amount. Owing to the coal stoppage production was greatly reduced during 1921, and the present normal output was about double that attained in that year.—(July 28.)

Prices of Lime Green

Answering Lieut.-Com. Kenworthy, Sir P. Lloyd-Greame said the National Federation of Paint, Varnish and Colour Manufacturers had informed him that whereas the German prices of the cheaper grades of lime green were about one-half those of equal grades of British make, the difference decreased as the quality improved, British and German prices approximating closely for the highest grade. As the Federation had informed the Dyestuffs Advisory Licensing Committee that the difference in price did not materially affect the cost of finished goods containing lime green, he did not propose to ask the Committee to reconsider its decision not to grant import licences for this colour.—(July 31.)

Dyestuffs Industry

Sir P. Lloyd-Greame stated, in reply to Mr. Galbraith, that proposals for assisting the dye-making industry as a whole by further co-operation of the dye-users and the State were being considered by the Board of Trade and the Chancellor of the Exchequer.—(July 31.)

Distinctive Colours for Poisons

In answer to Sir F. Flannery, Mr. Shortt said that the practicability of employing distinctive colours for poisons such as arsenic and strychnine was being inquired into.—(July 31.)

Australian Zinc Concentrates

Replying to Mr. D. Davies, Sir W. Mitchell-Thomson said the moment was inopportune for raising the question of determining the contracts for future deliveries of Australian zinc concentrates. The estimated loss per ton on concentrates delivered in this country during the six months ended June 30 was £3 14s. 8d.—(July 31, Aug. 4.)

Stocks of Lead and Spelter

Mr. Bridgeman informed Mr. D. Davis that stocks of pig lead in the metal-exchange warehouses amounted to 268 tons and of spelter to 4662 t. on June 30, including Government stocks of spelter; stocks were also held by private firms.—(July 31.)

Morphia

Answering Viscountess Astor Sir J. Baird stated that, in 1920, 643,985 oz. of morphine was manufactured in England and 322,464 oz. of morphine and heroin exported (excluding amounts exported by post or in preparations).—(Aug. 2.)

Imports of Cement

In a written answer to Lieut.-Col. J. Ward, Sir P. Lloyd-Greame gave the imports of cement in 1920, 1921 and the first half of 1922 as 38,438 tons, 105,711 t., and 60,264 t., respectively.—(Aug. 3.)

Milk and Dairies (Amendment) Bill

The object of this Bill is to postpone until 1925 the operation of the Milk and Dairies Act, passed in 1915 and due to come in force on September 1, 1922, and to ensure the sale of clean milk. Thus Clause 4 prohibits the addition of water, colouring matter, or any dried or condensed milk or any fluid econstituted therefrom, to milk, including skimmed nd separated milk, intended for sale. Clause 5 prohibits the sale of milk from a cow suffering with a tuberculous udder and Clause 8 enables the Minister of Health to make Regulations for preventing danger to health from imported milk. In moving the second reading, Sir A. Mond said that he was considering methods of grading milk; the question of the standard of condensed milk was one of food value, but a standard such as a bacterio-ogical count might be laid down.

Smoke Abatement Bill

This Bill proposes to amend the law relating to smoke nuisances by providing increased penalties for the emission of smoke, even if not black smoke, and of soot, ash, grit, and gritty particles from chimneys, not including those of private dwelling-houses. In proceedings for smoke nuisance, proof that the best practicable means was used for preventing the nuisance constitutes a defence. Power is given to the Minister of Health to extend, after consultation with the local authorities or other interests, the list of noxious or offensive gases and of works mentioned in the Alkali, etc. Works Regulation Act, 1906. Local authorities are empowered to require new buildings other than private dwelling-houses to be provided with heating arrangements calculated to prevent or reduce the emission of smoke. Two or more local authorities may combine to carry out their duties in respect of smoke nuisances and if a local authority fails to carry out these duties, the Minister may order the county council to carry them out.

Safeguarding of Industries Act

Order No. 1 *under Part II.*—In presenting the draft Order proposed to be made under Part II of the Act (*cf.* this issue, p. 339 R) Mr. Baldwin said that he had declined to make the Order apply to glassware from Czechoslovakia, as that country was making such efforts to stabilise its currency that any bounty it now derived from depreciation of the currency would soon cease. Amendments proposing to exclude glassware and hollow-ware from the Order on the ground that although German currency had depreciated, imports from that country had declined instead of increasing, were defeated. The Order was approved by 152 votes to 47.—(July 31.)

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Orders under Part II.—Action will be taken as rapidly as possible on any reports that may be received from Committees, but any Orders so made require confirmation.—(July 24.)

Glassware.—Evidence was given in public before the Committee on glassware that unemployment was being caused by importations of glassware, but it cannot be published for reasons of economy. The Board of Trade has no information suggesting that the imposition of a duty (under Part II) on German glassware would transfer the trade from Germany to Czechoslovakia. Glass jugs and tumblers are neither scientific glassware nor lamp-blown ware, and accordingly are not dutiable. Blanks for measure glasses are not held as dutiable, although glass articles such as pipettes and burettes, even when ungraduated, are still dutiable as scientific glassware or lamp-blown ware.—(July 24.)

Complaints.—Five complaints alleging dumping in the sense of Section 2 (1) (*a*) have been received since Part II came into force in August, 1921. Of these complaints, two have been referred to Committees, one was rejected, and two were referred back for further information.—(July 24.)

New Industries.—Since the Act came into operation the range of production of the branches of the chemical industry covered by the last heading of the Schedule has greatly developed and distinct progress is being made in respect of scientific glassware and optical and scientific instruments. There is no doubt that the Act has encouraged some manufacturers to keep in operation works that would otherwise have been closed down.—(July 24.)

"R" Commodities.—The Referee's judgment in the sodium hyposulphite case did not suggest that the exact scope and meaning of "R" should be defined in general, but that a more definite meaning was required in this particular case.—(July 24.)

Scheduled Articles.—One item has been added and seven removed from the list by direction of the Referee, and in consequence of the Referee's awards, 24 items have, on the responsibility of the Board of Trade, been deleted and the standard of the dutiable grade of 10 other scheduled chemicals has been raised. In nine complaints the Board's action was upheld by the Referee.—(July 24.)

Vulcanised Fibre.—No representations have been received from manufacturers of electrical apparatus that they depend on America for supplies of special qualities of vulcanised fibre.—(July 24.)

Gas Mantles.—The duty collected on dutiable ingredients of incandescent gas mantles up to July 1 amounts to £232. The Referee's award was not signed until May 17.—(July 25.)

Purity of Scheduled Chemicals.—Purity is not the only criterion used in deciding whether a chemical comes within the scope of Part I of the Act or not, as was shown by the Referee in deciding the sodium-hyposulphite case.—(July 31.)

Analytical Reagents.—Heavy chemicals are dutiable only when prepared in a state of special purity for use as analytical reagents.—(July 31.)

Sodium Pyrophosphate.—The Board of Trade is unaware that the Referee's decision respecting sodium pyrophosphate has injured the export trade of any company or has curtailed output and caused unemployment.—(July 31.)

Upon the adjournment of the House until November 14, the Royal Assent was reported to the Electricity (Supply) Act, 1922, and to the Milk and Dairies (Amendment) Act, 1922.

COMPANY NEWS

Mond Nickel Co.—The eighth annual meeting was held in London on July 26, and Mr. R. Mond, who presided, said that the consumption of nickel for peace purposes had not yet attained the pre-war level. The outlook was not reassuring, but as trade revived prospects would improve, especially as new uses of the metal or its alloys were constantly being discovered and no efforts were spared in investigating new outlets. The nickel coinage adopted in Canada and Italy had proved so satisfactory that its use had been extended and it had also been adopted in other countries. With a view to extending the use of nickel the company had participated in the formation of the American Nickel Corporation, of Clearfield, Pa., which supplied malleable nickel to manufacturers of nickel goods and had been appointed the company's representative for the sale of raw nickel in the United States. Sales of copper sulphate had been almost normal in quantity, but the price had been kept low; and sales of precious metals had also been well maintained. Costs of production, though lower, were still too high, but no effort would be spared to maintain the company's strong position in the nickel industry.

The taxation problems of the company have not been finally settled, but figures are now available to show the financial position for the two years ended April 30, 1922. The profits for 1921 and 1922 were £222,630 and £299,041, respectively, and £610,383 (including £114,794 brought forward from 1920) remains for distribution; £220,000 was allocated for dividends paid for 1921 and an interim dividend of £110,000 on the preference and ordinary capital has been paid. A further sum of £87,500 is to be paid in dividends on the preference capital to make up the dividend to 7 per cent. for the year and £45,000 (1s. per share) on the ordinary capital, making a total for 1922 of £242,500; £110,000 has been provided for income-tax and £37,883 carried forward.

Anglo-Continental Guano Works, Ltd.—At the fifth ordinary general meeting, held on July 26, Mr. J. S. Holmes, who presided, said that the demand for fertilisers in the spring of 1921 was good both in the United Kingdom and in Europe, but the summer drought reduced the consumption, and Belgian and French makers of superphosphate, aided by the depreciated value of the franc, attempted to find a market in this country. Consequently, prices fell steadily, buyers were waiting until prices ceased to fall, and trade in the autumn was very poor, so that the total output of all the company's factories decreased greatly. Despite foreign competition, the demand was much better in 1922 and all the old stocks were cleared. Prices had been adjusted more closely to the foreign level, and if they remained stable an increased volume of trade should result in the winter. The profit from last year's trading was £32,364, which with a carry-forward of £9666, made a total of £42,030. The dividend on the preference shares absorbed £22,500 and that on the ordinary shares £14,000 (5 per cent.), leaving a balance of £5530.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for July 27 and August 3*)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
Belgium	Iron, steel, cement	122
"	Steel, pig iron	123
Canada	Pottery	87
"	Drugs	121
Colombia	Paper	116
Denmark	Heavy chemicals	94
"	Tinplate, blackplate	95
"	Iron, metals in ingots	96
France	Oils, tallow, chemicals, sugar	125
Holland	Chemicals (tender for)	16376/F.W./G.P.
Hungary	Rubber goods, drugs	103
New Zealand	Tinplate, galvanised sheets, steel, crockery	88
"	Sodium sulphide, cream of tartar, tartaric and citric acids, chemicals for druggists, refrigerating works, fell-mongers and hide buyers, paper	89
Paraguay	Glass, glassware, pottery	225/84/F.G./M.C.
Sweden	Glass, glassware, pottery	225/1/F.G./M.C.
Switzerland	Copper sulphate, turpentine, linseed oil	111
"	Sugar, syrup	112

TARIFF CUSTOMS EXCISE

Bechuanaland, etc.—Proclamations have been issued restricting the importation into Bechuanaland, Basutoland and Swaziland of opium and other habit-forming drugs.

British India.—The tariff valuations for sulphur have been revised.

French W. Africa.—The "coefficients of increase" applied to imports of alcohol, potable spirits, alcoholic perfumery, etc. have been reduced from 2·5 to 1·5, the other "coefficients" remaining unchanged.

Germany.—A law has been passed authorising the reduction or suspension of the import duties under certain conditions. Cocoa products have been added to the export free-list.

Gold Coast.—Pharmacopœial preparations imported by medical practitioners and registered druggists are exempted from duty.

Greece.—Increased import duties have been applied to cocoa, vegetable oils, and plate glass, but those on coal-tar dyes, groundnut oil, ethers, etc. have been reduced. It is proposed to prohibit the importation for six months of certain cacao products and wares of glass.

Hungary.—From July 25 the surcharge when import duties on goods (not specified in lists "A," "B," and "C") are paid in paper currency has been fixed at 19,900 per cent., *i.e.*, 200 times the nominal rates. The surcharges on goods in lists "A," "B," and "C" amount to 12, 40, and 80 times the nominal rates, respectively.

Italy.—The "coefficient of increase" applied to the duty on sugar that yields more than 94 per cent. on refining has been reduced from 1 to 0·7, *i.e.*, the duty is reduced from 36 to 30·60 gold lire per 100 kg.

Norway.—Alterations in the customs tariff affect porcelain insulators, plate and sheet-glass (not including polished, bevelled, etc. glass or photographic plates), and iron sheets.

Rumania.—Importers of pharmaceutical products must show that the sale and manufacture of such products is sanctioned in the country of origin, furnish a certificate of their chemical composition, and state their therapeutic properties.

Sierra Leone.—The differential export duty on palm kernels has been abolished.

South Africa.—It is proposed to increase the customs duties on corks and stoppers made of mineral or vegetable material and on starch; to abolish the duty on scientific apparatus, glassware and porcelain made in the United Kingdom and reciprocating British Possessions; and to admit borax, boric acid, bromine, litharge, manganese dioxide, etc. duty free. Rebates of the duty on "plain spirits" are also proposed.

Switzerland.—All goods except scrap iron, and unmanufactured and coined gold may be exported under general licence. The restrictions on the importation of goods have been continued in force until June 30, 1923.

Tanganyika Territory.—The export duty on hides has been suspended until December 31. The prohibition of the importation of dyestuffs has been removed.

Trinidad.—Explosives (other than for industrial use), cocaine and opium may not be exported.

Tripolitania.—Import taxes are to be applied to alcohol, spirituous essences, sugar, and groundnuts.

United States.—The amendments adopted by the Senate to the Tariff Revision Bill are given in the issue for July 27.

GOVERNMENT ORDERS AND NOTICES

Safeguarding of Industries Act.—*Part I.*—In accordance with the Referee's judgment on the complaint relating to sodium hyposulphite, the Board of Trade has amended the lists of dutiable articles as follows:—For "R. Sodium hyposulphite" read "Sodium hyposulphite (photographic quality)." For "R. Sodium thiosulphate" read "Sodium thiosulphate (photographic quality)."

Part II.—The Board of Trade has issued the Safeguarding of Industries (No. 1) Order, 1922, under Part II of the Act. The Order, which came into force on August 8, imposes a duty of 33⅓ per cent. on, *inter alia*, unmounted domestic glassware, illuminating glassware (not including electric-lamp bulbs, miners' lamp glasses, oil-lamp chimneys, pressed glassware, or articles made of fused silica, vitresoil or similar material), and domestic hollow-ware made of aluminium, or of steel or wrought iron, enamelled.

The committee appointed to inquire into complaints relating to glass bottles made in Holland and Germany has reported that the conditions laid down in Section 2 (1) of the Act are not fulfilled. Consequently the Board of Trade can take no further action in respect of the complaints.

Industrial Property in Luxembourg.—In consequence of the accession of Luxembourg to the International Convention for the Protection of Industrial Property, an Order in Council has been made, applying the provisions of Section 91 of the Patents and Designs Act, 1907, as amended in 1914 and 1919, to Luxembourg from June 30. A copy of the Order may be consulted in the Patent Office Library, 25, Southampton Buildings, London, W.C. 2.

TRADE NOTES

BRITISH

Canadian Exports

According to the returns of the Department of Trade and Commerce, Canada leads the world in the value of exports per head of population. The returns show that Canada's exports now amount, in value, to $150 *per capita*, as compared with $65 for the United States and $98 for the United Kingdom.

The exported value of Canadian products for the fiscal year ending March 31, 1922, was $740,240,680, a decrease of almost 450 millions as compared with the preceding 12 months. The shrinkage, however, has been in value rather than in volume. The exports of paper and pulp make a useful illustration. In the fiscal year 1921, 14,363,006 cwt. of pulp, valued at $71,552,037, whilst in 1922, 12,435,238 cwt., valued at $35,924,877, were exported. The volume declined about one-seventh and the value about one-half. The export of newsprint in 1921 was 15,112,586 cwt., valued at $78,923,137, whilst in 1922 there was a slight increase to 15,138,328 cwt., valued at $64,635,627, or a shrinkage exceeding 14 million dollars. Agricultural products exhibit the same shrinkage in value, but an increased volume in many items.

FOREIGN

Imports of Chemicals into Lithuania

During 1921 Lithuania imported chemicals valued at 21,004,976 German marks, lubricating oil valued at 12,300,163 mk., and petroleum to the value of 15,366,530 mk.

German Trade in Colours, Oils and Fats

The extent to which the exports of colours, oils and fats from Germany have declined since the war can be seen from the following table, in which the exports are shown in 1000 metric tons and millions of marks:—

	1913		1920		1921 May-Dec.	
	1000 m. tons	Mill. mk.	1000 m. tons	Mill. mk.	1000 m. tons	Mill. mk.
Colours and colouring materials	262	272·9	101·5	3682·7	68·2	2505·6
Varnish lacquers, mastic	6·6	5·3	2·5	46·0	3·2	61·1
Mineral oils, etc. ..	117·9	8·3	25·8	82·0	25·3	91·9
Coal-tar, coal-tar oils, coal-tar products ..	259·2	32·1	67·7	207·7	149·9	348·1
Soap, candles, wax products	45·8	30·0	8·2	118·0	11·1	198·5

Statistics for the exports of colours during the first four months of 1921 are not available, but those for the rest of the year show an improvement compared with the previous year. Colours and colouring materials play an important part in the export trade, and in 1920 represented 5 per cent. of the total value of the exports, viz., 69·5 milliard paper marks. There was also a slight recovery in the exports of oils, fats, varnishes, lakes, etc. during 1921. Exports of varnish, lakes and similar products during the first quarter of 1922 were as follows:—Lac varnish, spirit-free, asphalt, and other lacquers, 1059·3 t., 46·4 mill. mk.; sealing wax, 41·5 t., 1·7 mill. mk.; spirit varnishes, 31·4 t., 2·4 mill. mk.; oil varnish, varnish salt, birdlime, 129·3 t., 3·5 mill. mk.; mastic, 79·2 t., 1·2 mill. mk.; indigo and indigo-carmine lakes, 3638 t., 330·7 mill. mk.; ultramarine lakes, 217·4 t., 14·1 mill. mk. The destinations of the two last categories are shown below:—

	Jan.–Mar., 1922	
	Indigo Lakes	Ultramarine Lakes
	Metric tons	
Austria	—	5·0
Denmark	—	7·9
England	—	6·6
Baltic	—	13·0
Balkan States	—	3·0
Holland	58·7	—
Italy	21·2	—
Spain	18·4	53·5
Turkey	6·6	—
N. Africa	74·9	—
E. Asia	2971·2	18·2
Dutch E. Indies, etc.	259·5	—
S. America	—	27·7
Other countries	227·5	82·5

Imports of these commodities also declined. Thus the imports of colours, etc. fell from 74,860 t. in 1913 to 11,500 t. in 1920 and 3740 t. in 1921; those of varnishes, lacquers and mastic fell from 3520 t. in 1913 to 790 t. in 1920 and 390 t. in 1921; those of oils, etc. from 41,602,160 t. in 1913 to 11,139,890 t. in 1920 and 8,830,650 t. in 1921, and of soap, candles, wax, etc. from 45,750 t. in 1913 to 41,190 t. in 1920 and 15,330 t. in 1921.

Spanish Export Trade in Turpentine and Resin

The provinces of Old Castille and Segovia are the chief producing centres of turpentine and resin in Spain. Exports in 1918, 1919, 1920, and during the first four months of 1921, were as follows:—

	1918	1919	1920	1921 Jan.–Apr.
	Metric tons.			
Turpentine:—				
Belgium	—	1,924	1,737	487
England	344	1,481	110	—
France	1,879	597	1,016	—
Morocco	0·3	0·5	0·5	—
Other countries	618	586	217	31
Pine-Tar:—				
England	—	18	62	—
Italy	7·3	10	231	—
Switzerland	578	809	9	—
Other countries	73	470	240	36
Resin:—				
Germany	—	—	873	338
Belgium	—	4,902	6,066	1,018
France	1,921	937	261	1·8
England	961	4,597	2,639	298
Portugal	104	28	0·7	—
Other countries	2,664	2,573	2,339	288

The industry is controlled by the Union Resinera Espanola, one of the most important trusts in Spain. Some time ago German capital was invested in the trust and the Industria Resinera Ruth was formed with a capital of 50 million pesetas, of which 70 per cent. was provided by the Union Resinera. The Ruth company, which owns 23 factories equipped with modern plant, will manufacture not only resin products but also fish and olive oils, varnish, lakes, driers, colours, linoleum, glue, aniline and other chemicals, including synthetic camphor.

REVIEWS

Catalytic Action. *By* Prof. K. George Falk. *Pp.* 172. *New York: Chemical Catalog Co., Inc.*, 1922. *Price* $2.50.

Catalysis has been the subject of not a few monographs recently, and one is tempted to anticipate some redundancy as additional books on this branch make their appearance. Prof. Falk's work, however, is to be heartily welcomed, because he deals with catalytic action on the basis of the simplest accepted principles of chemistry and examines the various current theories of catalysis from this standpoint, instead of considering each of the latter as more or less individual entities.

The result, even when one cannot perhaps accept the author's views in their entirety, is a very logical development of catalytic action, in which the relative importance of the subject itself and of the tentative theories put forward to account for it fall into due perspective with the fundamental principles of chemistry.

It is stated that the purpose of the book is to emphasise the *chemical nature* of so-called catalytic actions and that chemical (and also physical) relationships and laws which apply to chemical reactions necessarily must hold for catalytic actions.

The author's definition of the latter is an action in which the chemical composition of one of the final products of the action is the same as that of one of the initial substances: a formal statement of fact which has the advantage of being independent of the more involved "criteria" suggested by others.

An introductory chapter relates how the Berzelian classification of catalytic actions arose and sketches the history of the subject down to Ostwald's definitions of catalysis, with some stress on the manner in which, after Berzelius' time, this group of actions became rather the dumping-ground for chemical mysteries than a clear-cut subdivision.

Prof. Falk then applies his general "addition theory of chemical reactions" to catalysis; this postulates that the first step in a reaction is combination to form an addition compound. Hence he deals with catalysis in homogeneous systems from the viewpoint that the catalyst and reactants form an addition or intermediate compound, and with catalysis in heterogeneous systems on the basis that the first step is the formation of chemical compounds on the surface of the catalyst by the action of chemical forces.

The questions of mathematical expression of the rate of catalytic action, of the reaction velocity equations and of energy relations are then discussed, chiefly with reference to homogeneous systems, and subsequently enzyme action and contact catalyses are reviewed from the same standpoint.

Due restraint is shown in applying the ionic theory of electrolytic dissociation to action in aqueous media. The prevailing theories of electronic atomic structure, radiation, and adsorption (in Langmuir's sense, *i.e.*, as due to chemical force) receive adequate attention, especially in reference to catalytic action at the surface of living cells and porous solids.

As already indicated, one is impressed by the fact that, starting from simple definitely chemical premises, not only does catalysis appear as a simple special case of ordinary chemical action, but the physical and mathematical interpretation of the subject appears to be rendered more easy and more certain; moreover, it would seem unnecessary to restrict this method of approaching catalysis to the author's particular theory of the general mechanism of chemical reactions.

The general principles and arrangement of the work are thus entirely to be commended. The examples illustrating the development of the author's views, whilst on the whole well-chosen, might perhaps have been taken from a somewhat wider field; but this is, after all, largely a matter of personal opinion.

As regards catalysis in homogeneous systems, much stress is laid on Steiglitz's work on the hydrolysis of imino-esters, and it is shown that the results with imino-esters rather than with ordinary acid esters are more useful in the particular illustration in view. At the same time, one feels that the general argument would have been strengthened by appeal to a wider range of experimental work; and, perhaps, if no suitable data from American sources were available, it might have been well to scan the European literature more exhaustively than would appear to have been done!

Again, in dealing with contact catalysis, the only examples chosen from the very wide range of Sabatier's investigations are the decomposition of alcohols in presence of metals or metallic oxides and the similar decomposition of esters. The latter is a very complicated process with numerous possibilities of side-actions, and is not at the present stage sufficiently thoroughly investigated.

These minor points are mentioned only because it is felt that the general theory developed is worthy of even better exemplification that that which it has received, and not in any way in depreciation of the book. Professor Falk deserves the congratulations and thanks of chemists in general for his lucid, logical and straightforward exposition of his subject.

T. P. HILDITCH.

(1) A TEXT-BOOK OF ORGANIC CHEMISTRY. *By* A. BERNTHSEN. *New edition revised to date by* J. J. SUDBOROUGH. *Pp. xvi*+908. *London: Blackie and Son, Ltd.*, 1922. *Price* 12*s.* 6*d. net.* (2) DYES CLASSIFIED BY INTERMEDIATES. *By* R. NORRIS SHREVE. *Pp.* 631. *New York: The Chemical Catalog Co., Inc.*, 1922. *Price* $10 *net.*

(1) This revised edition of Bernthsen's well-known text-book is practically a new work. Although the arrangement is based on that of the older editions a great deal of extra material has been added, and Prof. Sudborough's claim that it has been brought up to date is fully justified. In addition to the incorporation of the results of recent research, new chapters have been added on the synthesis and degradation of ring systems, including a mention of spirans and cage systems, the organic compounds of arsenic, synthetic drugs, synthetic dyes and the chemistry of rubber. The thoroughness of treatment of the subject has, perhaps, rendered the book somewhat indigestible, but this seems nowadays an almost inevitable concomitant of works on organic chemistry. The laudable desire for compression has resulted in statements which may mislead a student by their brevity. For example, in dealing with the formation of diazonium compounds no mention is made of the fact that some primary amines do not diazotise readily at 0° C., nor is the influence of negative substituents described. Again, it is to be inferred that benz-antialdoxime does not react with acetic anhydride as readily as the syn-isomeride and that in the latter case the nitrile is the primary product of the reaction. Moreover, the statement that acids transform the anti- into the syn-oxime is much too brief, as this occurs only under very special conditions and dilute acids bring about the reverse change.

The book is well supplied with references, particularly to more recent work, and these enable the student interested in a special subject to extend his reading to the original papers, an advantage so often missing in elementary text-books. It is to be regretted, however, that these references are interpolated in the text and not put as footnotes as they militate considerably against the ease of reading of the book. The printing is clear, the paper good though somewhat transparent, and misprints rare. The price is unexpectedly low considering the bulk and get-up of the volume, and it is to be hoped that the period of inflation of prices of chemical books is coming to an end. Students of organic chemistry will find this book a very sound investment.

(2) This volume represents a new classification of dyestuffs which will probably be of great use to the manufacturer as showing the dyes which can be prepared from the intermediates he has at hand, together with some indication of the demand for these particular dyestuffs as shown by the quantities imported and manufactured in the United States. The intermediates are arranged in alphabetical order, their formulæ given and their chemical name or names, the synonyms being cross-indexed in their alphabetical order. Where available, statistics are supplied of the amounts imported or manufactured in the United States in recent years. The methods of preparation of the intermediate are briefly indicated, together with references, and there follows a table giving the dyes, listed in Schultz's Farbstofftabellen, 1914 edition, made from the particular intermediate, statistics of their import and manufacture in the United States, the other intermediates used in their manufacture, and the class of dye according to the method of application.

At the end of the volume is given a formula index of intermediates, a glossary of dye names and an index of Schultz numbers. The list of intermediates is fairly complete and the book represents the results of much painstaking labour, though it would seem to have been worth the extra trouble to have given references to the originals rather than to other reference books such as Lange's Zwischenprodukte, Ullmann's Enzyklopædie or Barnett's Anthracene, etc. A few misprints are observable, particularly in the form of dropped letters, but on the whole the work is very free from typographical errors; the print and formulæ are very clear and the get-up of the book excellent.

The English reader, though he may find the book of considerable use for reference, will be disappointed to find that even in the glossary of dye names but few of the current American and British trade names are given, probably owing to the difficulty of obtaining information on the composition of dyes supplied under such trade names. It is open to doubt whether the secretive policy of British firms as regards the chemical constitution of their products is in the interest of the development of the dye industry in this country.

O. L. Brady.

Dictionnaire Anglais - Français - Allemand de Mots et Locutions intéressant la Physique et la Chimie. *By* R. Cornubert. *Pp.* 297. *Paris: Dunod*, 1922. *Price, paper* 42 *fr., bound* 47 *fr.*

The object of this dictionary is to enable French scientists to read works on chemistry and physics written in German or English, and thus open to them a wider range of scientific literature than could be obtained by confining their studies to their own language. There is thus nothing novel about the purpose of the author, and the book has to stand or fall by comparison with other similar dictionaries. The requirements that such a book has to fulfil are that it must be accurate, it must be reasonably complete, and it must be conveniently arranged for ready reference. It is essentially in the matter of arrangement that this book differs from most others of the same kind.. It is not, as usual, in three parts; the author has arranged his vocabulary in three columns, in which the words in the respective languages are arranged in an alphabetical order applicable to all, a scheme which is generally possible, because the great majority of scientific terms are very much alike in all three languages; the words that run in true alphabetical order are printed in heavy type, equivalent words in the other languages that do not fall into this order being in ordinary type. For example, under the letter A we find Ausschalter in heavy type in the German column, the corresponding words in English and French, cut-out and interrupteur, being printed in ordinary type in their respective columns, all, however, under the letter A; in turn cut-out is to be found in heavy type in the English column under the letter C, and interrupteur in heavy type in the French column under the letter I. The author states that he has adopted this method in order to save space, which it undoubtedly does, and though it appears clumsy, it is quite possible that with practice the system might be found less inconvenient than it is in the hands of one not experienced in it.

On the score of completeness there is not much to be said; most of the ordinary words that are likely to occur in a work dealing with pure chemistry or pure physics are to be found. On the other hand, the far more difficult side, that of the applied sciences, is very imperfectly represented, whereas the names of minerals figure very largely, though these as a rule present very little difficulty.

It is mainly on the matter of accuracy that this dictionary affords ground for complaint, mistakes of all kinds being numerous. A few may be quoted at random: The German for pyrrhotite is given as Leberkies, whereas it should be Magnetkies; Leberkies is the name given to a variety of Marcasite. Raseneisenerz is incorrectly translated limonite, instead of bog ore. German silver is not the same thing as Constantan. Abraum salt is certainly not [illegible]ish, any more than is Amiant. A good example [illegible] careless work that disfigures this book is found in the translation of balance romaine as Sweedish (sic!) balance. It is obvious that this dictionary is anything but a trustworthy guide, and a work that will not stand this essential test cannot safely be recommended to the student.

H. Louis.

PUBLICATIONS RECEIVED

Technical Records of Explosives Supply, 1915–1918. No. 7. Manufacture of Nitric Acid from Nitre and Sulphuric Acid. *Ministry of Munitions and Department of Scientific and Industrial Research. London: H.M. Stationery Office*, 1922. *Price* 11*s*.

Laboratory Exercises in Inorganic Chemistry. *By* Prof. J. F. Norris *and* Prof. K. L. Mark. *Pp.* 548. *London: McGraw-Hill Publishing Co., Ltd.*, 1922. *Price* 10*s*.

Laboratory Manual of Colloid Chemistry. *By* Prof. H. N. Holmes. *Pp.* 127. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.*, 1922. *Price* 10*s*.

A Systematic Qualitative Chemical Analysis. *By* Prof. G. W. Sears. *Pp.* 119. *New York: John Wiley and Sons., Inc.; London: Chapman and Hall, Ltd.*, 1922. *Price* 8*s*. 6*d*.

Chemistry for Beginners and Schools. *By* C. T. Kingzett. *Fourth edition. Pp.* 237. *London: Baillière, Tindall and Cox*, 1922. *Price* 5*s*.

Filtration. *By* T. R. Wollaston. *Pitman's Technical Primers. Pp.* 102. *London: Sir Isaac Pitman and Sons, Ltd.*, 1922. *Price* 2*s*. 6*d*.

The Properties of Electrically Conducting Systems. *By* Prof. C. A. Kraus. *American Chemical Society, Monograph Series. Pp.* 415. *New York: The Chemical Catalog Co., Inc.*, 1922. *Price* $4.50.

Grundzüge der Angewandten Elektrochemie. Vol. I. Elektrochemie der Lösungen. *By* Prof. G. Grube. *Pp.* 268. *Dresden and Leipzig: Th. Steinkopff*, 1922. *Price, paper* 8*s*. 4*d*., *bound* 10*s*. 3*d*.

Quicksilver, 1913—1919. *The Mineral Industry of the British Empire and Foreign Countries. War Period. Imperial Mineral Resources Bureau. London: H.M. Stationery Office* 1922. *Price* 1*s*.

Some Properties of Powders with Special Reference to Grading by Elutriation. *Discussion held by the Oil and Colour Chemists' Association and the Faraday Society on March* 9 *and* 23, 1922. *Published in the Journal of the Association, Vol.* 5, *No.* 30, *March*, 1922. *Price* 2*s*. 6*d*.

Wear Tests of Concrete. *By* Prof. D. A. Abrams. *Bulletin* 10. *Pp.* 25. *Published by the Structural Materials Research Laboratory, Lewis Institute, Chicago, December*, 1921.

Publications of the United States Bureau of Mines. *Department of the Interior. Washington: Government Printing Office*, 1922:—

Preparation and Uses of Tar and its Simple Crude Derivatives. *By* W. W. Odell. *Price* 15 *cents*.

The Analytical Distillation of Petroleum and Its Products. *By* E. W. Dean, H. H. Hill, N. A. C. Smith, *and* W. A. Jacobs. *Price* 15 *cents*.

REVIEW

Vol. XLI] AUGUST 31, 1922 [No. 16

THE COMPARATIVE SWEETNESS AND PRESERVING QUALITY OF CANE AND BEET SUGARS

JAMES P. OGILVIE

AT the present time various grades of white cane and beet sugar are sold on our market, and broadly these may be divided into (1) refined and (2) direct-consumption sugars. By a refined sugar is generally understood a product which is obtained by re-melting raw cane or beet sugar, passing the resulting liquor through animal charcoal to decolorise and purify it, and finally re-crystallising. Granulated and cube sugars so produced in refineries in this country are of a remarkable degree of purity, and their sucrose content generally reaches 99·95 per cent., the traces of moisture, ash, reducing sugars, and organic non-sugars which may be present being hardly capable of determination even by the application of special methods. (Intern. Sugar J., 1920, 654). It is conceded by all that there can be no difference in the sweetness or preserving quality of such a highly refined product (which is in effect pure sucrose), whether it is derived originally from the cane or the beet.

DESCRIPTION OF DIRECT-CONSUMPTION GRADES

The direct-consumption sugars, as the term suggests, are grades produced directly from the cane or the beet without the intermediary of the refinery, or the use of animal charcoal, of suitable purity for use on the table or for manufacturing purposes. They are made by liming and sulphiting or carbonating the juice, filtering the syrup or allowing it to subside, and washing the resulting crystals with water and steam in the centrifugal machine. The best grades of cane or beet sugar thus made have a sucrose content of about 99·5 per cent., are of good colour, and can very well be used for domestic purposes, though admittedly they do not possess as a rule the faultless appearance of the best refinery product. Excellent direct-consumption cane sugar is now being imported into this country (though as yet in comparatively small amount) from the British West Indies (a recent analysis gave, per cent. :—sucrose, 99·5 ; reducing sugars, 0·23 ; ash, 0·02 ; organic non-sugars, 0·15, and moisture 0·10) ; whilst as an example of a superior direct-consumption beet sugar may be mentioned the granulated sugar produced at the beet-sugar factories in this country during the last season (*cf.* J., 1922, 149–154 B, Kelham sugar giving the following figures : sucrose, 99·9 ; reducing sugars, absent ; ash, 0·01 ; organic non-sugars, 0·04 ; and moisture, 0·05 per cent. Cantley sugar is equally pure). Other grades of direct-consumption sugars are used in the United Kingdom in the jam, confectionery, biscuit, and condensed-milk industries, though these are often " off-colour," and therefore not in demand in the grocery trade.

These lower grade direct-consumption sugars have only a slightly smaller sucrose content than the refined article ; and the difference between them and pure sucrose is to be attributed to the small amount of impurities, such as reducing sugars, ash, and organic non-sugar matter (the last-named including traces of colouring and aromatic substances), which are occluded in the interstices between the lamellæ of the crystals. Direct-consumption cane sugars generally contain reducing sugars, and may possess a slightly acid reaction, whilst the trace of non-sugar substances which they contain imparts a faintly pleasant flavour derived from the original juice. On the other hand, beet sugars normally do not contain reducing sugars, and in the case of the lower grades their solutions may be slightly alkaline. Further, the inferior grades of white beet sugars, such as the so-called "washed crystals," may still retain a trace of the objectionable (almost nauseous) flavour that is so characteristic of the juice from which they are extracted. Then in this description of direct-consumption grades mention may be made of the palatable and wholesome West Indian yellow crystal sugars, which are manufactured directly from cane juice by a special process of clarification and boiling ; that is, of course, the genuine Demerara or Trinidad crystal sugars, and not the yellow crystals made by some houses in this country by incorporating white crystals (sometimes beet) with a syrup containing a suitable organic dye. They consist approximately of 96 per cent. of crystal surrounded by a syrup containing reducing sugars, ash, and organic non-sugars, including the bodies imparting the very pleasant taste and aroma of the cane juice. The precise nature of these flavouring substances remains undetermined.

COMPARATIVE SWEETNESS OF CANE AND BEET SUGARS

The opinion appears to be quite widely held, and in fact is often definitely expressed, not only by the general public and by sugar salesmen, but also by physiologists who have considered the matter, that the various grades of sugar on the market do actually differ in sweetness, in spite of the fact that their sucrose content may be about the same. Even in Germany there are many who admit that "colonial sugars" (*i.e.*, cane products) are sweeter than the lowest grade granulated beet sugar sold there, or even than the char-refined beet product. It seems, therefore, of some interest to examine the question, and to state the known facts which may account for such an opinion.

Preliminarily, it may be pointed out that a correct judgment can hardly result from tasting the crystals themselves, since their size and hardness considerably influence the sweetening effect thus obtained. It is evident that a fine and soft-grained sugar will pass more quickly into solution in the mouth than a product consisting of hard and large crystals. Obviously, therefore, tasting experiments must be performed with solutions of the various samples, using preferably a saporimeter, such as that designed by Kremer (Nederl. Tijdschrift voor Geneeskunde, 1917, No. 3, 149-157), whilst also following a suitable method for diluting the sapid substance with water, and a definite procedure for eliciting the decision of the individual tasters, such as that described by Toulouse and Vaschide (Comptes rendus, 1900, 130, 803; 1904, 139, 898).

The reader may be reminded that on the surface of the tongue and soft palate are numerous papillæ, of which many bear at the base or on the top the so-called "taste buds," structures which are the terminations of the gustatory nerve fibres. These nerve endings are capable on excitation of giving rise to gustatory sensations, which are broadly classified as sweet, acid, bitter, and salt. Each of these sensations is believed by many physiologists to be registered by a specific set of nerves; in other words, the particular nerve endings producing the sensation of sweetness appear to be incapable of excitation by an acid, a bitter, or a saline substance.

An important fact here to bear in mind is that there appears to be reliable evidence for the statement that the intensity of a gustatory sensation (sweetness, for example) may be modified when another set of nerves in the vicinity (say, those producing an acid taste) is at the same time excited (Zeitsch. f. Psychologie u. Physiologie der Sinnesorgane, 1899, Bd. 21).

INFLUENCE OF TRACES OF ACID AND ALKALI ON SWEETNESS

Thus, it will be found that if two solutions be prepared, the first containing 15 and the second 12 per cent. of sucrose, and if to the latter a trace of acid be added, it is possible by gradually increasing this addition to arrive at a certain concentration of the mineral or vegetable acid at which most of the tasters would consider the weaker solution of sucrose to be the sweeter (Archives Néer. Physiol., 1917, 1, 625). A similar result has been obtained by adding quinine hydrochloride and other bitter substances (Du Bois Raymond's Archiv f. Physiologie, 1892). It has been established that if two solutions be made up both containing, say, 15 per cent. of sucrose, and if to one of them about 0·1 per cent. of sodium chloride be added, nine persons out of ten tasting the two liquids would declare the solution containing the small amount of salt to be appreciably the sweeter (Archives Néer. Physiol., 1917, 1, 625). It is, of course, well understood that if the amount of any one of these additions is increased beyond a certain point, the acid, the bitter, or the saline taste will become apparent, and the solution of sucrose will then certainly become less sweet. On the other hand, it has been proved that traces of alkali depress the sweetening effect of a solution of sugar, and a well-known German chemist once stated (Vereinszeitschrift, 1892, 42, 580): "According to my experience, the sweetness of sugar is greater when traces of acids, especially fruit acids, are present than in solutions which, as in the case of our beet sugars, contain a trace of alkali."

INFLUENCE OF ODORIFEROUS AND OTHER FOREIGN SUBSTANCES

Further, the sense of taste is certainly affected by odoriferous substances. In an authoritative textbook ("A Textbook of Physiology." By Sir Michael Foster, in Part IV. The Senses. Page 1513) the statement is made that if the nose be held, and the eyes shut, it is very difficult in eating to distinguish between an apple, an onion, and a potato, the three being recognised when their respective aromas are eliminated only by their texture in the mouth, and not by their "taste." W. H. Th. Harloff remarked (Intern. Sugar J., 1920, 105) that when palm sugar (which is exceedingly luscious) is dissolved in water and treated with a decolorising carbon for the absorption of its non-sugars, one obtains a liquid that is much less sweet than the original solution, although its content in sucrose and reducing sugars may be the same. A similar observation was made by F. I. Scard (ibid., 1904, 478) to the effect that the pure sucrose obtained by washing Demerara sugar to remove the adhering syrup, and recrystallising the white sugar left appeared almost tasteless in comparison with the original crystals.

These several points regarding the factors capable of influencing the sweetness of a sugar seem to be well established; and in fact are so well recognised that the proposal has been made to add traces of vegetable acids and flavouring substances to pure white sugar for the purpose of increasing its sweetness and palatability as a commercial article.

Summarising the conclusions to be drawn from the observations cited above, it may be said that there appears to be good evidence for the opinion that some grades of white sugars, namely, those containing traces of acid and flavouring substances, may be sweeter than others, when tasted in solution. Thus, by way of example, if one were to examine in the manner already indicated four different grades of sugars, viz., (1) the best refined; (2) a low grade cane direct consumption; (3) Demerara yellow crystals; and (4) an inferior beet direct consumption, there seems little doubt that in the opinion of the tasters the Demerara yellow crystals would be considered somewhat sweeter, weight for weight, than the refined article, in spite of there being a difference of about 4 per cent. in the sucrose content of the two sugars. Further, it seems certain that the direct-consumption cane sugar would be adjudged slightly sweeter than the refined, though less sweet than the Demerara product; whilst the least sweet of the four would probably be the inferior beet, especially if this were of the washed crystal type containing a small amount of alkali carbonates, such as was imported into this country from Germany and Austria previous to the war.

PRESERVING QUALITY OF CANE AND BEET SUGARS

The preserving quality of a sugar, whether derived from the cane or from the beet, depends upon several factors, two of the principal of which are: (1) its freedom from micro-organisms capable of inducing fermentation; and (2) its reaction, which should be neutral, or slightly acid. It should also be free from any flavouring or colouring matter which may adversely affect the taste or appearance of the preserve.

In regard to the first factor, namely, freedom from septic micro-organisms, it was formerly claimed that refined sugars only should be used for preserve-making on the ground that it was only by the use of animal charcoal that a sterile product could be obtained. However, direct-consumption sugars made from both cane and beet are in use at the present time in the jam, fruit-canning, and condensed-milk industries with results as satisfactory as those obtained with the refined grades.

It is now known that in the manufacture of direct-consumption sugar, whether by sulphitation in the cane-sugar house, or by carbonatation in the beet factory, a practically sterile juice results after allowing the precipitate of calcium sulphite or carbonate to subside or filtering off. (Intern. Sugar J., 1919, 465). Subsequently, both in refining and in manufacturing direct-consumption sugar, some re-infection occurs when the crystals are exposed to the air in the centrifugals, due no doubt to the large volume of air which is sucked against the mass during its very rapid revolution; but later if the sugar be treated with steam while still in the machines practically all the bacteria and moulds are destroyed (Intern. Sugar J., 1920, 591). The importance of the sterilisation of sugars in this way, and of their packing, storage, and transit under cleanly conditions, is now recognised by manufacturers of high-grade direct-consumption sugars.

Coming to the second factor mentioned above, namely the reaction of the sugar, it is of course well recognised that in jam and jelly manufacture the fruit juice must have a certain acidity, otherwise the pectin will not jell. Investigation of the reason why in preserve-making a syrup instead of a jelly may result has sometimes indicated, when a low-grade beet sugar has been employed, the presence of alkali carbonates in sufficient amount to lower the acidity of the fruit juice below the optimum for the setting of the pectin. However, this condition is hardly likely to be encountered at the present time, though it may well serve as some explanation of the origin of the popular prejudice which persists against the use of beet sugar for the purpose. Most of the white grades of cane and beet sugars now on our market are of high purity; and the British beet sugars have been shown to give entirely satisfactory results in the jam, condensed-fruit and other industries in which sugar may be used In jam and jelly manufacture it would seem that in the event of trouble the sugar used is usually the factor for suspicion; whereas the actual reason for the refusal of the fruit juice to jell is more likely to be connected with other causes, such, for example, as the low acidity of the fruit juice, an insufficient pectin content, the hydrolysis of the pectin by prolonged boiling, or the use of too high a proportion of syrup.

CANE SUGAR v. BEET SUGAR

The death-blow to the notion that for some peculiar reason or other sugar which is derived from the beet is unsuitable for use in the preparation of jam or jelly and fruit preserving was given by G. W. Shaw, of the Experiment Station of the University of California, in a series of comparative tests (Intern. Sugar J., 1919, 619). The cane sugar was a product originating from the Western Sugar Refinery, San Francisco, and had a sucrose content of 99·7; whereas the beet sugar was a white granulated product made directly from the root by the American Beet Sugar Co., of Oxnard, Cal., and polarised 99·8 per cent. A large number of fruit-preserving tests (about 2000) showed that the two sugars gave identical results, and that in both series the product was as clear as it was possible to be. Not the slightest difficulty was experienced in the preservation in either case.

EMULSIONS IN TECHNICAL PRACTICE

THE study of the physico-chemical basis of emulsions, and of the colloidal and surface-tension phenomena they exhibit, has advanced technical practice in the formation and breaking of emulsions to a considerable degree, and empirical experimentation has helped to solve many problems in this field by accumulating data for subsequent scientific investigation.

Processes for the formation of stable emulsions on the one hand, and the resolution of undesirable emulsions on the other, are of general interest to chemical technologists. Thus, every year in this country tens of thousands of tons of "soap stock" are produced in the refining of vegetable oils, and as much as 80 to 90 per cent. of the neutral-oil content can be recovered, instead of being sold at a relatively low figure in the "stock" for soap-making or in the "black grease" obtained on acidification.

The dehydration of tars involves the separation of emulsions, and it is well known that many water-gas tars cannot be dehydrated by settling, even at raised temperatures and after long periods of treatment. The slow process of settling raw linseed oil, to obtain oils free from water and mucilaginous matter for use in the paint and varnish industry, can be hastened considerably by applying the principles of emulsion breaking. A final instance, though not of direct interest to this country, is of world importance, viz., the separation of petroleum emulsions. Comparatively recently millions of gallons of mineral oil were wasted annually owing to the impracticability of removing the water from the oil emulsions found in many oilfields.

The value to the manufacturers of "solid" and colloidal lubricants and to the textile industry of scientific data regarding emulsion formation and stabilisation to the margarine industry cannot be overestimated.

EMULSIONS

To form a stable emulsion of two immiscible liquids, a third component is necessary, which may consist of an emulsoid. According as one or other component becomes the disperse phase (*e.g.*, in emulsions of oils and water) a hydrophilous or a hydrophobous colloid has to be found. Soap, gum arabic, starch, gelatin, etc. may serve as emulsoids, and a film is formed at the interface between the two components.

Finely-divided solids may also help to produce permanent emulsions. Thus, Pickering demonstrated that oil-water emulsions could be produced by means of finely-divided solids, provided that the solid was more easily wetted by the water than by the oil; in this case the water becomes the disperse phase and the oil particles of the continuous phase are coated with a stable film of finely-divided solid. Later it was shown that water-in-oil emulsions could be formed by means of carbon black and similar substances, more easily wetted by the oil than by the water. Thus, a stable emulsion of water in kerosene can be prepared by means of carbon black, the black separating at the oil-water interface. Emulsions produced by means of finely-divided solids resemble in most respects those formed with the aid of a soluble emulsifier—a hydrophilous or hydrophobous colloid.

The extensive subject of emulsion formation and stability cannot be discussed here, it must suffice to state that the above two methods of formation are of especial interest in considering such problems as those presented by oilfield emulsions, soapstock separation, tar-dehydration, etc. The breaking or resolution of emulsions involves consideration of the relation between stability and size of particles, of viscosity of the respective components, and relative specific gravity. In this place only the practical methods evolved for disturbing the equilibrium of the emulsion system will be considered.

SEPARATION OF EMULSIONS

Much of the work done on the separation of emulsions on a technical scale has been inspired by the wastage of valuable mineral oil in the oilfield emulsions (*cf.* J. Ind. Eng. Chem., Nov., 1921), but many of the developments are applicable to other types of emulsions, with little or no modification.

It may be of interest first to record methods as yet unused in practice, and depending upon the differential wetting of filtering media. The use of kieselguhr has been advocated, the underlying principle being that during filtration this substance should "cut" and destroy the protective film surrounding the water particles in an oilfield emulsion (water in oil) and so allow of rapid coalescence and subsidence of the water by gravity.

GRAVITY *

The first attempts to deal with oilfield emulsions were based upon subsidence, but the impossibility of treating many types even after very long periods of settling at ordinary temperature, led to settling in pools exposed to the heat of the sun. The reduction of viscosity consequent upon raised temperature allowed of separation to some extent and in certain cases, but was only feasible when low-boiling fractions of the crude oil commanded no market value. Continuous settling in closed tanks suitably heated, naturally followed upon the introduction of the internal-combusion engine. Heating of the oil cannot, in many cases, be effected by direct heat from steam-pipes or jackets, as the water particles near the steam-pipe volatilise and then condense in extremely finely-divided particles in the cooler parts of the oil emulsion, which becomes more stable. In such a case the emulsion should be floated upon water into which steam is blown. Convection currents are set up and the emulsion is heated without vaporising the water; in this manner coalescence and subsidence by gravity are hastened.

Such methods are, however, cumbersome in application, and are not in general use. Mention, however, should be made of the increased difference in specific gravity produced by adding an oil solvent, such as petroleum ether. The reduction of viscosity and specific gravity of the non-water part of the mixture allows more ready separation of the water component, but the method is seldom adopted in practice. The following suggestion may, however, be noted. The emulsification of certain oils of asphaltic base is said to be due to earthy matter coated with asphalt, a mixture which, being an oil-soluble colloid stabilises the water-in-oil emulsion. On adding a solvent the asphalt dissolves and leaves the finely-divided earthy matter, which is not an oil-soluble colloid, so that the emulsion becomes more easily resolvable. The effects of reduced viscosity and greater differences in density must, however, be of moment in the final separation of the components.

Addition of Reverse Emulsoid

If an emulsion is stabilised by a hydrophobous colloid, as in water-in-oil emulsions, the stability of the whole can be decreased by the regulated addition of a reverse colloid, a hydrophile, and breaking by settlement often results in relatively short time. Separation can often be caused by carefully adding a water-soluble soap and ensuring contact with the water globules in the emulsion. Such a hydrophilous colloid, however, will *stabilise* an oil-in-water emulsion, and it is therefore necessary to add a colloid which will easily make contact with the dispersed water in the water-in-oil emulsion. Such hydrophilous colloids are represented by a mixture of sodium oleate and oleic acid, sodium resinate and free resin, etc., the mixture being able to make contact with the dispersed water globules through the oil.

It is probably impossible to separate all types of oil-field emulsions by the use of one particular reverse colloid, and each emulsion should be regarded as a separate problem. Nevertheless, use of the compound known as "Tret-O-Lite" has met with considerable general success in recovering oil from emulsions that were formerly wasted. The compound consists of sodium oleate 83%, sodium resinate 5.5%, sodium silicate 5%, phenol 4%, paraffin 1.5% and water 1%. More recently the use of compounds containing sodium salts of sulphonated oils has been suggested.

Electrical Methods

It has been suggested that the addition of electrolytes to an oil-field emulsion will cause separation of the water particles, negatively charged; in particular, acids and ferric salts have been recommended, but they have not come into general use.

The coalescence and subsequent subsidence of the water globules has, however, been successfully accomplished by using a high-potential electrical field. The action, which was suggested by the successful methods of precipitating dust, is stated to depend upon the electrical charge borne by the water globules; the enveloping oil-film is ruptured, the water particles coalesce more readily, and separation by subsidence follows.

The apparatus that has found favour in many districts consists of a tank, 3 ft. in diameter and 8 ft. high, containing a centrally disposed revolving electrode. The electrode shaft carries a number of circular discs and is supported by an insulated bearing. The tank itself, being earthed, serves as the second electrode. The oil is fed continuously into the annular space between the tank and the central electrode, and a potential difference of about 10,000 volts is maintained between the tank and central shaft. The treatment of the oil-emulsion can be carried out at raised temperatures, say, 135° F., the maximum temperature advised being 180° F. To avoid loss of the valuable lower-boiling fractions, the treatment is carried out in closed systems and under pressure. After passing through the electrical field, the mixture is led to a trap settling-tank, where the oil and water are finally separated by subsidence.

The capacity of such an electrical system varies from 300–1000 barrels per 24 hours, and naturally the power consumption also varies. From 5–75 watt-hours may be required per barrel of oil treated, but the cost does not average above one cent per 20–50 barrels. The over-all cost, including steam, power, labour, repairs, interest, depreciation, and royalties ranges between 1 and 3 cents per barrel of oil recovered.

It is claimed that this system is universally applicable, and that it can be successfully used for such stubborn emulsions as "Tank bottoms." The system has been chiefly used in California.

The claim advanced by advocates of electrical treatment, that all emulsions can be economically treated in the above manner, is challenged in some quarters, but there is no doubt that similar methods are useful for breaking several different types of emulsions. The coagulation of finely-divided particles in suspension in oils by applying electrical force so that a rapid continuous settling process becomes possible, is a case in point.

CENTRIFUGAL SEPARATION

The increased rate at which emulsions can be separated by applying centrifugal force has been much advocated by the makers of the Sharples "Super-Centrifuge," which is capable of developing a speed of 18,000 revolutions per minute in large-scale apparatus. The emulsion can be treated at a raised temperature, as the loss of valuable light fractions is negligible on account of the speed at which separation is effected. The main factors of coalescence and subsidence are altered only in respect of time of operation, and the speed at which the oil and water are separated may be increased still further by the aid of reverse colloids.

Thus, the addition of starch in an oil-soluble state caused a certain oil emulsion to separate at the rate of 5 barrels per hour, and when 0·001 per cent. of oil-soluble sodium soap, starch, or glue was added to the emulsion several hours before centrifuging the rate of separation was 15 barrels per hour. Slightly larger amounts of hydrophilous emulsoid are required if centrifugal force is applied nearer to the time of addition.

On the ground that the hydrophobous emulsoid is present in all oil-field emulsions in approximately the same small amount, it is claimed that the above treatment, or a slight modification of it, is applicable to all forms of such emulsions. Much success has certainly been achieved by the use of the "Super-Centrifuge," but whether it is the alpha and omega of oil-field emulsion problems is still disputed.

The cost of treatment by centrifugal force has been placed at 7 cents per barrel, which compares unfavourably with the electrical method, provided emulsions are equally capable of treatment by the two methods. The Super-Centrifuge has, however, proved its great value in separating soap stock, an emulsion produced in large quantities in refining vegetable oils, and until recently sold without separation of its content of valuable neutral oil.

SOAP-STOCK SEPARATION

Of the methods of emulsion-breaking mentioned, the application of the Super-Centrifuge is the only one that has been worked successfully. As much as 80–95 per cent. of the neutral-oil content of soap stock has been recovered regularly in the form of an easily refined oil, which is much more valuable than as a component of original soap stock or of the "black grease" obtained from it.

The soap stock is treated in two distinct stages. In the first, the stability of the emulsion is decreased by diluting with 0·5–2·0 volumes of water, and heating to 100° C., 2 per cent. of sodium carbonate also being added. Other salts, or a weak acid such as boric acid, may be employed, but salting out of the soap and decomposition of either neutral oil or soap should be avoided. The diluted soap stock is then allowed to settle, and the lower layer of aqueous soap solution is withdrawn.

The second stage consists in the centrifugal treatment of the destabilised emulsion, whereby two products are obtained, the one consisting of neutral oil containing very small quantities of soap solution, and the other of soap solution with little oil. The neutral oil is treated with salt to separate the small quantity of soap, and is then ready for final refining to an edible product.

The value of the process can be judged by the fact that from 80–95 per cent. of the neutral oil can be recovered, say, from an oil-content totalling 25 per cent., and this oil is approximately three times more valuable than that present in soap stock.

The constructional details of the Super-Centrifuge need be indicated but briefly, full descriptions being available elsewhere. The machine consists of a small, high-speed elongated or tubular bowl capable of revolving at 18,000 revolutions per minute. The bowl, 4–5 in. in diameter, is supported and driven from above, and there is only one set of ball bearings. There is little wear and tear, and the machine runs very smoothly, except perhaps whilst attaining its full speed. An extension from the bowl, however, runs in a socket and guides the rotating bowl during this period. Afterwards the bowl is free to find its own axis.

CORRESPONDENCE

THE CHEMIST AND THE MANUFACTURER

Sir,—The contribution of Mr. A. A. Drummond to an old-time controversy suggests a treatment of the problem by the psychological method of Oliver W. Holmes.

The Manufacturer, M, represents three personalities, M', M'', M''': the Chemist similarly.

M'—C' are the actual men.

M''—C'' the ideals of M'—C', each of each.

M'''—C''' the respective reciprocal ideals.

Consequently, in any and every contact, the number of psychological equations to be satisfied is not less than 3×3, a complication which partly explains. "Plus ça change, plus c'est la même chose," and, freely translated, "maimed shows."
—I am, Sir, etc.,

C. F. CROSS.

Lincoln's Inn, London.
August 8.

Sir,—In your issue of August 15 a letter under this heading raises the interesting and important question of what the colleges are doing for industry.

One may presume that a large number of the chemical students in our colleges and universities are anxious in due course to obtain situations in British chemical factories. Apparently some of those responsible for their training consider it necessary to provide those embryo factory chemists with a complete supply of German chemicals for their laboratory work.

In spite of all the lessons of the war, in spite of the tremendous efforts which have been made to render our teaching institutions independent of German laboratory chemicals there are again, I regret to say, cases, which one could name, of prominent universities obtaining the bulk of their supplies from German sources. These universities are supported by grants of public money—the money of the British taxpayer. I know that these institutions will reply that they can buy these foreign chemicals so much more cheaply. Perhaps they can for the moment, but one wonders whether in the long run it is cheap to teach our young chemists the use of foreign chemicals, and thus help to stifle a section of that very chemical industry to which many of them are looking for future employment. With your correspondent I would say to the universities: "Broaden your outlook; teach patriotism toward your industry." Who but madmen would train students for occupations in any industry which they are helping to kill? Yet is not this the position of those who unnecessarily fill their laboratories with German chemicals for education and research purposes?

The colleges *can* do something for British chemical industry. They can, and should, endeavour to support it.—I am, Sir, etc.,

A Fine Chemical Manufacturer.

London, August 23.

NEWS AND NOTES

UNITED STATES

Autumn Meeting of the American Chemical Society

The meeting to be held in Pittsburgh from September 4 to 8 will probably be attended by 1500—2000 chemists. The chief address will be delivered by Dr. E. E. Slosson, author of "Creative Chemistry" and now editor of Science Service, Washington, on "The Constructive Chemist"; and the papers to be read include one by Mr. F. G. Breyer on a new form of zinc oxide consisting of smaller particles than any existing form, and which is claimed to double the life of the tread of an automobile tyre. Dr. T. Midgley, jr., and Mr. T. A. Boyd will demonstrate the detonation of various motor fuels and explain how "knocking" of the engine may be reduced.

Following the meeting (September 11—16), the Eighth National Exposition of Chemical Industries will be held in the Grand Central Palace, New York, where the exhibits will be confined to products of American firms. About 450 American manufacturers are expected to participate, and an interesting feature will be the provision of kinematograph pictures and lectures on subjects relating to various branches of the industry. Two special sections, on fuel economy and on containers, have been added to this year's exhibition.

Pulverised Coal and Explosion Risks

The precautions which should be taken to minimise the risk of explosions when pulverised coal is used in industrial plants have been investigated by the Bureau of Mines and form the subject of a paper by Mr. L. D. Tracy. It is most important to prevent any accumulation of dust exposed to the air in any part of the plant as this is always liable to form an explosive cloud on being disturbed; a mixture of 0·032 oz. of coal dust with one cb. ft. of air has been found sufficient to cause an explosion when brought in contact with a flame. It is often assumed that sufficient inert matter becomes associated with the dust near furnaces to render it non-explosive, but this is not always the case. The proportion of inert matter which must be present with the coal dust to render it harmless is correlated with the ratio of volatile matter to total combustible matter in the coal. A dust containing over 30 per cent. of ash and only 11 per cent. of volatile matter was found to form an explosive mixture.

In France and Germany vacuum cleaning plants have been installed in connexion with coal-crushing plants in order to facilitate the removal of dust from all parts of the buildings and machinery. Much may be done to prevent the accumulation of dust deposits by maintaining plant in an efficient state, and the risks resulting from any accidental escape of dust may be minimised by consideration of the general lay-out. The drier should be in an isolated position and storage-hoppers should be isolated from boilers or furnaces. Particular attention is directed to all electrical equipment and to the possibility of an electrical discharge from any rapidly moving machinery. Spontaneous combustion of the dried coal is a frequent source of serious trouble. It is questionable whether greater efficiency is attained by working the drier at a higher stack temperature than 150° F., but in any case coal at a higher temperature should not be kept in storage. When the system of circulating pulverised coal is used there is always a risk of fires travelling back from the furnaces. This may be minimised by maintaining the pressure at all points of the distribution system higher than that of the secondary air supplied to the furnaces. A suitable vent should be provided near the outlet of the fan so that in the event of an explosion within the distribution-main the fan will not be damaged.—(*Proc. Eng. Soc. of W. Pennsylvania, June,* 1921.)

Lime in 1920

Although the sales of lime in the United States in 1920 increased in quantity by 7·2 per cent. to 3,570,141 short tons and in value by 27·5 per cent. to $37,543,840, the demand was greater than the supply. This shortage was due entirely to lack of skilled labour and to transport deficiencies, as many of the plants did not operate at full capacity. In all 1,000,550 t. of "chemical lime" was sold, 316,293 t. being used in making refractories, 104,250 t. for alkalis, 90,533 for purifying water, 88,465 t. for calcium carbide, 48,361 t. for acids and 21,845 t. for soap, oils and fats. The chemical industry also consumed the following quantities of lime and of hydrated lime, respectively:—Paper 365,897 t., 7237 t.; glass 54,747 t., 3232 t.; sugar 14,145 t., 4111 t.; tanneries 61,162 t., 14,828 t.; metallurgy 344,921 t., 1521 t. Of the 853,116 t. of hydrated lime sold, 116,748 t. was used in chemical industry. Sales of marl amounted to 97,487 t., mostly for use as an agricultural dressing and partly as a filler for fertilisers, and 38,506 t. of oyster-shell lime was sold for use on the land. Imports (mainly from Canada) and exports were small, amounting to 22,638 t. and 5921 t., respectively (*cf.* **J., 1922,** 175 R).—(*U.S. Geol. Surv., Nov.* 3, 1921.)

Production and Consumption of Sugar in 1921

According to figures published by the U.S. Department of Agriculture, the production of sugar in the United States in 1921 was as follows:—Beet sugar 1,012,382 short tons; cane sugar 270,270 t.; maple sugar 2547 t.; or a total of 1,285,199 t., compared with 1,269,913 t. in the previous year. The actual consumption of sugar in 1921 is given as 5,274,225 t., or 28·4 per cent. of the world's production and an increase of 25·9 per cent. over the average for the 10-year period ending 1920. The *per capita* consumption in 1920 was 97·8 lb., the largest amount recorded. About 1,066,463 t. of sugar was supplied by non-contiguous territories of the United States (Hawaii 488,869 t., Porto Rico 409,022 t., Philippines 168,572 t.) and 3,336,521 t. from foreign countries. Exports amounted to 394,632 t., a small increase compared with the average of the previous ten years. (*U.S. Com. Rep., Mar.* 6, 1922; *Ind. Tr. J., May* 18, 1922.)

Sugar Industry in the Philippines

Owing to the prosperity of the sugar industry in the Philippine Islands during 1919 and 1920, the Philippine National Bank and other corporations have built sugar centrals that bring the total up to 32. These centrals are scattered through central Luzon, the Manila district, and Negros, the chief cane-producing areas, and have an annual productive capacity of 320,000 tons of 96° sugar. The planters believe that it will pay to build more centrals and to cease marketing muscovado sugar in quantity. In Cotabato, province of Lanao, the area of suitable land is greater than that now under cane in Cuba, and the island of Negros already produces 60 per cent. of the cane crop of the Philippines. The prospects of building up a very important sugar industry are excellent.—(*Ch. of Comm. J., Apr.* 14, 1922.)

CANADA

Mining

Free gold bearing ore has been found on the property of the Gold Nugget Mining Co. at Ess Lake, Northern Ontario.

It is stated that some valuable mica properties, near Ottawa, Quebec, have been purchased by the Westinghouse Electric Co. of America.

South African mining interests have made an offer for the Teck-Hughes and the Orr Gold Mines, in the Kirkland Lake district of Northern Ontario.

The Nichols Copper Co., New York, has obtained the contract for selling the copper output of the Granby Consolidated Mining Co., which averages about 3,000,000 lb. a month, and is shipped from Anyox, B.C., to Laurel Hill, near New York, for refining.

The new cyanide plant of the Pioneer mine in Lillovet district, B.C., is ready for operation. There is a possibility of the Consolidated Mining and Smelting Co., Ltd. taking over the smelter at Ladysmith, Vancouver Island. If so, it would treat the gold, copper, silver and lead ores available from coast mines and drawn from the Omineca, Skeena, Naas River, Portland Canal and other mining districts. These ores now go to the Tacoma (Wash.) smelter or to the Selby smelter at San Francisco.

The Consolidated Mining and Smelting Co. is installing a copper rod mill at Trail, B.C., at a cost of about $250,000. It is expected that this will lead to the development of copper wire drawing in Canada.

Considerable activity is being shown in staking mining claims in the district east of Matheson, Northern Ontario. The Blue Quartz property near Painkiller Lake, has been bagging some good ore from the 100 ft. level. The vein is about two ft. wide and assays show the gold content to be from $44 to $166 per ton.

Petroleum

The Canadian Western Natural Gas Co. is boring, with a rotary drill of 17¾ in. diameter at Barnwell, Alta., to a depth of 2,600 ft.

Another syndicate, known as the White River Oil Co. is putting down test holes for petroleum in the Hay River country. The Hay river flows from Hay Lake north-easterly into Great Slave Lake, and the boring will be done at a point 13 miles up the river.

An oil boom has begun at Medicine Hat, Alberta, a city which is the centre of one of the world's largest gas fields. Since the discovery of gas about ten years ago, the borers have been satisfied to stop operations at the second gas level of 1700 feet. It is now believed that beneath the city and district is an immense lake of petroleum and the fever to bore for oil has developed. The Medicine Hat Development Co. has struck a heavy flow of wet gas at 1700 ft. which is reported to yield 2—3 galls. of gasoline per 1000 ft. This well is about 40 miles from Medicine Hat and, whereas the local gas is odourless, that from the new well has a pronounced odour. Five drilling rigs are in operation boring for oil in this district. Oil has been found in paying quantity in the northern part of Montana, just across the international boundary, in the Sweet Grass district (60 to 70 miles south of Medicine Hat). Boring has been started in the same territory on the Canadian side of the line, and rigs are being put up to drill for oil. The Imperial Oil Co. has purchased the oil lease on a farm ten miles east of Coutts, which joins the boundary, and faces a large block of land leased by two companies on the Montana side.

Pulp and Paper Industry

The Bathurst Lumber and Pulp Co., Bathurst, B.C., proposes to build a paper mill for newsprint. The new mill will give employment to 500 men.

The Westminster Paper Co., a corporation newly organised by capitalists from Peshtigo, Wisconsin, is erecting a paper mill at New Westminster, B.C. The company will specialise in the manufacture of tisue paper for home consumption and export.

Hollingsworth, Whitney, Ltd., of Boston, Mass., has purchased the timber areas and properties of C. T. White and Sons, Ltd., New Brunswick, and Davison Lumber Co., Ltd., Nova Scotia.

The timber areas of the White Co. in New Brunswick aggregate nearly 50,000 acres, including 83 sq. miles of Crown lands under license. The price paid for the properties is stated to exceed $2,000,000. It is proposed to erect pulp mills in New Brunswick and Nova Scotia.

A survey of the forests of Canada shows that, during the past 55 years, one-half to two-thirds of the forest area of Canada, or approximately one million square miles, has been destroyed by forest fires, and some of this territory has been devastated by fire as many as six times within half a century.

SOUTH AFRICA

Proposed Iron Works at Bloemfontein

It is announced that the Carron Co., of Falkirk, has applied to the Bloemfontein Municipality for 10 acres of ground on the Industrial Development Sites, for the purpose of establishing an iron foundry. The company proposes to spend £20,000 on buildings, and to import twelve skilled men from Scotland. Local unskilled labour will be used, made up equally of Europeans and natives.—(*S. Afr. J. Ind., June*, 1922.)

AUSTRALIA

Water Power in North Queensland

We have received a communication from Mr. J. Hastings Reed, who states that within 12 miles of the Port of Cairns, North Queensland, there exists an almost unlimited supply of water with a fall of 900 feet. It is proposed to instal a hydro-electric station, and excellent sites with cheap power will be available for electrochemical and similar factories. Local minerals include copper, lead, silver, gold, zinc, antimony, tungsten, molybdenum, manganese, iron, etc. Coal, coke, pure carbonate of lime, alumina, pure white siliceous sand and phosphate rock are available in large quantities. The port is served by the line of steamers plying between Australia and New Zealand, Japan, China, India, and the Straits Settlements.

NEW ZEALAND

Manufacture of Pig Iron in New Zealand

It is announced that the new blast furnace at Onakaka was first tapped on April 27. The furnace was erected by the Onakaka Iron and Steel Co., Ltd., formed for developing part of the large deposits of iron ore at Golden Bay. A modern plant has been installed and the company owns supplies of coal, iron ore, and limestone in favourable situations, but production at capacity will not be initiated until the coking ovens and transport arrangements have been completed. The cost of raw material per ton of iron at the furnace, including royalty, labour and freight, is stated to be: iron ore 12s., limestone 3s., coke 40s.—55s. Labour does not cost more than 15s., and it is estimated that coal from the company's mine, when opened up, will not cost more than 15s. at the works. The output will probably be 24 to 30 tons of pig iron per 24 hours.—(*Bd. of Trade J., July* 13, 1922.)

BRITISH INDIA

Industrial Notes

Bengal.—Dr. R. Lal Datta, who was recently appointed Industrial Chemist, has begun to investigate problems relating to the manufacture of shellac, the comparative efficiency of salt-raising on the sea-coasts of Bengal, Orissa, Madras and Bombay, the chemical composition of matches, the deodorisation of fish oil for making soap, the preparation of chemically-pure lime for industrial use from the shell-lime deposits of Bengal, the economic possibility of sugar-making as a home industry in Bengal, and of yarn-dyeing as a home industry. Schemes submitted to the Government include one for developing the glass and allied industries of Bengal and another for manufacturing dynamite glycerin under Government patronage.

Bombay.—A sample ton of improved casein will probably be sent shortly to the United Kingdom to ascertain the increased price commanded by material of better quality. Dr. Meldrum is investigating the preparation of rennet casein, the type required by makers of galalith; all Indian casein is lactic and has, therefore, been rejected for galalith manufacture.

The Geological Survey has made suggestions for improving the working of the alkali deposits of Sind, and a chemist will probably be detached to carry out check analyses on the spot.

The research work in Bombay on the discoloration of local magnesium chloride has not given satisfactory results, but the inquiry on the same subject at the Indian Institute of Science, Bangalore, offers more promise. The royalty payable by the Pioneer Magnesia Co. to the Government has now been fixed.—(*J. Ind. Indust., May*, 1922.)

Oil and Tallow in the United Provinces

The Industrial Chemist reports that the price obtainable for refined tallow is insufficient to pay the cost of refining on modern lines, as the price paid by textile workers for tallow refined by crude, native methods leaves very little margin of profit. Dr. E. R. Watson, of the Technological Institute, is investigating the possibility of using Indian vegetable oils to a greater extent in manufacturing lubricating oils for internal-combustion engines.—(*J. Ind. Indust., May*, 1922.)

New Sulphuric-Acid Factory in Bombay

The Dharamsi Moraji Chemical Co. has built a sulphuric-acid plant with a capacity of 7500 tons per annum which is the largest plant of its kind in India. It is reported that superphosphate will also be manufactured in the factory, which is one of the first to be built in the Ambernath area (on the G.I.P. Railway) now being developed in Bombay.—(*Chem. and Met. Eng., July* 19, 1922.)

GENERAL

Liverpool Section

The Liverpool Section of the Society is taking part in the organisation of an Associated Scientific Soireé to be held in the Liverpool Public Museum on Saturday, November 4. Space will be reserved for exhibits from members of the participating societies, and it is suggested that members of the Society of Chemical Industry in the district who would care to show specimens of materials or apparatus likely to be of interest, should communicate as soon as possible with the local secretary.

Platinum and Allied Metals, 1913—1919

A concise account of the properties, uses, prices and production of platinum and allied metals is given in this publication of the Imperial Mineral Resources Bureau (pp. 84, price 2s.). The world's output of platinum up to the present is estimated at about 11 million oz. troy, of which Russia has contributed about 90 per cent., Colombia 7 per cent., and Borneo 2 per cent., the remainder being furnished by the United States, Australia, and Canada. Probably 99 per cent. of this output has been derived from placers, but increasing amounts are being recovered at electrolytic-copper and bullion refineries. During the war period the output of platinum metals from placers declined from 175,181 oz. in 1913 to 73,435 oz. in 1920, but the fall in the Russian output from 157,735 oz. to 35,000 oz. was partly offset by an increase in that of Colombia from 15,000 to 35,000 oz. (crude). The geological features in certain areas of South Africa (Rhodesia and Cape Province) and of Spain suggest that platinum may eventually be won in payable quantities in these countries. Prices of platinum fluctuated greatly during the war, rising from 185s. per oz. early in 1914 to 220s. in September, 1916, 400s. in March, 1918, and 770s. in January, 1920, but falling to 390s. per oz. at the end of 1921. Platinum came into greater use as a catalyst in the contact process of making sulphuric acid, about 500,000 oz. being employed for this purpose towards the end of the war; losses of only 0·25 g. of metal per ton of acid made were reported, so that very little renewal was required. Platinum-iridium and nickel-chromium alloys, tungsten and molybdenum are gradually replacing platinum for use in the electrical industry, and in 1919 and 1920 in the United States over half the platinum consumed was used in making jewellery.

Iron and Arsenic in 1921

The following advance statistics, compiled by the Imperial Mineral Resources Bureau, show the world's production, imports and exports of iron and arsenic during 1921:—

IRON

			1921 Long tons
United Kingdom	Production	Pig iron	2,611,400
	Imports	Iron ore, including manganiferous iron ore	1,887,574
		Pig iron, including ferro-alloys	681,955
	Exports	Iron ore, including manganiferous iron ore	1,472
		Pig iron, including ferro-alloys	135,998
Union of S. Africa	Production	Iron ore	2,157
	Imports	Pig and ingot	1,023
Canada	Production	Iron ore	38,337
		Pig iron and ferro-alloys	616,847
	Imports	Iron ore	590,329
	Exports	Iron ore	3,804
India	Imports	Iron ore	9
		Pig iron	14,129
	Exports	Pig iron	51,942
Australia	Production	Iron ore	689,275
		Pig iron	352,365
	Exports	Pig iron	2,765
Austria	Production	Iron ore	670,000
		Pig iron	220,000
Belgium	Production	Pig iron	862,305
France	Production	Iron ore	13,879,000
		Pig iron	3,362,038
	Imports	Iron ore	418,196
		Pig iron and ferro-alloys	37,266
	Exports	Iron ore	5,212,845
		Pig iron and ferro-alloys	648,960
Germany	Production	Pig iron and spiegeleisen	8,000,000
Italy	Production	Iron ore	275,480
Luxemburg	Production	Pig iron	955,000
Norway	Imports	Pig iron and ferro-silicon	5,889
	Exports	Iron ore	188
		Pig iron and ferro-chrome	1,083
Soviet Russia	Production	Pig iron	967,741
Spain	Imports	Pig iron	24,135
	Exports	Iron ore	1,795,428
		Pig iron	4
Sweden	Production	Pig iron	3,036,000
Switzerland	Imports	Pig iron	24,282
Algeria	Exports	Iron ore	673,956
Tunis	Exports	Iron ore	200,733
United States	Production	Iron ore	29,547,000
		Pig iron	16,688,126
	Imports	Iron ore	315,768
		Pig iron and ferro-alloys	44,516
	Exports	Iron ore	440,106
		Pig iron and ferro-alloys	28,305

ARSENIC

			1921 Long tons
Southern Rhodesia	Production		322
Canada	Production	White arsenic and arsenic in ore	1,331
Queensland			220
France	Imports	Metal	5
United States	Production		5,116
	Imports	Arsenic and sulphide of arsenic	2,985

The Uses of Cotton Linters

An account of the characters, production and uses of linters is given in *Departmental Circular* 175 (1921) of the U.S. Department of Agriculture. Linters, which consist of the fuzz of the cotton seed together with any cotton fibre that has escaped removing during ginning, are used for stuffing mattresses and cushions, making absorbent cotton, felt, low-grade yarns for wicks, rope, felt, and, as cellulose, for making artificial silk, paper and explosives. During the war linters were greatly in demand for explosives manufacture, and by the introduction of new systems of delinting the yield was increased from 25 to 75 lb. to 140 to 200 lb. per ton of seed. By the "suction" system the fibre is blown from all the different delinting machines, mixed and united into one uniform grade. Although this system has since been abandoned as it does not give a product in the form of a felt, being therefore only of use in explosives manufacture, its value in saving labour and giving a cleaner and more uniform product has been appreciated and a method has now been devised by which the linters are converted into a felt. From 556,000 bales, or 3·5 per cent. of the cotton crop in 1911–12, the output of linters in the United States increased to 1,331,000 bales (10·9 per cent.) in 1917–18, but fell to 7·7 per cent. of the crop in 1918–19 and 5·4 per cent. in 1919–20. At present production exceeds demand, but it is hoped that the paper industry will use large quantities of it, and that other commercial applications will be found.—(*Imp. Inst. Bull.* XIX, 4, 1921.)

Determination of Hydrosulphite

Messrs. Brotherton and Co., Ltd., of Leeds, have published a pamphlet relating to the methods of determining sodium hydrosulphite in use in their laboratories. The preparation of pure indigo-carmine solution and of the hydrosulphite solution for analysis are described. A special apparatus is sketched, its use explained, and the precautions necessary to avoid oxidation of the indigo carmine reduced during the determination are detailed. In the silver method of estimating hydrosulphites a silver solution is prepared by dissolving one gram of silver nitrate in 10 c.c. of distilled water and adding 15 c.c. of a 20 per cent. solution of ammonium hydroxide. This solution is poured on to about 0·4 gram of solid hydrosulphite and the whole is well stirred. After about 5 minutes the grey precipitate of silver is filtered off, washed thoroughly with dilute ammonium-nitrate solution until free from silver nitrate, dried, ignited, and weighed; 216 parts of silver are equivalent to 174 parts of pure anhydrous sodium hydrosulphite.

A New German Periodical

Under the title "Wissenschaft und Industrie," Plauson's Forschungs Institut, of Hamburg, is issuing a new monthly publication under the editorship of Dr. H. Schmidt devoted to scientific and industrial research. The first number, published on July 15, contains articles by Plauson on the colour shown by colloid dispersions under the ultramicroscope, by Dr. H. Schmidt on corpuscular phosphorescence, and by Dr. J. Schmitt on a new organic reagent.—(*Chem.-Z., July* 6, 1922.)

"Germanit"

In *Metall und Erz* (1922, 13, 324) Prof. Pufahl, of the Berlin Technical *Hochschule*, describes the results of his investigation of a copper-sulphide mineral occurring in considerable quantities at Tsumeb in South-West Africa and containing nearly as much germanium as the mineral argyrodite (Saxony) in which C. Winkler discovered that element. The new mineral is always found associated with zinciferous arsenical pyrites and has a dark reddish-green colour and a weak lustre. Analyses of two hand-picked specimens gave (per cent.): Cu 45·4, Fe 7·22, Ge 6·20, Zn 2·61, Pb 0·69, S 31·34, As 5·03, and SiO_2 0·75. The name "Germanit" has been given to the mineral.

The Fertiliser Situation in Germany

In a recent debate in the Reichstag, the Minister of Food and Agriculture said that during the past fertiliser year synthetic nitrogenous fertilisers were utilised in greater quantity than in the years before the war. Supplies of phosphoric acid, although not so abundant as those of nitrogen, were twice as large as in the previous year, and would probably improve still further in the current season. Potash, as in former years, would be available in sufficient amount. Although prices of fertilisers had been kept stable during the past year and the prices of superphosphate, "Rhenania" phosphate, and bone meal had been temporarily reduced in June, 1921, the heavy costs of production and diminished output made great increases necessary at the end of the year. As doubt had been cast on the accuracy of the basis upon which the prices had been calculated, the question of evaluation was to be investigated. The value of fertilisers in maintaining yields was being increasingly recognised, especially among the peasantry, owing to propaganda work and demonstrations.—(*Chem. Ind., May* 29, 1922.)

The Industrial Value of Ostwald's Colour Rule

Ostwald has proposed to replace the prevailing custom of describing colours merely from their appearance by a method which enables any colour to be expressed as a numerical quantity. In this method all the colours are arranged in a circle, starting from yellow and passing through orange, red, violet, ultramarine, blue-green, sea-green, yellow-green, to yellow again. If the circle is divided into 100 parts the "colour tone" of yellow is 00, of red 25, of blue 50, of green 75. Conceptions of lightness and purity of colour are expressed by means of letters. If one colour is merely lighter than a second the first contains more white; if pure in shade it contains more black. Thus 53 *l c* represents a colour of "tone" 53 with whiteness *l* and blackness *c*. Ostwald has also propounded rules for combining two colours to form a third and for making up colour schemes involving a number of colours. The German colour industry does not seem to have accepted the system on account of practical difficulties which arise probably because the personal factor is not entirely eliminated.

Treatment of Acute Benzene-Poisoning with Lecithin Emulsion

A workman, 37 years of age, who had inadvertently drunk 80 g. of benzene came under treatment 1½ hrs. after, and when the stomach had been washed out, 5 c.c. of 10 per cent. emulsion of lecithin was injected. After an hour the chief symptoms—coma, depressed pulse, cyanosis, etc.—had disappeared, and after 36 hours the only sign of the poisoning was a slight albuminuria, which disappeared after a few days. It is uncertain whether the lecithin combined with the benzene in the blood stream and thus prevented it from accumulating in the cells, or whether it removed the poison already deposited in the cells. No untoward consequences resulted from intravenous injection and the fear of a fat embolism proved ungrounded. Lecithin emulsion has also proved useful in a case of acute oxalic-acid poisoning.

The Glass Industry in Belgium

In 1921 the Belgian glass industry failed to maintain the level of exportation that had been reached in 1920, and the weight of glass exported was 39 per cent. less than in 1920 and 46 per cent. below that of 1913. Despite this decrease, Belgium regained, and even improved, its former position in foreign markets for plate and window glass and table ware; thus the export of window glass to the United States was over twice as much as in 1913. Imports in 1921 were 61 per cent. greater than in 1920 and 28 per cent. less than in 1913. France supplied all the rough plate glass, but Germany, though still leading, monopolised some lines and shared others with France, Great Britain, Holland and Austria. Details of the imports and exports in 1921 are appended:—

	1921	
	Imports	Exports
	Metric tons	
Plate glass	44·4	24,629·4
Window glass	816·3	111,008·3
Bottles	14,924·7	2,374·7
Demijohns, wicker-covered	52·4	32·6
Ware of green glass (not bottles)	168·7	158·8
Table-ware	170·4	18,087·7
Other glassware	2,503·6	1,244·1
Total	18,680·6	157,335·5
Value, francs	23,222,784	271,665,662

Conditions in the Belgian glass industry were unfavourable during the first quarter of 1922; the demand was poor, prices were reduced by plate-glass factories in the United States, Germany and Czechoslovakia were competing strongly in flint and table glass, and prices of certain staple raw materials were rising. In the window-glass industry only 17 furnaces were operating, the plate-glass factories were working at about 50 per cent. of capacity and only five furnaces were producing special glass. Plants producing superior types of bottles were fully occupied, but those producing common bottles lost trade to Germany. In view of the increasing use of Fourcault machines—over 150 are being installed in various foreign countries—and of Libby-Owens plants, the future of the hand-blowing plants in Belgium is not promising. Current prices of raw materials (in francs per 100 kg.) for the glass industry are as follows:—Sodium sulphate 27; sodium bicarbonate 32·5; calcium carbonate, ground, 29; nitre, refined, 150; borax, crystallised, 157; fluorspar, ground, 25; felspar, ground, 21; cryolite 250; alumina, calcined, 280; manganese (87 per cent.), ground, 120 fr.—(*U.S. Com. Rep., Apr.* 17, *May* 8, 1922.)

Sugar Crop of Mauritius

According to the final estimate issued by the Mauritius Department of Agriculture, the sugar crop for 1921-22 is placed at 206,000 tons, or 20 per cent. below the normal yield, and the smallest crop since 1904, when it was 190,000 t. The sugar content of the 1921-22 crop was only 10·2 per cent., the lowest recorded during the past 10 years. This decline is due to the severe drought during the summer of 1921.—(*U.S. Com. Rep., July* 3, 1922.)

Chemistry in the Sudan

The work undertaken in the Wellcome Tropical Research Laboratories is very varied, ranging from the briquetting of charcoal (*cf.* J., 1921, 190 T) to wood preservation, sources of tannin, and cassava as a source of alcohol. Various samples of wood tar were examined in 1921, tamarisk wood yielding 8·9 per cent. of tar, which on distillation gave about 40 per cent. of tar oils and 60 per cent. of pitch—both products that could be utilised locally. The effect of the oils on wood as a protection against attack by white ants was tested and found to be inferior to that of coal-tar creosote; the method and material used, however, constituted a much more severe test than would be met in practice. Of the local sources of tannin, "dirimi" bark (*Burkea Africana*) has been examined, and the analysis gave, per cent.:—Moisture 6·5; ash 3·6; soluble solids 27·0; tannin 17·0. On account of the high price of petrol in South Sudan, bitter cassava (*Manihot utilissima*), a food crop grown in the Mongolia Province, was investigated as a source of alcohol. The material contained 72 per cent. of moisture and as the percentage composition of the dried material was:—Crude fibre 4·6; protein 5·5; ether extract 1·0; ash 3·5; carbohydrates 85·4, the material could probably be used as a source of alcohol.

Alcohol as Motor Fuel in Brazil

The National Brazilian Agricultural Society has recently completed tests relating to the value for motor fuel of a mixture of alcohol (95°) 65 parts, ether 25 parts, kerosene 9·5 parts, and pyridine 0·5 part. With this mixture, consumption per kilometric ton was 98.5 c.c., compared with 126 c.c. for gasoline, and the engine started easily and ran smoothly. With a mixture containing alcohol (95°) 83 parts, ether 10, kerosene 5, and pyridine 2 parts, difficulty was experienced in starting, the fuel consumption was 129 c.c. per kilometric ton, and the engine ran well only at the end of the test, which was carried out over a distance of 45·1 kilometres. Alcohol made from sugar-cane residues is sold at the Campos sugar factories in Brazil for about 275 reis per litre (about 9d. per gall. at current exchange), whereas gasoline costs 750 reis per litre in Rio de Janeiro (1000 reis = 2s. 3d. at par, now 7·4d.; litre = 0·22 gall.). The local factories could almost supply the needs of the Federal District and the State of Rio de Janerio, their productive capacity being 5·5—6·0 million gallons of alcohol. At present, however, the output does not exceed 1·75—2·2 mill. galls., and much of it is wasted through lack of transport facilities. If alcohol motor-fuel is to be used on a large scale, the cost of production must be reduced by organising storage and supply facilities, and the composition of the alcohol mixture must be standardised so as to produce the same power as gasoline.—(*U.S. Com. Rep., May* 15, 1922.)

PERSONALIA

Sir Robert Hadfield, Bart., has presented to the Metallografiska Institutet of Stockholm a scholarship of £150 per annum, tenable for two years, "as an expression of the debt of gratitude which the world owes to Swedish science.

Dr. J. Meisenheimer, professor and director of the Chemical Institute in the University of Greifswald, has been appointed to the chair of chemistry in the University of Tübingen, vacant by the death of Prof. W. Wislicenus, who had occupied it since 1903.

Engineer Vice-Admiral Sir George Goodwin, late Engineer-in-Chief of the Fleet, and Dr. J. C. Irvine, Vice-Chancellor and Principal of St. Andrew's University, have been appointed members of the Advisory Council to the Committee of the Privy Council for Scientific and Industrial Research.

In the examination for the Fellowship of the Institute of Chemistry, held in July, Mr. P. D. Oakley passed in Metallurgy, and Messrs. R. E. Essery and J. R. Walmsley in the Chemistry and Microscopy of Food and Drugs, and Water. Twenty-eight out of 45 candidates were successful in passing the examination in General Chemistry for the Associateship, and 6 out of 9 candidates passed the examination under the regulations in force prior to March, 1920.

In the United States, Dr. J. A. Ambler has been appointed chemist in charge of the colour laboratory of the Bureau of Chemistry, in succession to Dr. H. D. Gibbs; Mr. C. E. Betz has been appointed chief chemist of the Pittsburgh Testing Laboratory; and Prof. C. S. Bisson has left the S. Dakota School of Mines to take charge of the Department of Chemistry in the Northern Branch of the University of California; Dr. G. L. Wendt, professor of chemistry in the University of Chicago, has been elected president of the Standard Oil Co. of Indiana.

Ramsay Memorial Fellowships, of the value of £300 each, have been awarded to Dr. R. W. Lunt, to continue his work at University College, London, on chemical effects of electromagnetic waves over the frequency range 10^{-5}—10^{-8} cycles; to Mr. J. A. Mair, of Glasgow University, to pursue his research on the chemistry of the terpenes; and to Mr. W. Davies to continue his investigation on the preparation of synthetic reagents from the toluic acids. Fellowships have also been granted to Dr. J. O. Lublin and Mr. A. W. Bernton (Sweden); Mr. Dag Nickelsen and Miss M. Prytz (Norway); and Dr. C. S. Piggott, of Baltimore.

The British Research Association for the Woollen and Worsted Industries has awarded research fellowships to Mr. G. W. Chester, of Liverpool, to investigate wool fats at the University of Manchester; to Mr. J. L. Raynes, of Nottingham, to study the bleaching of wool at the University College, Nottingham; and to Mr. G. Barker, of Baildon, to conduct research at the University of Leeds on the effect of water on the strength, elasticity, lustre, dyeing properties, etc. of wool. Advanced scholarships have been awarded to Mr. A. Banks, Keighley, and Mr. W. E. Elliot, Hawick, tenable, respectively, at the Bradford Technical College and the Central Technical College, Galashiels.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for August 10 *and* 17).

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents, or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
Argentina	Earthenware	154
"	Disinfectants, sheep and cattle dips	156
"	Sulphuric acid, aluminium sulphate (tender for)	4390/F.L./C.C.
Australia	Perfumes in bulk	133
"	Perfumery, soap	161
"	Commercial sodium acetate (tender for)	9320/E.D./C.P.
Belgium	Paper	174
British West Indies	Steel sheets, tubes (tender for)	135
Chile	Enamelware, glassware, crockery, lubricating oils, tinplate, galvanised sheets	201
Egypt	Animal oil for denaturing ethyl alcohol (tender for)	8759/F.E.
Finland	Perfumery, polishes	177
Hungary	Copper sulphate	180
Luxembourg	Ferromanganese for iron and steel works	181
Mexico	Tin	160
"	Tinplate, black and galvanised sheets	202
Netherlands	Chile saltpetre (tender for)	15665/F.W./C.P.
Netherlands East Indies	Paint	153
New Zealand	Glassware	167
Norway	Tinplate, galvanised plates	142
"	Chemicals, iron and steel	F.R./5840
South Africa	Glass bottles, enamelware	169
Spain	Steel, tinplate, varnish, gums, shellac, fish oils	144
Switzerland	Raw materials for the chemical industry, intermediates for making coal-tar dyes	151
"	Pharmaceutical chemicals	152
United States	Fire-bricks, cement	198

TARIFF CUSTOMS EXCISE

Belgium.—The "coefficient of increase" applied to the duties on crystallised and granulated sugar has been reduced from 2 to 1·5.

Cyprus.—Imported fertilisers must be accompanied by a declaration of origin and the percentage contents of nitrogen, phosphoric acid, and potash in a soluble form.

Federated Malay States.—The import duties on matches have been revised.

Gold Coast.—The system of valuing goods for customs duty has been amended.

Ireland.—The Provisional Government has prohibited the importation, save under licence, of liquid fuels, lubricating oil, sheet metal, and iron plates.

Kelantan.—The import duty on lime has been raised from 3 per cent. to 10 per cent. *ad valorem.*

Memel Territory.—A list of customs duties applied to spirits, ether, salt, mineral and resin oils, and hides is given in the issue for August 10.

Newfoundland.—It is proposed to exempt imports of kerosene oil, gasoline, bark, bark extract, cutch, potassium dichromate, and logwood from the sales tax of 5 per cent. *ad valorem.*

New Zealand.—Celluloid and other capsules are admitted duty-free under the British preferential tariff. The conditions under which dumping duties will be levied are set out in the issue for August 17.

Nigeria.—The export duties on hides and skins have been reduced.

Portugal.—Special surtaxes have been imposed on exports of cork, oilseeds, palm oil, and vinegar.

Portuguese East Africa.—The additional duties levied on imports of sugar, spirits, alcohol, edible oils, benzol, gasoline, dynamite, gunpowder, mirrors, lubricating oil, soap, candles, salt, vinegar have been modified.

Southern Rhodesia.—Recent amendments of the customs tariff affect corks, kinematograph films, medicinal preparations, essences, syrups and tinctures, and starch.

REPORTS

THIRD REPORT OF THE DEPARTMENTAL (HOME OFFICE) COMMITTEE ON LIGHTING IN FACTORIES AND WORKSHOPS. *Pp.* 38. *London: H.M. Stationery Office,* 1922. *Cmd.* 1686. *Price* 9*d.*

Commencing with a brief review of the recommendations contained in two previous reports (*cf.* J., 1921, 318 R), the present report is devoted principally to the classification of industrial processes according to the illumination they need, and to the effects of mixed natural and artificial lighting. For the present it is recommended that definite legal minima of illumination shall not be imposed for processes carried on in factories and workshops, but that a specification of minima as "recommended practice" for different groups of processes shall be issued. Schedules A and B, contained in Appendix 1 of the present report, covering "fine work," for which the recommended minimum illumination is 3 foot-candles, and "very fine work" for which a minimum of 5 foot-candles is recommended, are suggested as the basis of such specification. Only those industries have been scheduled in which at least one process was judged to be "fine work" or "very fine work." Thus the iron and steel industry is entirely excluded and very few, if any, distinctly chemical processes are scheduled. Although no definite recommendations are made respecting processes needing only moderate illumination, it is pointed out that if the recommendations of the first report are adopted, the illumination at floor level in workrooms cannot fall below 0·25 foot-candle.

No conclusive results indicating special effects of mixed lighting (partly artificial light and partly daylight) were obtained, and at present no definite recommendations can be made on this matter.

The customary use of a naked source of light appears to be unnecessary for the examination of glass sheets during the bevelling process, and it is suggested that glass-bevelling shops should comply with the recommendation, contained in the second report, for avoiding glare.

Owing to the need for economy, the inquiries of the committee are concluded for the present. It is pointed out, however, that hardship to employers and administrative difficulties in the imposition of definite legal minima of illumination in workshops and factories would be largely avoided if a sufficient number of observations were collected indicating the best existing practice in the various processes, and if the conditions of illumination desirable on physiological and psychological grounds were investigated. The principal industries scheduled in Appendix 1 are invited to co-operate in this scheme by arranging for the collection of actual data, if possible through research associations.

Report on Peat by the Commission of Inquiry into the Resources and Industries of Ireland. *Pp.* 110. *Published by the Commission,* 87, *Grafton Street, Dublin.* 1921. *Price* 2*s.* 6*d.*

Many attempts have been made to develop the Irish peat deposits on a large scale and a special report was made to the Fuel Research Board only last year (*cf.* J., 1921, 229 R). All the attempts to manufacture pressed peat-briquettes have failed, and research has been directed towards the more efficient winning of peat by the use of machines of the Wielandt, Baumann, or other type, and the generation of cheap power in installations comprising either a water-tube boiler and turbo-generators or large gas-producers and gas-engines (*cf.* J., 1920, 213 R).

The commission of inquiry considers that experiments should be made to determine how far the percentage of water in peat can be reduced by "bottom drainage," and would compel turbary owners to co-operate in drainage operations. A recommendation is made that one or more of the automatic machines which have proved so successful in dredging, forming and spreading peat should be acquired by the Irish State and tested carefully on the Irish bogs. Air-drying of peat, depending, as it does, on the climate, makes the peat-winning industry discontinuous, and well-considered experiments should be initiated from time to time with a view to devising some successful method of drying peat by artificial means, even though at present it would seem to be quite uneconomical to do so. The manufacture of peat charcoal has proved commercially successful, whereas carbonisation for the production of illuminating gas has been a failure. Another outlet for peat would be its use in pulverised form, either alone or mixed with powdered coal, although this would have to be confined to rotary kilns or locomotives, and would not apply to large power stations. The most promising method of utilisation seems to lie in gasifying the peat in producers, and using the gas in stations not exceeding a few hundred horse-power in capacity. For large stations, the use of turbo-alternators is advocated, although when the peat contains a high percentage of nitrogen, it might be advisable to gasify it in by-product recovery plants and to use the resultant gas for boiler-firing, the steam being then used in turbo-alternators as before. The Commission is of the opinion that four stations, each designed to carry about 20,000 kw. constant load, would more than suffice for Ireland's requirements of combined nitrogen for the manufacture of nitrogenous fertilisers and explosives. The establishment is advocated of at least one station of 20,000 kw.-capacity by the Irish State in a suitable locality, part of the electrical power developed to be utilised at the bog for manufacturing calcium cyanamide and the remainder transmitted to centres of industry.

Moss-litter manufacture is commercially sound, but the Commission states that little hope can be entertained for any scheme for producing alcohol from peat. The cellulose constituents, on hydrolysis, yield unfermentable sugars, *e.g.*, arabinose, in addition to fermentable sugars such as glucose. It rarely happens that the percentage of dry turf which can be converted into alcohol exceeds 12 per cent. One ton of air-dried moss yields about 10 gallons of absolute alcohol, but the main expense is incurred in distilling the very weak wash, which contains only about 0·6 per cent. of alcohol.

The Bogs Commissioners of 1809—1814 recommended the utilisation of cutaway and virgin bog, a recommendation with which the present Commission agrees, whereas an agricultural sub-committee appointed by the Department of Agriculture and Technical Instruction for Ireland reported that the reclamation of virgin bog would not be remunerative even under the most favourable conditions, although the reclamation of cutaway bog might possibly be remunerative under certain conditions (*cf.* J., 1921, 229 R). It is recommended that, in order to avoid speculation, the State should acquire all the larger bog lands of the country at bog value, and that a few very large bogs should be reserved by the State primarily for meeting national needs, and secondarily for carrying out national experiments on the utilisation of peat.

Report on the Trade, Industry and Finance of Syria, Dated April, 1922. *By* H. E. Satow, *H.M. Consul-General, Beyrout. Department of Overseas Trade. Pp.* 25. *London: H.M. Stationery Office,* 1922. *Price* 9*d.*

Syria possesses no industries, coal or petroleum, and agriculture is undeveloped and primitive Apricots, pistachio nuts, and wool are exported, but shipments of olive oil are declining owing to poor quality, and silk cocoons are produced for export to France and Italy. There is a certain amount of water power, but except at Damascus none is harnessed. The minerals include gold, copper, iron ore, manganese ore, chromite, gypsum, lignite (none of any value), and asphalt. Alluvial gold occurs in an extensive deposit near Antioch and panning tests are said to have yielded about 1·5 dwt. of gold per cb. yd. Large nodules of copper are found between Alexandretto and Aleppo, iron ore occurs to the north of the former town and manganese ore in Northern Syria, but neither of the two last-named minerals are suitable for industrial use. Chromite occurs abundantly, especially between Suedia and Alexandretta, and small amounts have been extracted. Gypsum is said to exist in quantity at Suedia and asphalt is found in many localities, especially at El Becheri on the Euphrates.

Until the mandate for Syria is confirmed and the political situation in the Near East becomes clearer, the country's commercial future cannot be foreseen, and trade statistics are of value only in showing what goods are required. Imports through Beyrout in 1921 were valued at £9,889,458 (£2,629,161 from Great Britain and £1,895,844 from France) and included iron and steel bars, copper bars, cement, tiles, window glass, matches, dyes, paint, chemicals and soap. Exports were valued at £553,843, of which nearly one-half was directed to France.

COMPANY NEWS

The British Cyanides Co., Ltd.

The directors report states that the company's Tat Bank Factory was closed down throughout the whole of the year ended April 30, 1922, and that owing to foreign competition in potassium compounds it has not been reopened. The Pope's Lane Factory was reopened in August, 1921, and is now operating on a profitable basis. New processes have been worked out on a small scale for the manufacture of refined potassium compounds; one such compound is now being made by electrolysis on a profitable scale.

The experiments on the barium process for the fixation of atmospheric nitrogen have been energetically pursued and, although seriously hindered by the crises in the coal and engineering trades, have given definite results of a satisfactory nature. The merits of the new type of furnace designed by Sir Arthur Duckham have been proved and the directors believe that this great problem will be solved during the current financial year.

Severe competition in foreign potash having made it necessary to close down the works of the British Potash Company, Ltd. during the year under review, active negotiations have been entered into and are now in progress which, if successful, will enable the company to recommence operations on a satisfactory basis, but these negotiations are being conducted under considerable difficulties owing to the unsettled state of Europe.

The company has embarked upon the merchanting of foreign chemicals, and the profits earned during the year covered the initial heavy expenditure. The total net profit for the year was £2383, and after meeting the dividend on the preference shares there remains a balance of £492 to be carried forward.

Minerals Separation, Ltd.

At the 17th ordinary general meeting, held in London on July 29, Mr. F. L. Gibbs, chairman, described the success of the company's new processes for treating coal. The company had now a perfect system of cleaning fine coal; a system that would solve the problem of reducing the moisture-content of fine coal; and a new system of manufacturing briquettes which was less expensive and produced a much purer fuel than the present method. The trials of the briquetting system, carried out in conjunction with the Powell Duffryn Steam Coal Co., had been very satisfactory. Ground coal mixed with 50 per cent. of water was briquetted in a press, all the water, save about 4—5 per cent., was expressed as a clear jet, and the resulting briquettes became so hard in a few hours that they could be thrown about without breaking. The amount of binder required was only about one-third of that usually employed, and the briquettes made from coals belonging to the Powell Duffryn company could be obtained with only about per cent. of ash and 3 per cent. of moisture. It was unnecessary to dry the coal before briquetting and no pugmills were required. A plant with a daily capacity of at least 2000 tons of the new patent fuel ("Minseps") was to be erected on a site already acquired in Wales. The fuel had been tested on a Welsh railway passing up steep gradients and had given great satisfaction.

TRADE NOTES

BRITISH

Leeward Islands in 1920–21

Antigua suffered from severe and prolonged drought during 1920–21, and consequently the sugar crop was so reduced that only the abnormal prices ruling for sugar saved the industry from serious loss. Exports from Antigua included:—Sugar, molasses and syrups £314,562; cotton £16,362; hides and skins £1782; lime juice £1079; and green limes £246. High prices were again obtained for the sugar (12,483 tons) and cotton (251 t.) produced in St. Kitts and Nevis, but the fall in prices of all tropical products seriously affected the planters in Dominica and the export of lime products declined in value by £10,991 to £185,410; these products included lime juice, concentrated, 154,040 gallons, raw, 273,082 galls.; citrate of lime 304 t.; essential oil of limes 22·6 t.; and otto of limes 9 t. The factory established in St. Dominica by L. Rose and Co. for making citric-acid crystals should prove successful, as over 84 per cent. of the export of lime products in 1919 and 1920 consisted of concentrated juice and calcium citrate. Coconut-growing offers great possibilities in Dominica, but has received little attention; the export of coconuts increased by 214,553 to 706,979, which constitutes a record. Cotton is the chief product of Montserrat and the export was 248 t.; other exports were:—Lime juice 96,851 galls.; concentrated lime juice, citrate of lime, fresh limes £2734; muscovado sugar 116 t.; and papaine 821 lb. Good progress was made in extending the area under cultivation in the Virgin Islands; the cultivation of coconuts is spreading, but cotton is still the chief crop.—(*Col. Rep.-Ann.*, *No.* 1074, 1922.)

FOREIGN

Exports of Soap, Oils and Fats from Germany

Official statistics give the German exports of soap, oils, fats and related products during the first quarter of 1922 as follows:—

	Jan.–Mar., 1922 Metric tons	Mill. mk
Soaps:—		
Soap in cases and jars ..	1817·9	63·2
Hard soap, solid creolin, fat lye powder, etc.	143·1	2·7
Soft-soap, liquid creolin, etc. ..	348·7	6·9
Toilet soap, alumina soap, etc. ..	467·4	11·6
Total	2772·1	84·4
Related products:—		
Polishes etc.	546·6	16·9
Glycerin and soap by-products ..	263·2	14·2
Cart grease	76·1	0·3
Lubricants prepared with oils or fats	600·7	8·4

The total export of soap in 1920 was 4121·5 t., valued at 55·7 million marks. Danzig, Memel, the Saar district, Luxembourg, Switzerland, and other adjacent States are the chief markets for German soap products.

Dyes in the Red-Sea District

Prior to the war over 800,000 lb. of dyes, valued at £38,000, was imported annually into the Red-Sea district through Aden. The dyes were chiefly lac scarlet, vegetable indigo and saffron from India, but Germany supplied all the aniline red and synthetic indigotin. Following the war, importations declined to 162,671 lb. in 1919–20, but improved to 528,503 lb. in 1920–21, the shipments originating as follows:—Aniline red: Bombay 198 lb., United Kingdom 1296 lb., Austria 3248 lb. Lac scarlet: India 473,872 lb. Vegetable indigo: India 25,984 lb. Synthetic indigotin: Austria 10,524 lb., Belgium 3248 lb. Saffron: India 133 lb. Germany is reported to be regaining a footing in this market.—(*U.S. Com. Rep., June* 12, 1922.)

German Exports of Red Lead, Zinc Dust, and Bronze Powders from January to March, 1922

Destination	Red Lead	Zinc Dust	Bronze Powders
		Metric tons	
Austria	159·1	70·1	—
Belgium	—	119·8	7·1
Czechoslovakia	172·1	—	—
Denmark	32·1	—	3·1
England	—	—	17·4
France	—	—	9·5
Holland	93·9	1466·2	9·8
Italy	—	—	19·7
Spain	—	—	2·9
Sweden	57·8	19·4	2·2
Switzerland	—	—	9·6
S. E. Asia	79·3	—	—
United States	—	—	122·4
Other countries	374·5	508·4	39·6
Total	968·8	2183·9	243·3
Value. mill. mk.	25·1	24·6	28·3

The total amount and value of the exports of the above products during 1920 were:—Red lead, 3370·4 t., 35·3 mill. mk.; zinc dust, 4261·2 t., 19·3 mill mk.; bronze powders, 832·7 t., 49·9 mill mk.

GOVERNMENT ORDERS AND NOTICES

Export of Fertilisers.—The Board of Trade has issued an open general licence authorising the exportation to all destinations of basic slag; superphosphate of lime; and manures, compound, containing either basic slag or superphosphate of lime.

Phosphate Deposits in Morocco.—A copy of the *Bulletin Officiel* (No. 503, June 15), containing a report on the work of the Sheerifien Office of Phosphates during 1921, may be consulted at the Department of Overseas Trade, 35, Old Queen Street, S.W. 1.

Chemical Works Regulations, 1922.—The Home Secretary has issued Regulations for chemical works dated July 11, 1922, which constitute the final form of the draft Regulations issued in December, 1920, and in March, 1922. Copies may be obtained from H.M. Stationery Office, price 4d.

Safeguarding of Industries Act.—*Part I.*—The Board of Trade has received a complaint under Section I (5) that acetic acid of 80 per cent. grade or higher has been improperly excluded from the lists of dutiable articles. The complaint will be submitted to the Referee, and any person directly interested should communicate immediately with the Assistant Secretary, Board of Trade (Industries and Manufactures Department), Gt. George St., S.W.1.

International Exhibition of Liquid Fuels in Paris.—This exhibition, which is being organised by the Société de Chimie Industrielle in connexion with an International Congress on Fuels (October 9—15), will be held in Paris from October 4 to 15. Applications for space should be made to Monsieur J. Gérard, Commissaire Général, 49, Rue des Mathurins, Paris, and all particulars can be obtained from the Department of Overseas Trade (Exhibitions and Fairs Division), 35, Old Queen Street, S.W.1.

REVIEWS

(1) Engineering Steels. *By* Leslie Aitchison. *Pp.* xxxii.+390. *London: Macdonald and Evans*, 1921. *Price* 25*s. net.*

(2) Metallography. *By* C. H. Desch. *Text-books of Physical Chemistry, edited by Sir W. Ramsay and Prof. Donnan. Third edition. Pp.* x+440. *London: Longmans, Green and Co.*, 1922. *Price* 16*s. net.*

(1) This book is published in the Reconstructive Technical Series, the aim of which is to diffuse the new knowledge and enlarged technical skill gained during recent years and so make it available for the practitioner of to-day, as a means towards greater all-round efficiency and increased competitive power in the world's markets. The series is published under the editorship of G. W. de Tunzelman. Each volume is designed to serve a particular trade or vocation, the present volume dealing with steels from the engineer's point of view and providing the information which the engineer should possess in order to enable him to understand the steels which he is using. Prof. W. C. Unwin has written the foreword in which he compares modern requirements with those of the days of wrought iron. The developments in engineering practice during the last twenty years have resulted in the necessity for steels capable of performing higher duties than the older-fashioned plain carbon steels, and the requirements of the automobile and aircraft industries in particular have created a demand for steels possessing high orders of mechanical properties. This demand for high-quality steels has led to extensive inspection and the compilation of many specifications. The earlier specifications merely aimed at securing stipulated mechanical test results but the modern requirements must necessarily include correct chemical composition and correct heat treatment.

The purely metallurgical portions of the subject are dealt with very briefly; for instance, steel-making processes occupy fifteen pages, and this chapter seems a little unbalanced as more than five of these pages are devoted to the Bessemer process which is of minor importance in connexion with the type of steels mainly dealt with in the book.

The casting and working of steel receive attention, the solidification of molten steel in ingots being followed out in detail together with the nature of the crystallisation which takes place and its bearing on the properties of the resulting metal. This is of particular importance for its bearing on the position of planes and zones of weakness in the ingot, which may become the centres of definite defects. The effect of work, such as forging, on the crystals situated in different parts of the ingot and on the mechanical properties of the steel is described.

The chapter devoted to the heat treatment of steel occupies fifty pages, the thermal equilibrium diagram of the iron-carbon system and the effect of alloying elements on the hardening of steel receiving attention. Mass and volume effects in heat treatment and the engineering value of hardened and tempered steels are also discussed. The methods used for the mechanical testing of steel receive considerable attention as it is recognised that the metal will finally be judged by its mechanical properties, and from the engineer's point of view the details of composition, heat treatment, etc. are only of secondary value. The tests which have recently become so important to the engineer, such as hardness, impact, alternating stress, and other tests are dealt with and the mechanical properties of steel are described, the definitions of the British Engineering Standards Association for elastic limit and yield point being used. A chapter is devoted to plain carbon steels in which the effect of varying carbon, high and low manganese, mass, etc. is described and followed by details of the mechanical properties of certain steels of selected compositions. A separate chapter is devoted to the important subject of alloy steels, and in this a classification is used based on the maximum stress obtainable with the steels. Steels with air-hardening properties are described in detail. Nickel-chrome steels receive most attention, but nickel, chrome-vanadium and "stainless" or high chromium steels are also described.

Case-hardening is of considerable importance to the engineer, especially for the lighter forms of machinery, and the operation itself, the carburising mixtures, the temperature necessary, the steels suitable, and the after-treatment of the case-hardened parts receive attention. The influence of cold work on the mechanical properties of steel is of greater importance than is generally realised, and cold worked material, in the form of bright drawn bar, is largely used in the manufacture of comparatively unimportant parts, particularly those in automatic machines. The changes in mechanical properties produced by varying amounts of cold work and also by reheating to temperatures below the critical range, that is, in the operation of blueing, are illustrated by tables and curves. The concluding chapter deals with tool steels, and in this chapter it appears that a disproportionate amount of attention has been given to plain carbon tool steels and too little to self-hardening and high-speed steels.

The book contains fourteen appendices, on such subjects as the influence of sharp corners and scratches on mechanical properties, Young's modulus of elasticity, the properties of steels at high temperatures, various classes of machines for impact testing, determination of hardness; and the last one consists of a bibliography of original papers on the hardness of metals. It is illustrated by a number of photomacrographs and photomicrographs showing crystalline structure of ingots, defects met with in ingots and forgings, effect of heat treatment and similar subjects; it is a pity that among such an excellent series of photographs, a very poor hand-drawn representation of pearlite has been inserted.

This book should prove to be very useful to engineers requiring a knowledge of the possibilities of modern steels and to metallurgists requiring definite knowledge of the more recent methods of testing metals. The subject could have been treated from a somewhat broader point of view, as it must not be forgotten that the engineer has many requirements not covered by aircraft and automobile specifications, which appear to constitute the chief interests of the author.

(2) This third edition of Professor Desch's well-known book on metallography will be welcomed by all interested in the subject because in it the most important results of recent investigations and references to recent publications have been incorporated. The last edition appeared in 1913; since then the demands for the book have been met by a new impression of the second edition, published in 1918. The most important changes have been made in the chapters dealing with the physical properties of alloys, with corrosion and with the metallography of iron and steel. With reference to the physical properties of alloys, further information is added on hardness, a subject which has received considerable attention during the last few years. The subject of corrosion also receives further treatment, the work of the Corrosion Committee of the Institute of Metals being specially referred to. In the chapter on the metallography of iron and steel, the results of the study of the space lattices by the X-ray method have been added. The actual amount of new material in this edition is not great and its increased value is due to small additions and modifications together with references to the latest work. There is probably no one with a better knowledge of the literature of the subject than the author, and his tables of alloy systems contained in the appendix of 24 pages are probably more frequently referred to by metallographers than any other published matter on the subject.

C. O. BANNISTER.

INORGANIC CHEMISTRY. *By* T. MARTIN LOWRY. *Pp. x+943. London: Macmillan and Co., Ltd., 1922. Price 28s. net.*

To everyone engaged in teaching senior students the appearance of a new book on advanced inorganic chemistry by an author of reputation is an event of very real interest. For in spite of all the developments of chemical science inorganic chemistry must remain common ground to all chemists, and no chemical education can exclude the study up to a certain point. It is, however, becoming always more difficult to fix the reasonable limits and to assort from the overwhelming mass of material such a body of facts as should be brought to the notice, and to a large extent be established in the memory, of the student. There is also the difficulty of deciding how much of the general theory of chemistry, which in recent times it has been the growing habit to detach as "physical chemistry," should be elucidated in connexion with the facts, processes and applications of inorganic chemistry. There is here a great demand on the sense of proportion of the author and, be it added, on the consideration of his critics. Finally when the selection has been made there remains the crowning task of presenting the material with the utmost lucidity, coherence, and interest attainable within the limits of a book of marketable price.

Professor Lowry has evidently taken very great pains with his book, he has secured valuable assistance from a number of highly competent authorities and he has achieved his task in rather less than a thousand well-written, well-printed, and well-illustrated pages. As soon as the book appeared the present writer read the first 200 pages and has since devoted many short periods to sampling the rest. As the result he is inclined to rate the book very highly indeed, and—though he awaits the experimental trial with students for a final judgment—to place it as a strong competitor for the first place among all books that attempt the same object, subject only to the price not proving prohibitive.

It is not easy to state fully the grounds on which this judgment is based, but they are mainly two; first that Dr. Lowry exhibits what seems to be a very wise choice of material and secondly that he gives the impression of having not merely assembled it but of having exercised a critical judgment upon it and given to a great deal of it the impress of his own mind. It is inevitable that there should be the defects incidental to a necessary compression. So far as the historical side is concerned this is fully compensated by the fact that it drove the author to publish separately his Historical Introduction to Chemistry, a book of high and enduring value. But the physical chemistry of the present volume is so compressed that much of it can only rank as a reminder of what must have been learned, under more degrees of freedom, elsewhere. One can see also how the author has been under constraint in his excellent handling of practical applications. But to get an idea of what confronts the writer of a text-book on inorganic chemistry to-day consider for example what you are to do with iron. Think of the advance of knowledge in thirty years! What are you to say about its metallurgy—what about the various steels—are you to say that gamma iron differs from the alpha and beta forms in being constructed on a face-centred cubic lattice—and if you do, are you to elucidate the statement? At every point facts that you would like every student to know stand in queues, waiting for admission, in no clearly rightful order of precedence.

Professor Lowry has adorned his book with a number of beautiful pictures of minerals. They will have the effect of stirring the memory and exciting a salivary flow in those who have been nurtured and subsist on a less splendid mineral diet than is here portrayed. But to those who have not seen the things at all in reality, what is really to be got from these pictures? Perhaps Dr. Lowry will consider the advisability of replacing in a future edition some at least by the beautiful microphotographs of Sir George Beilby's recent book.

Very few minor errors have been noticed and no really indictable offences of commission or omission have obtruded themselves during this first examination. On the question of price it is to be hoped that the publishers are competent judges and that Professor Lowry's book may be put to the extended trial that it certainly deserves.

ARTHUR SMITHELLS.

BEITRÄGE ZU EINER KOLLOIDCHEMIE DES LEBENS. *By* DR. RAPHAEL ED. LIESEGANG. *Second edition, revised. Pp.* 39. *Dresden and Leipzig: Theodor Steinkopff*, 1922. *Price, paper*, 1*s*. 2*d*.

This pamphlet discusses the bearing of colloid chemistry upon the problems of its relations to living matter. The pamphlet begins with an introductory section on diffusions, followed by five different sections under the following heads:—(2) Diffusions with chemical exchanges, (3) Lime precipitation in gelatin gels, (4) Stratified structures, (5) Crystalisation in gels, and (6) Dissimilation, assimilation, and membrance action. The author has, on the whole, treated the subject with clearness, the material is well selected, and references to the literature are given where neceessary. It will undoubtedly prove a useful and interesting summary to all those seriously interested in the subject.

DINSHAW R. NANJI.

CHEMISTRY OF RADIOACTIVE SUBSTANCES. *By* A. S. RUSSELL. *Pp.* xi+173. *London: John Murray*, 1922. *Price* 6*s. net.*

Dr. Russell has written an "Introduction to the Chemistry of Radioactive Substances" in a series of 12 chapters covering about 170 pages. It is perhaps a sign of the way in which this subject has developed that the present volume, instead of being a monograph, with detailed references to almost every paper that has been issued, takes on the familiar form of an elementary text-book, and does not profess to do more than provide an introduction to the study of the subject.

Dr. Russell possesses in a special degree the two qualifications that are needed to make a success of such an enterprise, namely, a complete knowledge of the subject with which he has to deal and considerable experience in explaining scientific phenomena to non-technical readers. In this volume he has fulfilled in an excellent way the task he has set before him, and, although the student must look elsewhere for references to serve as an index to the original literature, he will, after mastering Dr. Russell's book, have obtained a knowledge of the subject which is amply sufficient for any chemist who does not propose to undertake original work in this field.

T. M. LOWRY.

PUBLICATIONS RECEIVED

THE PETROLEUM AND ALLIED INDUSTRIES. *By* JAMES KEWLEY. *Industrial Chemistry Series, edited by Dr. S. Rideal. Pp.* 302. *London: Ballière, Tindall and Cox*, 1922. *Price* 12*s*. 6*d*.

CALCULATIONS OF QUANTITATIVE CHEMICAL ANALYSIS. *By* L. F. HAMILTON *and* S. G. SIMPSON. *International Chemical Series. First edition. Pp.* 196. *New York and London: McGraw-Hill Book Co., Inc.*, 1922. *Price* 10*s*.

DOCUMENTS AND THEIR SCIENTIFIC EXAMINATION *By* C. AINSWORTH MITCHELL. *Pp.* 215. *London: Charles Griffin and Co., Ltd.*, 1922. *Price* 10*s*. 6*d*.

KOLLOIDCHEMIE, 1914—1922. *By* DR. R. E. LIESEGANG. *Wissenschaftliche Forschungsberichte. Vol. VI. Pp.* 100. *Dresden and Leipzig: Th. Steinkopff*, 1922. *Price, paper*, 3·4*s*.

DIE METHODEN ZUR HERSTELLUNG KOLLOIDE LÖSUNGEN ANORGANISCHER STOFFE. *By* DR THE SVEDBERG. *Third edition. Pp.* 507 *Dresden and Leipzig: Theodor Steinkopff*, 1922 *Price* 13*s*. 2*d*.

THE NATIONAL PHYSICAL LABORATORY. COLLECTE RESEARCHES. *Pp.* 354. *London: H.M. Stationery Office*, 1921. *Price* 20*s*.

THE MINING LAWS OF THE BRITISH EMPIRE AND FOREIGN COUNTRIES. VOL. III. PART GENERAL PRINCIPLES APPLICABLE TO SOUT AFRICA: THE TRANSVAAL. *Imperial Miner Resources Bureau. Pp.* 400. *London: H. Stationery Office*, 1922. *Price* 30*s*.

IRON ORE. SUMMARY OF INFORMATION AS TO T PRESENT AND PROSPECTIVE IRON-ORE SUPPL OF THE WORLD. *Imperial Mineral Resourc Bureau. London: H.M. Stationery Offi* 1922. PART VII.—FOREIGN AMERICA. *Pp.* 1 *Price* 4*s*. PART VIII.—FOREIGN ASIA. *Pp.* *Price* 2*s*. 6*d*.

REVIEW

Vol. XLI] SEPTEMBER 15, 1922 [No. 17

CHEMISTRY AT THE BRITISH ASSOCIATION: HULL, 1922

At the ninetieth meeting of the British Association for the Advancement of Science, held in Hull from September 6 to 13, Prof. J. C. Irvine, F.R.S., Principal of St. Andrews University, delivered the presidential address to Section B (Chemistry). The following abstract of this address was prepared under the author's supervision, and the succeeding abstracts are those of papers presented to the same meeting by workers in Principal Irvine's laboratories.

PRESIDENTIAL ADDRESS TO SECTION B

ART I—The Organisation of Research

LOOKING back on the sixty-nine years which have elapsed since the British Association last met in Hull, it is vident that, in the interval, a revolution has aken place in the public and official attitude owards scientific research. The change has ome rapidly, but it was not spontaneous. Many years had to be spent in disseminating he idea that scientific research is a vital ecessity, and toward this end Presidents of he British Association have added the weight f their influence and eloquence. Although any other factors have doubtless played a art in creating a research atmosphere in this ountry, the work of the British Association as not been the least important.

Scientists have been given the opportunities hey desired now that the State, acting through he Department of Scientific and Industrial esearch, provides facilities for graduates to ake a part in advancing scientific knowledge. hemistry bulks largely in each of the research ganisations operative in this country, and e future of our subject is intimately connected ith their success or failure. We are at the ginning of a new phase in research, which s become a unit in our national scheme of ucation, and chemists must not forget that consequence fresh responsibilities devolve on them. By their own efforts they must stify what has been done.

The Government grants are awarded gener- sly and widely, and there is a rush to chemical search in our Colleges, but no matter how eat the enthusiasm and ability of these young aduate workers, they have to be trained, ided and inspired, if their research period to be spent to the best advantage. Help of s kind can come only from the man of mature ars and experience, and the duties of such upervisor cannot be light. He must possess rsatility, must command the ready sympathy and understanding which enable him to enter into the beginner's difficulties, and he must avoid the temptation to use the research student as a scientific labourer.

Experience has shown that young research graduates require firm handling, and that constant effort is necessary to secure that they work in a business-like manner, keep proper records, and avoid extravagance and waste. The fulfilment of these requirements absorbs the main energies of the research supervisor, who is called upon to sacrifice his leisure and, in large measure, his own private research. The success of the scheme will be imperilled if our Universities and Colleges fail to realise this and are unprepared to afford members of the professor or lecturer class, who join in the movement, relief from formal teaching and administrative duties. Otherwise, we shall have made the mistake of focussing unduly on the research apprentice to the neglect of the interests of the mature investigator.

To secure these ends it is suggested that, in each institution, there should be a board or standing committee entrusted with the supervision of research. The functions of such a body would be widely varied and would include :—

1. The allocation of money voted specifically from university or college funds for research purposes.
2. The power to recommend additions to the teaching staff in departments actively engaged in research.
3. The recommendation of promotions on the basis of research endeavour.
4. The supervision of regulations governing higher degrees.

Among the more specific problems which would confront such a Board are :—

1. The creation of research libraries where reference works can be consulted immediately.
2. The provision of publication grants, so that where no periodical literature is available, the work will not remain buried or obscure.
3. The allocation of travelling grants to enable workers to visit libraries, to inspect manufacturing processes, and to attend meetings of the scientific societies.

PART II—Some Research Problems in the Carbohydrates

CELLULOSE—STARCH—INULIN

Twenty years ago, the first paper on the alkylation of sugars was given by Purdie and Irvine to the meeting of the British Association in Belfast. The principles then communicated have since proved of wide application in furnishing well-defined evidence of the structure of sugars and their derivatives, so that one by one the natural groups of carbohydrates have been studied by this method. As a result, ideas regarding the constitution of these compounds have become more secure and more definite. Simple sugars, glucosides and disaccharides have all been brought under review, and the results now submitted justify the application of structural formulæ to cellulose, starch and inulin.

CELLULOSE

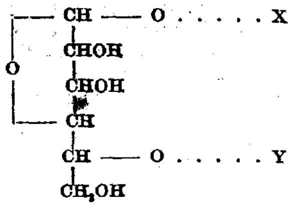
(*with W. S. Denham and E. L. Hirst*)

The difficulties which stand in the way of ascribing a molecular constitution to cellulose are too numerous to mention, but the stability of the complex, coupled with its limited solubility and lack of volatility, are outstanding obstacles. Although it is obvious that real progress can come only as a result of patient and systematic research, and that impetuous theorising does infinite harm, many suggestions have nevertheless been put forward to represent the polysaccharide structurally.

A necessary preliminary to speculation on the formula of cellulose is to ascertain if the aggregate $(C_6H_{10}O_5)_n$ is composed entirely of glucose units. The required evidence has been obtained, as cotton cellulose has been converted into pure crystalline methylglucoside, the yield of which is 95 per cent. of the theoretical amount. Structures which are unrelated to glucose can therefore be disregarded and the various formulæ for cellulose may be appropriately divided into three classes :—

1. Constitutions modelled on that of the glucosides, involving the addition of numerous glucose residues by mutual condensation. According to this view, cellulose consists of large molecules.
2. The unit of cellulose may be regarded as a simple anhydro-glucose, $C_6H_{10}O_5$, highly polymerised.
3. The unit has been claimed to be a simple anhydro-*n*-saccharide (where *n* is a small multiple), polymerised in unknown numbers.

In 1910 Dr. W. S. Denham succeeded in alkylating cellulose and obtained a derivative containing 25 per cent. of methoxyl. This, on hydrolysis, yielded a mixture of methylated glucoses from which 2.3.6.-trimethyl glucose was isolated. Denham's work thus gave the first clear evidence as to the linkage of part of the cellulose molecule which must contain the unit :—



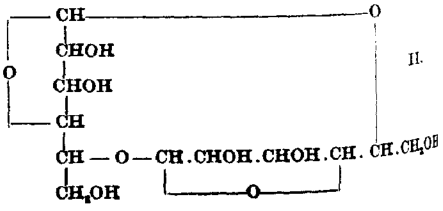
I.

His research left unexplained the nature of th residues X and Y, and the investigation wa therefore, continued. In consultation wit Dr. Denham, we find that the exhaustiv methylation of the polysaccharide, when repeated twenty times, gives a product containing 43·0 per cent. of methoxyl in place o 45·6 per cent. required for a trimethyl-derivative. The carbon and hydrogen values als agree with the formula $(C_6H_7O_2(OMe)_3)_x$ and as the material preserved a fibrous structure there is little likelihood that profound molecula alteration had taken place. The trimethy cellulose was then submitted to simultaneou depolymerisation, hydrolysis, and conversio of the scission products into the correspondin methylglucosides. These were distilled in high vacuum, the total yield obtained bein 90 per cent. of the theoretical amount. Th distilled material consisted of 2.3.6-trimethy methylglucoside and *no trace of tetramethy methylglucoside was present.*

On hydrolysis of the distilled glucoside, a 89 per cent. yield of crystalline 2.3.6.-trimethy glucose was obtained showing $[\alpha]_D$ +108° → +67·0°. *No isomeric trimethyl glucose wa present : higher and lower methylated glucose were absent.* The reactions involved in th research are shown below, and considering th nature of the operations involved the yield may be claimed to be quantitative.

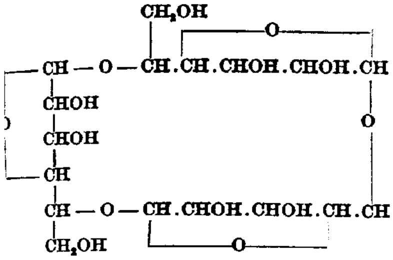
Cellulose
↓
Trimethyl cellulose } Yield 90%
↓
2.3.6–Trimethyl methylglucoside
↓ } Yield 89%
2.3.6-Trimethyl glucose

The scheme affords a proof that all the glucos residues in cellulose are identical in structur and have the hydroxyl groups 2, 3, and 6 unsubstituted. To satisfy this condition and t account for the formation of cellobiose, it i necessary to include in the formula at least tw glucose residues. This is fulfilled by th structure II.



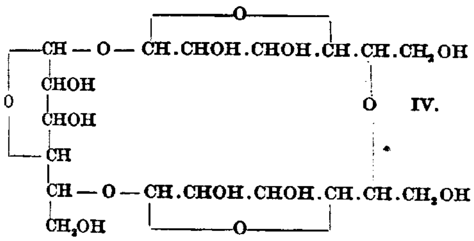
II.

In terms of the above, 100 parts of cellulose should give 105·5 parts of cellobiose, and here the difficulty is encountered that the yields of this disaccharide are extremely variable and rarely exceed 35 per cent. The highest claimed is of the order 50—60 per cent. and, in the meantime, it is prudent to select a formula for cellulose which will give a result only slightly higher than this figure. We, therefore, propose the symmetrical tri-1.5-anhydro-glucose for the unit of cellulose on the ground that this structure would give a 70 per cent. yield of cellobiose as the theoretical maximum.



III.

There is, however, an alternative method of coupling the glucose residues and this gives the structure shown below :—

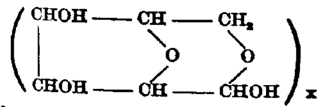


IV.

Taking into account the fact that it can yield only one disaccharide, we prefer Formula III. The essential properties of cellulose, so far as they are displayed in chemical reactions, are accounted for by both formulæ.

Various formulæ which have been previously suggested for cellulose are excluded by the results now submitted. Selected examples are :—

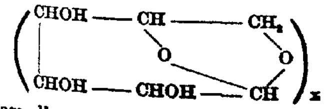
Green's formula :—



V.

which would give a trimethyl cellulose and, on hydrolysis, would be converted into 3.4-dimethyl glucose of the amylene-oxide type.

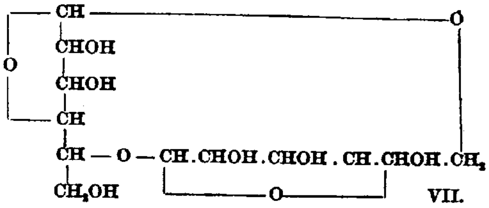
Vignon's formula :—



VI.

is equally unsatisfactory in that the final product should then be 2.3.4-trimethyl glucose of the amylene-oxide type.

The formulæ proposed by Tollens, Cross and Bevan, Bartelemy and Pictet are unsuitable for similar reasons. It is also possible to dispose of Karrer's formula which is that of an anhydro-cellobiose (termed " cellosan ")



VII.

A compound possessing this structure would yield on methylation and hydrolysis:—

1 molecule of 2.3.5-trimethyl glucose,
and 1 molecule of 2.3.6-trimethyl glucose.

Our experimental evidence is completely opposed to this view.

An entirely different type of formula for cellulose has been proposed by Hess, who regards the polysaccharide as a complex glucoside. The feature common to all such glucosidic formulæ is that the hydroxyl groups are not symmetrically distributed in the glucose residues. The simplest structure suggested by Hess would give, by our processes, five molecules of 2.3.5.6-tetramethyl glucose and one molecule of glucose, whilst his more elaborate molecules would produce these same compounds together with trimethyl glucose. The reactions of trimethyl cellulose exclude all formulæ of this nature.

STARCH

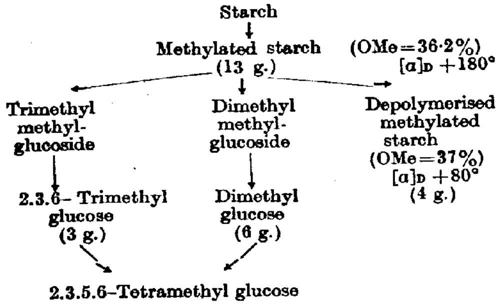
(*with John Macdonald*)

Turning to the problem of the constitution of starch, we encounter very much the same difficulties as have already been referred to under the heading of cellulose. At the present time there is little tendency to regard starch as a highly complex glucoside in which a large number of hexose residues are mutually condensed together, and the view prevails that the polysaccharide is derived from a comparatively simple anhydro-sugar by profound polymerisation. Attention may be focussed on three formulæ based on such ideas.

The unit of starch has been claimed to be :—

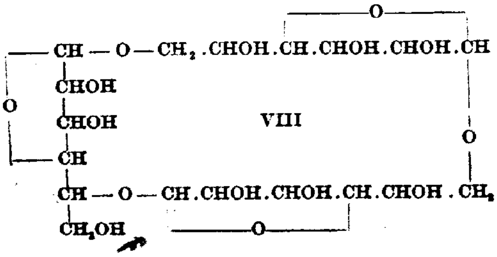
1. β-glucosan	(Pictet).
2. anhydro-maltose	(Karrer).
3. triamylose	(Pringsheim).

It is possible to test these views by the methylation method. When the polysaccharide is methylated repeatedly the reaction ceases when the methoxyl content is 37 per cent. Now, this value for methoxyl corresponds exactly with the theoretical amount calculated on the basis that one hexose residue has acquired three methyl groups whilst four are shared by two glucose residues. Ultimate analysis is also in agreement with this view. Hydrolysis of the methylated starch has shown that this is not a fortuitous coincidence, and we thus obtain a direct clue to the magnitude of the unit which goes to form the starch molecule. When digested with methyl alcohol containing hydrogen chloride, the methylated polysaccharide was converted into trimethyl methylglucoside and dimethyl methylglucoside. These were separated by distillation in a high vacuum and thereafter hydrolysed to give the parent sugars. A totally unexpected result was encountered in that the trimethyl glucose isolated proved to be the crystalline form in which the methyl groups occupy the 2.3.6-positions. One glucose-residue in starch must thus be substituted as shown in Formula I., and must have the linkage characteristic of cellulose. In order to accommodate the formation of maltose from starch, either one or two additional glucose residues must be present at X and Y in the unit, but before developing a formula which will fulfil the above conditions, an outline of the reactions involved may be given :—


Starch
Methylated starch (13 g.)
(OMe=36·2%) [a]D +180°
Trimethyl methyl-glucoside
Dimethyl methyl-glucoside
Depolymerised methylated starch (OMe=37%) [a]D +80° (4 g.)
2.3.6– Trimethyl glucose (3 g.)
Dimethyl glucose (6 g.)
2.3.5.6–Tetramethyl glucose

It will be seen that the removal of trimethyl glucose and dimethyl glucose in the molecular ratio of 1:2 is effected without alteration in the *composition* of any methylated starch which survives hydrolysis.

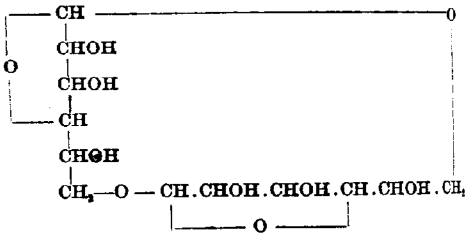
Four different structures may be built up to accommodate the formation of maltose and the results afforded by methylation. These possible formulæ differ in an important respect in that maltose may be obtained in two ways from one of the structures, and in only one way from each of the others. Pending the completion of further work on this subject, we prefer the Formula VIII. :—



The above constitution postulates that starch is derived entirely from the butylene-oxide form of glucose, and this we have shown experimentally to be the case.

Two objections to the molecular unit proposed may be discussed. In the formation of maltose no more than one molecule of this disaccharide could be obtained from one unit. The maximum yield of the sugar, without making allowance for any synthetical action of the enzyme, would therefore be of the order 70 per cent. (74 per cent. calculated as maltose hydrate). Another objection to the new structure is that the acetolysis of starch might result in molecular rupture in such a manner that cellobiose would be produced. So far, this disaccharide has not been encountered in the degradation products of starch, a result which is not surprising in view of the uncertainty attending the isolation of cellobiose.

It is perhaps advisable to point out that the experimental results now presented demand the rejection of various formulæ for starch proposed from time to time by Karrer. His structures are based on a diamylose (anhydro-maltose), two formulæ for which have been put forward, differing in the position of the anhydro-ring. The unit he prefers at present is :—



and it is clear that the only trimethyl glucose to which such a structure could give rise is the 2.3.5-form described by Irvine and Oldham. No trace of this compound was detected by us and, moreover, the 2.3.6-variety of trimethyl glucose actually obtained cannot possibly be accommodated by Karrer's formula. For similar reasons, it can no longer be maintained that starch is an aggregate of β-glucosan residues.

INULIN

(*with Ettie S. Steele, G. McOwan, and M. I. Shannon*)

Inulin is derived from fructose and, until recently, there was no reason to doubt that the parent hexose was the well-known lævorotatory form of the ketose. This view is no longer tenable as, although inulin itself yields the normal form of fructose on hydrolysis, trimethyl inulin is converted into a *dextro-rotatory* trimethyl fructose. In similar manner, dimethyl inulin gives a *dextro-rotatory* dimethyl fructose. Each of these alkylated ketoses was proved to be a derivative of the γ-fructose which is a constituent of sucrose.

This result places inulin in a position which is unique, and the evidence is conclusive that the polysaccharide is entirely composed of γ-fructose residues, each of which retains three hydroxyl groups. One important point left unsettled in previous papers on this subject was whether the trimethyl γ-fructose obtained from trimethyl inulin is a single chemical substance or a mixture of isomerides. The experimental difficulties in the way are formidable, as methylated fructoses of the γ-type are liquids and give no crystalline derivatives. By the following method, however, it has been established that only one form of trimethyl fructose is produced from inulin.

Trimethyl inulin was digested with methyl alcohol containing hydrogen chloride under conditions which effected (*a*) depolymerisation, (*b*) hydrolysis, (*c*) condensation, to give trimethyl methylfructoside. The product was distilled in a high vacuum and fractions were abstracted at frequent intervals while the boiling point remained constant. All the fractions showed the same refractive index and specific rotation. Moreover, the speed of hydrolysis of the fructoside was in each case the same, and in each experiment the trimethyl fructose then formed showed identical physical constants. Of greater importance is the fact that all the specimens of trimethyl methylfructoside reacted in the same way when dissolved in acetone containing hydrogen chloride. Under these conditions, trimethyl fructosemonoacetone was formed, and here again the speed of the reaction showed no difference in any of the specimens.

There can be no doubt, therefore, that inulin is an aggregate of anhydro-γ-fructose residues and that each of the units is identical. As the exact structure of the methylated fructoses of the γ-type is not yet determined with certainty it is premature to speculate on the manner in which these residues are united, but the subject is engaging our attention.

* * *

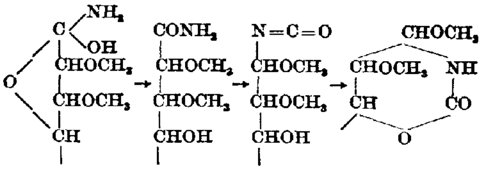
Looking at the position which has been reached, it may be said that the polysaccharides, like many other fields of research, are after all not so complicated as they appeared when viewed from afar. The close relationship now established between cellulose and starch, starch and lactose, inulin and sucrose will, it is hoped, play a part in bringing within the range of exact experiment the structural study of all types of natural compounds related to the simple sugars.

A New Type of Nitrogenous Sugar Derivative

By J. Pryde

In extending his studies of the action of sodium hypochlorite on amides of α-hydroxy acids, Weerman applied his reaction to the amides of simple hexonic acids and so devised what has proved to be the best practical method of degrading hexoses to pentoses. In the present communication the results of applying this degradation method to a fully methylated hexose are given. The investigation was originally undertaken in the hope that a propylene-oxide form of a methylated arabinose would be obtained in place of the normal butylene-oxide type, or alternatively that the intermediate compounds would be isolated and thus elucidate the course of the reaction as applied to the sugar group.

Tetramethylglucose was oxidised to tetramethylgluconic acid, which was isolated as its internal lactone. The lactone, dissolved in absolute alcohol, was treated with dry ammonia and the amide was isolated in a crystalline condition. Evidence is available to show that this compound does not possess the structure of a true acid amide, but exists in the form of an aminolactone. On subjecting the amide to the action of cold alkaline hypochlorite a crystalline body of the composition of the intermediate isocyanate was obtained and from its behaviour the constitution of an internal urethane has been assigned to it. The reaction proceeds as follows:—



The formation of this intermediate urethane affords striking evidence of the stabilising effect of methyl groups in the sugar chain. It is also interesting in showing the conversion of a carbohydrate into a derivative in which nitrogen is present in a stable cyclic substituent.

The Preparation and Constitution of Synthetic Fats containing a Carbohydrate Chain

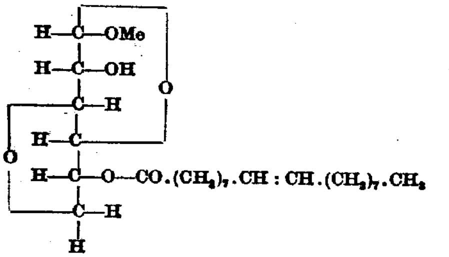
By Helen Simpson Gilchrist

The products obtained when a carbohydrate chain is coupled with the unsaturated groups characteristic of natural fats have been studied with the object of establishing the constitution of the synthetic fats thus formed.

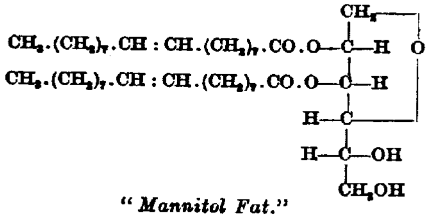
As shown by Lapworth and Pearson, α-methylglucoside and mannitol both combine, on heating in the presence of sodium ethoxide, with the oleyl residues of olive oil, thereby liberating glycerol. The present research has proved that a mono-oleate is initially formed in the first case, whilst in the second two oleyl groups enter the hexitol chain. This condensation is immediately followed by internal dehydration, the carbohydrate chain in each case losing one molecule of water, and the fatty residues remaining intact.

Anhydro-methylglucoside mono-oleate and mannitan di-oleate are definite chemical individuals. On methylation they yield monomethyl derivatives, which are unstable in the high vacuum of the Gaede pump. On being heated with acid alcohol, these methylated compounds both give methyl oleate, together with an alkylated sugar derivative. In both cases the anhydro-ring in the molecule persists during hydrolysis and thus a passage is opened into the series of anhydro-sugar derivatives and alcohols.

Examination of the above cleavage products confirms the views already held regarding the mechanism of the reactions discussed, and complete structural formulæ are assigned to the original "methylglucoside" and "mannitol" fats.



"*Methylglucoside Fat.*"



"*Mannitol Fat.*"

THE SIGNIFICANCE OF CRYSTAL STRUCTURE*

SIR WILLIAM BRAGG

A CRYSTAL can be considered as built up by the repetition through space of a unit of pattern. The unit preserves throughout its internal character, its orientation, and its relations to neighbouring units. There is a minimum value for the volume of the unit, and its form is definite; but its boundaries may be chosen in different ways. For instance the smallest portion of a crystal of rock salt which fulfils the definition of a unit is a cube whose edge is 5·62 Angström units: and its corners may coincide either with chlorine atoms or with sodium atoms. We may call such a unit the "crystal unit."

The crystal unit contains every kind of atom or bond, every feature, and every property which the crystal possesses as a whole. If we investigate the physical properties of the crystal we investigate the physical properties of the unit. If we can discover the number and the arrangement of the atoms within the unit we may hope to discover also the part which each atom plays in forming the characteristics of the whole. The methods of X-ray analysis tell us very readily the number of atoms in the unit, and are throwing more and more light on their arrangement.

This mode of progress has its analogies in the history of physics and chemistry. Some of the properties which substances possess are also possessed by the individual atoms or molecules of which they are composed. In the main the properties are those which are displayed when the substance is gaseous or liquid: when, in fact, its atoms or molecules are not linked together into crystalline form. Progress has followed on the discovery of the constitution of the smallest portion of the substance, molecule or even atom, which displays in full the properties referred to. As far as possible the part played by each atom in the molecule is then laid bare. The further this analysis is carried, the more does it become possible to carry out the reverse process, and to design, or it may be to construct, a substance having any desired characteristic.

The general limitation to the properties of gases or liquids is really severe. We remove it when, by the aid of X-ray analysis, we examine the structure of the crystal unit, because the unit displays all the properties of the solid. A crystal has elasticities, thermal expansions, thermal and electric conductivities, dielectric capacities, optical activities, and all these not only as scalars but as vectors. Quartz, to take a simple instance, has many properties as a crystal: all of them are displayed also by the crystal unit of quartz, that is by three molecules of SiO_2 arranged in a particular way. They are not characteristic of the separate molecule of SiO_2, still less of the separate atoms of silicon or oxygen. When we know the exact arrangement of the nine atoms in the unit, we can apply all that we know about quartz to this small group. In this way a wide field of research opens out, in which the crystal unit plays a part like that of the molecule in other fields, and the magnitude of the results may be just as great.

So far as X-ray analysis of the crystal unit has progressed in the few years since its inception, it has followed the natural course. Some property of the whole substance is considered as capable of explanation by what is to be found within the unit. The first property to be treated in this way was that of form or symmetry, one of the most striking of crystal characteristics. In fact many of the first determinations of crystal structure were made by the aid of the principles of symmetry with a very little, but very necessary, assistance from the X-ray analysis. In the case of rock salt, for example, the symmetry is that of a cube, and of the highest class of cubic symmetry, so that, as soon as the analysis had assigned four molecules to the crystal unit, and had shown also certain differences in the spectra of the isomorphous substances NaCl and KCl, the structure was determined completely. Even with more complicated structures, considerations of symmetry are of great assistance, for they limit the number of possible configurations. Many instances are to be found already in the short history of X-ray analysis.

---

* An abstract of papers delivered before Sections A and B of the British Association, Hull, 1922.

When the symmetry of the crystal is considered as belonging also to the unit, and when at the same time the number of atoms or of molecules in the unit is known, very interesting deductions may be made concerning the symmetries of the atoms or molecules themselves. We may take a simple example from an organic crystal. Naphthalene belongs to the monoclinic prismatic class, that is to say, it has an axis of digonal symmetry and a plane of symmetry at right angles to it. There are two molecules in the unit. If the molecule had no symmetry of its own, the symmetry of the unit could not be achieved by the use of two molecules only; four would be required. We might imagine ourselves constructing the crystal with reference to a given axis and a given plane of reflection perpendicular thereto. We place one molecule in position, and a second so that it is the reflection of the first: then we turn the pair about the axis through 180° and so find the positions of the third and fourth molecules. Since only two molecules are required, not four, we conclude that the naphthalene molecule has already a degree of symmetry. If it has a plane or centre of symmetry, the latter of the two operations described is sufficient; the former, if it has a centre of symmetry, or a digonal axis. In mathematical terms, if the molecule has symmetry represented by $[(x, y, z,)\ (x, -y, z,)]$ *i.e.*, a plane of reflection, the digonal rotation adds $[(-x, y, -z,)\ (-x, -y, -z,)]$; if it possesses a centre of symmetry as represented by $[(x, y, z,)\ (-x, -y, -z,)]$ or digonal symmetry $[(x, y, z,)\ (-x, y, -z)]$, then reflection adds $[(x, -y, z,)\ (-x, -y, -z,)]$. The result is always the four-point symmetry of the monoclinic prismatic class, as already described.

It seems almost certain that we can go further than this and say that the naphthalene molecule has no more symmetry than is required for the construction of the unit: it has *either* a plane of symmetry, *or* a digonal axis, *or* a centre of symmetry and no more. Mr. Shearer, who has been investigating these questions, concludes that we can lay down, at least provisionally, the two following principles:—

(1) Any symmetry in the molecule itself is reproduced in the crystal.

(2) The number of molecules in the elementary lattice is always the minimum number necessary to give the full symmetry to the crystal.

It follows that the symmetry of the crystal can never be less and will in general be greater than the symmetry of the molecule.

The replacement of a hydrogen atom by a hydroxyl-group destroys all the symmetry of the naphthalene molecule: because the X-ray analysis shows that it takes four molecules to make the crystal unit of either α- or β-naphthol. On the other hand, acenaphthene has as much, though conceivably not the same, symmetry as naphthalene. There are four molecules in the unit cell which is rhombic bipyramidal or, in other words, which can be obtained from a totally unsymmetrical molecule by reflecting across all three of a set of rectangular co-ordinate planes, as represented by $[(x, y, z,)\ (x, y, -z,)\ x, -y, z,)\ (-x, y, z,)\ (x, -y, -z,)\ (-x, y, -z,)\ (-x, -y, z,)\ (-x, -y, -z,)]$, an eight-point system. The molecule of acenaphthene has, like that of naphthalene, a two-fold symmetry of some kind.

The crystal unit of benzene itself attains the same symmetry by the use of two molecules only: the molecule itself has a four-fold symmetry, it might be itself monoclinic prismatic in form, $[(x, y, z,)\ (x, -y, z,)\ (-x, y, -z,)\ (-x, -y, -z,)]$ or rhombic pyramidal $[(x, y, z)\ (x, y, -z,)\ (-x, y, z,)\ (-x, y, -z,)]$. It has, in the crystal, no trigonal or hexagonal symmetry as might be suggested by the usual graphic formula.

Quartz has a sixfold symmetry which can be represented in cylindrical co-ordinates by $[(r, \theta, z)\ (r, \theta+\pi/6, -z)\ (r, \theta+\pi/3, z,)\ (r, \theta+\pi/2\ -z,\ (r, \theta+2\pi/3, z,)\ (r, \theta+5\pi/6, -z,)]$. Three molecules make up the crystal unit: and it is the threefold repetition of the molecule about the axis which introduces the 3 as a factor. Each molecule itself has digonal symmetry and no more: this symmetry is necessarily found in the crystal and gives the three digonal axes.

All these considerations are based on the principles of symmetry, which concern themselves with the *angular* dimensions of the crystal unit. With the examination of the *linear* dimension we enter another field of inquiry. The main lines were laid down by my son, W. L. Bragg, in a Friday Evening Discourse at the Royal Institution and subsequently in the Philosophical Magazine (August, 1920). It appears that to every atom may be assigned one or more radii of combination: so that when two atoms are neighbours in the construction of the crystal unit the distance apart of the centres is given by the sum of the two appropriate radii. An atom may possess more than one radius, according to the nature of the combination: but the number of such radii is so limited that the conception is most useful. In the case of the alkali halides, for example, each atom can be given a definite radius of combination, with consistent results. But if the nature of the combination is varied, so may be the radius. A simple example is that of calcium in the metal and calcium in calcium fluoride: it is necessary to assign a larger value to the radius of combination of calcium in the former case than in the latter.

Even the rule that, if an atom is surrounded by a number of like neighbours, it must be at the same distance from all of them, is sufficient at times to assist in the solution of a crystal structure. For example, in the case of ice, it is certain, *a priori*, that either an oxygen atom is surrounded by eight hydrogen atoms at equal distances from it, and a hydrogen atom by four oxygen atoms, or there is a six-to-three arrangement, or a four-to-two: and it is quickly found that the last is the only solution possible. Consequently every oxygen atom is at the centre of gravity of its four oxygen neighbours, from each of which it is separated by a hydrogen atom. This defines the structure, except that there are two alternatives, corresponding to the two alternative forms of close packing, hexagonal and cubic. The former is usual in the case of ice, but apparently the latter has been observed.

Other properties of the crystal have also been examined: Born, Landé, and others have considered the elasticity of the crystal in reference to the unit, especially in the case of polar crystals, such as rock salt. Older measurements of the physical properties of crystals are applicable now that the structure of the unit can be examined: but the whole field is barely touched as yet. Backhurst, who has investigated the effect of temperature, up to 900° C., on the reflecting powers of crystals has obtained some very interesting results, incidentally, on their behaviour during expansion. A cubic crystal expands uniformly in all directions of course; but the examination of the expansion of the crystal unit in various directions must give important results. For example, Backhurst finds that the expansion of graphite along the axis is very great: whilst across the axis it is small, perhaps no more than in the case of diamond. In the sapphire the effect of temperature upon the intensities shows that the relative arrangement of the molecules changes: the two aluminium atoms keep apparently at the same distance, 2·7 A.U., from each other—they are in a sense in contact—whilst the other atoms move with respect to them. A very interesting line of research opens up in this way.

Very little, indeed, has been done with respect to optical properties. Astbury has been examining the structure of tartaric acid: he finds that there are two molecules in the unit cell, and as the latter possesses twofold symmetry only, the molecule has no symmetry at all, as might be expected.

When a model is constructed in accordance with the indications of the X-ray analysis, it shows two spirals in each molecule. One of them lies in the carbon atoms at the core of the molecule and might be expected to persist in solution. It implies an optical activity peculiar to the molecule. The other spiral lies in the hydroxyl groups: it is due to the crystalline structure, and would disappear in a dilute solution in which the molecules have become totally independent. Lowry has predicted the existence of two terms in the expression of the optical activity of tartaric acid; the X-ray analysis suggests their origin.

In this short account it has been possible to describe, no more than briefly, the beginnings of what we may hope will be a great development of scientific research.

THE CHEMIST'S PART IN THERAPEUTIC PROGRESS

SIR WILLIAM POPE

THE daily Press has lately given a good deal of attention to a new chemical material which is supposed to be an absolute specific in cases of sleeping sickness; this interest is well deserved, but it is not clear that sound views on the subject are being placed before the public. It appears that a substance described as "Baeyer 205" has been found more useful than any previously known as a cure for sleeping sickness (*cf. J.*, 1922, 218 R); as it is very probable that many substances can be made which will effect this cure, no reason exists for doubting the justice of the claim.

So much importance is attached to the question that it has been thought necessary to send a deputation of German experts to British Central Africa to test the efficacy of their product and to prove its value. It is probable, and indeed greatly to be hoped, that they will succeed. The composition and method of manufacture of the substance are, of course, kept secret so that Germany may be enabled to sell it, at a profit, to the British Government. We are further informed by *The Times* of August 25 that the Baeyer works has provided material for use in the Belgian Congo against malaria and the various coast fevers. We are also told that at the meeting of the "Association of Tropical Diseases," held at Hamburg, the statement was made that "Baeyer 205" is the key to tropical Africa, and consequently to all the colonies, and that the German Government must "be required to safeguard this discovery for Germany; its value is such that any privilege of a share in it granted to other nations must be made conditional upon the restoration to Germany of her colonial empire."

It may be stated at once that no vast effort on the part of any scientific genius is required to produce a cure for sleeping sickness, or, indeed, of malaria, coast diseases, leprosy and many other maladies which make colonisation difficult. During centuries past a certain number of diseases have led to such extreme suffering and have proved so resistant to treatment that exaggerated views have been formed concerning the difficulty of finding a radical cure or an infallible preventive. The more mysterious is a disease in its nature and in its mode of attack, and the more horrible it proves in its effects, the more prone is the mind, by a simple psychological process, to attach difficulty to the problem of finding a cure or a prophylactic. Not many years ago one of the foremost of English physiologists remarked to me that he conceived two eventualities which would justify him in committing suicide: if he were suffering from cancer or from syphilis. He may retain his opinion with regard to cancer, a disease which we do not yet understand, but he has certainly abandoned syphilis as a justification for desperation.

As a result of scientific work of the very highest order of excellence we now know the nature of syphilis; this disease is due to the presence of a minute organism, the *Spirochæta pallida*, in the blood stream, and kinematograph exhibitions have been given showing the organism at work. The nature of the disease once established no great scientific genius was required for the production of a cure; a comparatively simple routine method is available for discovering a cure for syphilis and for those many diseases of allied character—malaria, coast diseases, leprosy—which make colonisation difficult. This efficient method of attacking the problem has been applied by the Germans; it consists in studying the toxic effects of all likely chemical substances on the lower organisms which may cause disease by establishing themselves in the blood stream. Ehrlich found that substance numbered 606 is more toxic to the organism of syphilis than it is to its human host; substance 606 then at once took precedence of all other means of treatment and established itself as the first definite cure for syphilis. Similarly it was found that injections with trypan-blue cure piroplasmosis or red-water, which had long been recognised as the scourge of all the great cattle-raising areas of the world. In the same way, if Baeyer 205 destroys the trypanosome before it kills the patient it will cure sleeping sickness.

If we have any faith in the methods of science and repose any confidence in the direct and logical conclusions drawn from experimental results we must believe that each disease of this particular parasitic class—syphilis, malaria, sleeping sickness, leprosy, etc.—can be cured by one application of some one of the myriads of chemical substances which can now be made. This being the case it seems shameful that this country, with its great overseas responsibilities, should be content to allow Germany, with no colonies, to carry out the simple programme of investigation which leads to the discovery of infallible curative agents for tropical diseases which are otherwise fatal.

The National Medical Research Council is well organised for studying the properties of any particular drug which may be brought to its notice, but something more than a medical or pharmacological organisation is needed for the efficient working-out of the problems presented. The Government requires a council of chemists capable of drawing up a programme of work involving the preparation of series of allied compounds which may be expected to be toxic towards the lower organisms productive of this particular large class of diseases; with means of promptly making these compounds, and with the facilities already in existence for studying their therapeutic action, our country would quickly take precedence of Germany in the discovery of curative methods, and would make impossible the ridiculous claims recently put forward at the Hamburg meeting referred to above. The fact that an "Association of Tropical Medicine" exists in Germany, with the main objects of curing diseases which do not occur in German territory, and of drawing a commercial profit by treating those diseases in the territories of Britain and her Allies, is ample condemnation of our method of coping with tropical problems.

Clearly, what is required is the establishment of an advisory council of chemists to the Government to confer, to draw up a programme, and to see that it is carried out; the supply of the necessary research materials to the National Medical Research Council would thus be assured. As has often been pointed out before, such an advisory council would render inestimable service in connexion with the applications of chemical science and technology to many branches of national activity.

MEETINGS OF OTHER SOCIETIES

INSTITUTION OF RUBBER INDUSTRY

At the meeting held in the Engineers' Club, London, on September 4, Mr. F. Kaye read a paper on "Rubber Latex in Paper-Making."

Rubber latex is a limpid liquid which contains 30 to 35 per cent. of rubber and is miscible with water in all proportions. Ammonia is an efficient preservative, the cost being from 1½d. to 2d. per gallon of latex, and material thus preserved is selling in London at 4s. 3d. per gallon. The cost of breaking down the coagulated rubber used for compounding may be from £7 to £8 per ton, and this can be set against the increased freightage on rubber imported in the form of latex.

The method of using rubber latex in paper-making is comparatively simple, the essential condition being extensive dilution of the latex before addition to the beaten pulp, so that the latex quickly penetrates and becomes intimately associated with every particle of the beaten fibre. After thorough mixing with the pulp the rubber is thrown out on the fibre by suitable coagulative agents, such as magnesium sulphate or acetic acid. Alum is found, however, in most cases to be effective, used exactly as in ordinary paper-making processes. If the paper has to be tub-sized alum can be used as the coagulative agent, and if the paper is machine-sized the latex may be added before or after the size and alum, provided that sufficient alum is added to throw out the size and rubber completely.

Rubber latex has some specific effect upon the fibres in the beating engine and upon the rate of hydration of the fibres. Fibres in paper made with small or large amounts of rubber latex are often closer and more uniform in texture than a paper made of the same fibre without rubber latex. Paper can be considerably improved by adding such small amounts of latex as will give a rubber content of 0·1, 0·2, and 0·5 per cent., and vegetable, animal, and even mineral fibres, such as asbestos, may be used in paper containing rubber latex. New qualities of paper can be made, and if larger proportions of rubber are introduced it will be quite possible to make leather substitutes and linoleum substitutes on a paper-making machine. Experiments show that all kinds of stock—paper, boards, leather and linoleum substitutes—can be dyed during the process of manufacture in the beating engine, as rubber in the latex form takes up the dye quite as freely as the fibre, so that a great variety of effects can be produced.

INSTITUTION OF CHEMICAL ENGINEERS

At the twelfth meeting of the Provisional Committee, held on August 2, Sir Arthur Duckham presiding, it was reported by the solicitor that the registration of the Institution by the Board of Trade was still delayed.

The suggestions of the Institute of Chemistry were agreed to, viz., that the definition of Chemical Engineering should be omitted, and that a clause should be inserted stating that the Institution claims no right to prescribe courses of study or to hold examinations whereby qualifications, or authority to practice or to use any distinctive title, can or may be conferred in respect of the practice as such of analytical or technical chemists (other than chemical engineers) or of teachers of chemistry.

The Committee was unanimously opposed to changing the title of the Institution.

A balance-sheet and revenue account were submitted by the hon. treasurer, showing a surplus balance of £225 6s. 8d.

The hon. secretary reported that over 100 completed application forms for membership had already been received. It was agreed that the question of membership must be held in abeyance until negotiations with the Board of Trade were completed, which it was hoped would be in about six weeks' time.

CORRESPONDENCE

PASTEUR COMMEMORATION FUND

Sir,—I have to inform you that a sum of £848 14s. 6d. has been subscribed to the above fund, and you will find appended a list of the subscribers. This amount is in addition to sums which had previously been sent to France in response to earlier and direct appeals.

In accordance with a resolution passed at a recent meeting of the Pasteur Commemoration Committee, presided over by Sir Charles Sherrington, a draft for the above amount is being forwarded to Monsieur Héring, the General Treasurer, with an intimation that should the amount prove more than the French Committee desires to expend upon the monument, the excess should be devoted to some other form of permanent memorial of Pasteur in the University of Strasbourg.

On behalf of the Committee, I desire to take this opportunity of thanking you for your assistance.—I am, Sir, etc.,

A. Chaston Chapman,
Treasurer and Secretary.

London.
August, 1922.

	£	s.	d.
Messrs. Ansells Brewery, Ltd.	50	0	0
J. L. Baker, Esq.	1	1	0
Messrs. Barclay, Perkins & Co., Ltd.	50	0	0
Prof. G. Barger	1	1	0
Messrs. T. & J. Bernard, Ltd.	5	5	0
Messrs. Boddingtons' Breweries, Ltd.	10	10	0
Messrs. Brickwood & Co., Ltd.	5	0	0
Lawrence Briant, Esq.	1	1	0
Dr. Horace T. Brown	2	2	0
Messrs. Campbell, Hope & King, Ltd.	3	3	0
A. Chaston Chapman, Esq.	3	3	0
Messrs. The Cheltenham Original Brewery Co., Ltd.	5	0	0
Messrs. The City of London Brewery Co., Ltd.	21	0	0
Messrs. Robert Deuchar, Ltd.	2	2	0
J. Doull, Esq.	1	1	0
H. E. Field, Esq.	2	2	0
J. S. Ford, Esq.	5	5	0
Prof. Percy Frankland	2	2	0
Messrs. Friary, Holroyd & Healy's Breweries, Ltd.	5	5	0
Messrs. Georges & Co., Ltd.	10	10	0
Messrs. Groves & Whitnall, Ltd.	25	0	0
Messrs. A. Guinness, Son & Co., Ltd.	100	0	0
Messrs. Huggins & Co., Ltd.	5	5	0
Messrs. The Hull Brewery Co., Ltd.	25	0	0
Institute of Chemistry	10	10	0
Prof. A. R. Ling	2	2	0
Messrs. The Lion Brewery Co., Ltd.	10	10	0
Messrs. Mackie & Co., Ltd. (Laboratory Staff)	1	1	0
Messrs. Mann. Crossman & Paulin, Ltd.	50	0	0
Messrs. Marston, Thompson & Evershed, Ltd.	10	0	0
C. G. Matthews, Esq.	1	1	0
Messrs. Meux's Brewery Co., Ltd.	10	10	0
Dr. A. K. Miller	1	1	0
Messrs. Mitchells & Butlers, Ltd.	50	0	0
E. R. Moritz, Esq.	1	1	0
Messrs. J. & J. Morison	1	1	0
Messrs. The Northampton Brewery Co., Ltd.	10	0	0
Messrs. The North British Distillery Co., Ltd.	5	5	0
Prof. Sir William Pope	2	2	0
Prof. J. Ritchie	1	1	0
Sir E. Sharpey-Schafer	1	1	0
Messrs. R. D. Sharp, Ltd.		10	6
Prof. Sir Charles Sherrington	3	3	0
Messrs. H. & G. Simonds, Ltd.	25	0	0
A. Skinner, Esq.	1	1	0
Messrs. Smith Garrett & Co., Ltd.	5	0	0
Society of Chemical Industry	21	0	0
Messrs. Steel Coulson & Co., Ltd.	5	5	0
A. S. Stenhouse, Esq.	2	2	0
Messrs. Stretton's Derby Brewery Co., Ltd.	10	10	0
Messrs. The Tadcaster Tower Brewery Co., Ltd.	25	0	0
Messrs. Wm. Teacher & Sons, Ltd.	1	1	0
Messrs. Joshua Tetley & Son, Ltd.	25	0	0
Messrs. Truman, Hanbury, Buxton & Co., Ltd.	25	0	0
Messrs. Thos. Usher & Son, Ltd.	2	2	0
Prof. Sir James Walker	3	3	0
Messrs. Peter Walker & Son, Ltd.	25	0	0
Messrs. Watney, Combe, Reid & Co., Ltd.	60	0	0
Messrs. The Wenlock Brewery Co., Ltd.	10	0	0
Messrs. Whitbread & Co., Ltd.	50	0	0
Owen Wightman, Esq.	2	2	0
W. R. Wilson, Esq.	5	0	0
Sir E. Almroth Wright	5	0	0
Messrs. Robert Younger & Co., Ltd.	5	5	0
Messrs. Wm. Younger & Co., Ltd. (Abbey and Holyrood Breweries)	25	0	0
Brewing Staff—Abbey and Holyrood Breweries	2	2	0
Laboratory Staff—Abbey and Holyrood Breweries	2	2	0
Messrs. Youngs, Crawshay & Youngs, Ltd.	2	2	0
	£848	14	6

SCIENTIFIC INSTRUMENTS: THEIR CONSTRUCTION AND APPLICATION

Sir,—Science, in the minds of many, is a side issue in the business of life—something that real, live industry can very well get along without. To such the mention of a scientific instrument merely draws attention to something considered unessential to material prosperity and national expansion. For this reason I am sorry that the Institute of Physics has chosen such a title as "Journal of Scientific Instruments" for its proposed publication. I do not dispute the fact that its mission is to describe instruments that have been developed by scientific research and perfected by an appreciation of the value of scientific precision; but I believe that, although the publication of details will help science to make fresh discoveries, the main object of the new publication should be educative—so that the scope and uses of such instruments can be appreciated by industry.

It is mentioned, tentatively, in the prospectus that Dr. Leonard Hill is to describe the katathermometer in a forthcoming issue. Although its invention was a scientific achievement, I am interested in it chiefly because of its application as a valuable guide to atmospheric conditions underground. Another interesting instrument is an electrical CO_2-recorder, which dispenses with chemicals—an additional example of scientific research of considerable value to economical power-plant operation.

The new journal, I feel sure, will do better commercially if it conveys by its title some idea of the immense service it can be to industry.

A. W. ALLEN.

Berkeley, Cal.
July 11, 1922.

NEWS AND NOTES

FRANCE

Alcohol as Motor Fuel

The following is a summary of an article contributed to *La Dépêche* by Monsieur E. Barthe, president of the Wine Industry Association (Groupe Viticole), and also of the "Carburant National," a committee appointed by the Government to investigate the use of alcohol either in place of or admixed with petrol.

In France it is permitted to incorporate 10—15 per cent. of alcohol with petrol, and chemists have recently been concentrating their attention on such mixtures without, however, losing sight of the possibility of gradually increasing the production of alcohol so that it may eventually replace petrol to a very much larger extent. On mixing 90 parts by volume of petrol and 10 parts of industrial alcohol (95—96 vol. per cent.), the liquid invariably separates into two layers, owing to the 4—5 per cent. of water originally present in the alcohol; but if the alcohol be absolute, or nearly absolute (99·5 vol. per cent.) such separation does not occur. The problem therefore was to manufacture alcohol of this strength on an industrial scale. M. Lorette, an engineer, has succeeded in making it at a cost very little exceeding that of industrial alcohol by the simple process of dehydrating the *vapour* of aqueous alcohol with quicklime, instead of the liquid, as hitherto. No essential alteration of the distillation apparatus is necessary; it suffices to interpose a column containing lime between the plate distilling-column and the condenser. In this way alcohol of 99·8 per cent. by volume is obtained in a single distillation. Trials have been made on a large scale at the arsenal of Sevran with improvised columns working intermittently, and 5000 litres of absolute alcohol has been produced with the consumption of about 21 kg. of quicklime, which is readily saleable after use. It has been proved that mixtures of the alcohol with petrol remain homogeneous at a very low temperature (—25° C.), and that the stability of the mixture is not affected by exposure to moisture. Motor trials made with the mixture at Sevran, and by the Autobus Cie., have given very satisfactory results.

It will now be possible to make compulsory the addition of a proportion of alcohol to all imported petrol. During a debate in the Parliamentary Commercial Committee, it was objected that since notable quantities of petrol are used for lighting purposes, it would be difficult to make compulsory the admixture of alcohol and lamp petrol; but M. Patart has shown conclusively that these two liquids mix in all proportions and that the mixtures burn well in stoves, lamps, etc. Thanks to the discovery described above, it is probable that the proposal of compulsory admixture of alcohol with petrol made by the Groupe Viticole will be approved and adopted.

UNITED STATES

Government Assistance to the Chemical Industry

The Chemical Division of the Bureau of Foreign and Domestic Commerce, organised by Secretary Hoover, came into being on August 1. Its object is to place at the disposal of American chemical manufacturers accurate and detailed information concerning foreign markets for their products. The Division is sub-divided into the following sections:—Chemicals, general organic and inorganic; dyes and coal-tar chemicals; pigments, paints and varnishes; fertilisers and fertiliser materials; botanical drugs, pharmaceutical and medicinal preparations; essential oils, perfumery, cosmetics, and toilet preparations; explosives and fireworks.

One of the first tasks will be to compile a list, to be called the Exporters' Index, of American firms interested in the development of foreign trade, which will serve as the basis for distributing information on trade opportunities and conditions in foreign markets. Another will be the appointment of advisory committees to promote co-operation among the several branches of the industry, including existing trade associations, and the Department of Commerce; and an important feature of the work will be the periodical publication of analyses of export and import statistics relating to chemical commodities.—(*U.S. Com. Rep., Aug.* 14, 1922.)

CANADA

Industrial Notes

The Winchester Dye Co., Ltd., has been incorporated and is equipping a plant at Trenton, Ont. It expects to place colours on the market at an early date.

The Dominion Dyestuffs, Ltd., has erected a plant at Fergus, Ont., for the production of a line of ten or twelve standard colours including acid, direct and chrome dyes.

The Rocky Mountain Paint Co., Calgary, Alberta, will start the manufacture of paints and colours at an early date. The company controls vast deposits of mineral colour-bearing materials in the western area of the province.

The Firestone Tire and Rubber Co., Akron, Ohio, will soon commence the construction of a new plant at Hamilton, Ont., to be equipped for an initial capacity of 3500 tyres a day. It is proposed to have the factory ready for operation before the end of the year.

Two new paper and pulp companies have been incorporated in British Columbia: the Wigwam Pulp and Paper Co., Ltd., with a capital of $5,000,000, and the Bloedel, Stewart and Welch Corporation, with a capital of $1,000,000. Both companies will operate in the Province.

Operations will be commenced this season in the construction of the plant of the Peninsula Sugar Co., Ltd., at Petrolea, Ont. The refinery will have a capacity of 600 tons of beets a day. Lambton County is one of the best sugar-beet growing areas of the Province, and thus the new refinery will be situated in the centre of its raw material. The machinery will be electrically driven and of special design. The plant will cost nearly one million dollars.

Forests and Forest Products

The area of the Province of Quebec is now 450,337,761 acres or 703,653 sq. miles. The Crown controls 434,724,394 acres of which 44,500,000 acres are under licence for the cutting of timber. The total acreage in the Province capable of producing saw logs, pulpwood, etc. is 130,000,000, divided into the following five classes according to their tenure: (*a*) private forests, 6,000,000; (*b*) forests on lots under location ticket, 1,300,000; (*c*) forests leased or timber limits, 44,500,000; (*d*) township forest reserves, 200,000; (*e*) vacant lands, 78,000,000 acres.

The estimated wealth of the forests in terms of timber is as follows:—

Species.	Volume. Billion feet board measure.
White and red pine	30
Spruce, fir, hemlock and resinous trees, except cedar	125
Cedar (arbor vitæ)	20
Pulp wood	100
Hard woods (deciduous trees)	35
Total	310

From 1867 to 1920 the forests, under licence, have yielded to the Provincial Treasury $48,148,220.

Railway sleepers of creosoted fir from British Columbia have been tried upon the Indian railways and found to withstand attacks of fungi and ants. Last year over 8 million feet and this year, to date, over 7 million feet have been forwarded to India.

Mining and Metallurgy

The value of the mineral production of the Province of Quebec for 1921 amounted to $15,522,988, as compared with $28,392,939 in 1920. The past year shows a decline in value of $12,869,951, or 45·3 per cent. The metallic products reached a total value of less than $100,000, whereas in 1920 they represented $483,888. In 1919 the value was $1,014,088, and $2,855,120 in 1918.

It is reported that an extensive deposit of iron ore, running 60 per cent. iron, has been discovered north of Hudson's Hope, near the boundary of Alberta, in British Columbia, west of Peace River. This district produces considerable amounts of high-grade coking coal.

A geological survey is being made this summer of the iron-ore deposits of British Columbia, special attention being given to the haematite ores of the Kootenays and the magnetite deposits of the coast. Analyses of the iron ores from the north shore of Lake Athabasca, near Crackingstone Point, show iron 49·5, sulphur 0·08, phosphorus 0·03, and silica 21 per cent. The Consolidated Mining and Smelting Co. has developed an electrolytic process for the production of pure iron from the pyrrhotite gangue of the Sullivan Mine.

Ten tons of iron ore from Sarita River district, Vancouver Island, have been tested and reported to be satisfactory.

A meeting was recently held in Toronto at which a number of metallurgists interested in iron production were present. The matters considered were chiefly plans for the encouragement and development of the iron-ore industry in Ontario, and particularly regarding the possibility of working out methods by which low-grade ores can be treated economically. Suggestions were made which are having the attention of the Ontario Government.

GERMANY

Society for Colloid Chemistry

A new society, to be called the "Kolloidchemische Gesellschaft" and to be devoted to pure and applied colloid chemistry, is to be inaugurated on September 15 at a special meeting in Leipzig. A large number of distinguished scientists and many industrial firms have agreed to become members, and at the meeting in question, following the transaction of business matters, some eighteen chemists and physicists will speak on the relations of colloid chemistry to other sciences and to industry. The programme, in fact, is so full that each speaker will be restricted to a maximum time-limit, which will be recorded by a special automatic (acoustical) time-keeper. A kinematograph film depicting "Snapshots of Colloidal Solutions" will be shown and explained by Prof. Siedentopf of Jena. Prof. Wo. Ostwald is acting as secretary *pro tem.*

Metallurgical Research

The economy of material necessitated by the sharp competition which has existed among makers of machinery during the last ten years, has led to the erection, both by large and small firms, of laboratories in which practically every property of a metal or alloy is tested prior to use, and which have become indispensable adjuncts to the works. Much of this work was promoted by the late Prof. Emil Heyn, who actively investigated the strength and behaviour of materials under various conditions. In these laboratories a great deal has been done to improve the technically valuable properties of those metals which are produced in Germany, and many new alloys have been prepared. Of late, non-ferrous metals have received most attention, and in particular such light alloys as "elektron," "duralumin," and "silumin," whose properties have been improved, and whose use is increasing.

Capital Increases in the German Chemical Industry

Already in 1920 the average share capital of German chemical companies had increased fourfold, and now the increase is about tenfold. Particularly noteworthy is the increased capitalisation of the companies forming the "Interessengemeinschaft," whose stock has only been "watered" to a small extent, much new capital having been invested in plant extensions. The falling off in the average dividend disbursements since the Peace is not only connected with increased capitalisation, but also with the high level of profits which was achieved before the war. The reports of the companies show that their position is not wholly indicated by the dividends. Especially is this seen when market quotations are examined with reference to concessions to shareholders. Where the dividends show most marked disproportion to the quotation, an explanation is found in some expectation of preferential treatment.

Efficiency of Labour in German Factories

From observations made at the Höchst Farbwerke the following table has been compiled showing the time taken to execute various industrial operations during recent years, the time required prior to 1914 being taken as 100:—

	1919	1920	1921	Jan.-Feb. 1922
Coopery and joinery	94	95	102	120
Turning	51	86	107	110
Forging	86	106·5	110·5	—
Filling containers with dyestuffs	—	—	85·8	93·7
Loading coal by hand	—	—	71·5	62·8
Loading coal by steam crane	70	79	79	91·7

The results of the investigation show the great influence exerted by the change from hourly to piece rates.

The Cellulose and Paper Industry

The cellulose and paper industry, which before the war made few profits, is stated to have mproved its position during recent years. The verage dividend has increased from 7·7 per cent. efore the war to 21·6 per cent. in 1921, whilst the verage capital in 1920-21 was less than double that n 1913-14. Each of the ten chief companies (upon he results of which the present figures are based) urther increased its capital in 1921. The average hare quotation has increased 31·2 per cent. above hat of June 5, 1920, and 83·3 per cent. above the ominal value. The average amount written off ncreased from 0·61 million marks in 1913-14 to 4·42 ill. mk. in 1920-21. It is well-known that profits n this industry have been derived almost entirely rom the home trade.

uel Production

The Government Statistical Bureau (Statistisches eichsamt) gives the following figures of production for the year 1921 and the first six months of 922 (exclusive of the Saar district):—

	1921	1922 Jan.–June
	Millions of metric tons	
Coal	136·21	66·647
Brown coal	122·99	65·938
Coke	27·92	14·366
Coal briquettes	5·689	2·567
Brown-coal briquettes	28·24	14·107

There was a considerable decline in production uring June, 1922.

oal Research

The Kaiser Wilhelm Institute for Coal Research ompleted its eighth year at the end of July. The ork, both scientific and technical, done at the nstitute is recorded in the five published volumes f the "Abhandlungen zur Kenntnis der Kohle," nd in a sixth volume now in the press. On the cientific side the Institute has investigated the rigin and chemical constitution of coal, and the ode of formation of the products of distillation. he chief result of the investigations is that, in he main, coal is not formed from vegetable cellulose ut from lignin through humic acid, the cellulose enerally disappearing through fermentation during the process of decay. The technical work has ncluded the production of oils by low-temperature istillation of the fuel in a rotary furnace. Oils roduced from coal, lignite and peat contain nearly ll the substances occurring in mineral oils, such as enzine, lubricating and fuel oils. The tar contains p to 50 per cent. of higher phenols for which no use as yet been found, but last year a simple method of separating them was discovered, viz., by distillation in superheated water at 225° C., the less soluble phenols separating out on cooling. It was also found that these phenols are converted almost quantitatively into a mixture of benzene and toluene by passing them with hydrogen through a tinned iron tube at 750° C.

Lime in German Chemical Industry, 1919—21

Since its enforced restriction during the war the production of lime and related products has increased very largely. The combined production of the firms constituting the "Deutscher Kalk-Bund" was as follows in 1920 and 1921:—

	1920	1921
	Metric tons.	
Quicklime	3,052,968	4,048,034
Calcined dolomite	144,264	142,681
Marl	623,750	693,780
Ground lime (crude)	134,434	115,578

The output of quicklime in 1921 was more than double that in 1919 (2,003,565 t.), but was much below the average pre-war figure of 6·5 million tons.

In the period 1919-21 the quantities of lime used by the chemical industries were 177,006 t. (9·0% of total) in 1919, 257,267 t. (8·5%) in 1920, and 258,555 t. (6·4%) in 1921. In the sugar industry the amounts consumed were 6066 t. (0·3% of total) in 1919, 8220 t. (0·3%) in 1920, and 8545 t. (0·2%) in 1921. After the building industry, the iron and steel industry is the largest user of lime. In 1919 it consumed 578,120 t. (29·3%), in 1920 676,859 t. (22·5%), and in 1921 876,815 t. (21·8%).

GENERAL

Vanadium Compounds in Medicine

Falling in the same group of the Periodic Law as arsenic, antimony and bismuth, it is not surprising that vanadium has frequently been tried in some form or other in medicine. The simple vanadates have been applied in anæmia, tuberculous infections and other chronic diseases with little or no success. Vanadic acid has, however, been recognised as an efficient antiseptic in skin affections. Compounds of vanadium, with vanadium directly linked to carbon, analogous to the valuable arsenic compounds, are unknown, but compounds in which vanadium is linked to carbon *via* oxygen atoms have recently acquired some prominence. In 1917 Pröscher, Seil and Stillians demonstrated the antisyphilitic action of vanadium on the rabbit and in man, and the experiments have borne further fruit in the hands of the French observers, Fournier, Levaditi and Schwartz. These workers, following up the beneficial effects observed by themselves in the treatment of syphillis in man with complex bismutho-tartrates, have now tried various compounds of vanadium, niobium and tantalum with successful results only in the case of vanadium. The complex tartaro-vanadates of sodium or potassium, when injected intravenously or subcutaneously into syphilitic rabbits, have effected permanent cures, and in man the results were sufficiently encouraging to justify further search for somewhat less toxic combinations.

Vanadylformates, salicylates and tartrates were described some years ago by Barbieri, and coordination compounds of vanadium and acetylacetone and benzoylacetone by Morgan and Ross, but their therapeutic action has not yet been recorded.

The Swiss Aluminium Industry

Before and even during the war the policy of the Swiss aluminium industry was to supply the German aluminium-working industries with raw aluminium, but the depreciation of the mark and the increase in home production during the war reduced exports to Germany from 5644·7 metric tons of aluminium in 1913 to 3542·4 t. in 1920 and 1646·1 t. in 1921. This compelled the Swiss aluminium industry to look for new markets, which were found in the United States and Japan. Thus in 1921, 3420·6 t. of aluminium to the value of 8,523,000 fr., found its way to the United States, and 894·1 t. valued at 2,075,000 fr. to Japan. Besides this, Switzerland's aluminium industry, which is concentrated in the hands of the Aluminium Industry Society, of Neuhausen (capital 42,000,000 fr.), has commenced to pay more attention to the home aluminium-working industries and to participate financially in these. During 1921 the Swiss aluminium rolling mills exported 1193·4 t. (valued at 5,402,000 fr.), half of which went to the United States, and one quarter to British India. There are also several factories of aluminium vessels and other goods, the export figures of which totalled nearly 5,000,000 fr. in 1921.

Output of Minerals and Metals in Italy, 1921

According to figures prepared by the Central Inspectorate of Mines, the output of minerals and metals in Italy in 1921 was as follows:—

	Metric tons 1921 Estimated output	1920 Actual output
Minerals:—		
Iron ore	274,000	389,876
Manganese-iron ore	6,980	90
Manganese ore	4.700	36,158
Copper ore	22,700	14,450
Argentiferous copper	—	1,759
Lead, silver-lead and silver ore	26,509	40,729
Zinc ore	69,000	95,985
Lead-zinc ore	340	570
Lead-zinc-copper ore	500	1,043
Pyrites	448,600	321,589
Anthracite	21,000	28,402
Coal	90,400	123,460
Lignite	1,019,700	1,571,735
Bituminous schists	3,150	16,325
Peat	63,500	147,607
Mercury, metallic	1,070	1,401
Sulphur	313,400	296,099
Salt, rock	45,400	46,989
Salt, brine	45,300	22,026
Petroleum	4,780	4,937
Asphaltic and bituminous rock	91,800	106,642
Bitumen, crude	600	984
Ichthyol shale	1,100	800
Alunite	1,170	3,445
Bauxite	49,100	13,139
Leucite	9,900	8,200
Magnesium sulphate	350	1,200
Boric acid	2,490	1,719
Graphite	5,750	5,398
Marble	254,000	352,421
Calcium carbonate, powdered	6,500	8,500
Pumice	10,900	25,200
Talc and steatite	21,000	21,475
Barytes	13,500	15,380
Mineral colours	10,900	11,838
Quartz	31,000	63,480
Felspar	2,400	2,600
Kaolin	13,600	19,323
Magnesian earths	9,400	33,850
Refractory materials	42,000	54,627
Metals, etc.:—		
Iron	60,400	88,072
Steel	683,200	773,761
Alloys	15.400	20,881
Copper	100	685
Lead	11,500	15,947
Zinc	380	1,177
Antimony	40	160
Aluminium	740	1,238
Zinc white	280	1,308
Coke, metallurgical	50.000	95.727

(*G. Chim. Ind. ed App., May*, 1922.)

Mineral Production of Mexico in 1921

Statistics published by the Department of Mines give the mineral production of Mexico in 1921 as follows:—

	Fine oz.
Gold	684,673·0
Silver	64,468,064·41
	Metric tons
Lead	60,318·3
Copper	15,228·1
Zinc	1,256·9
Mercury	46·2
Molybdenum	3·2
Graphite	2,911·1
Arsenic	785
Tin	0·5
Antimony	44·5
Tungsten	14·3
Manganese	558·8

—(*U.S. Com. Rep., June* 26, 1922.)

Vegetable-Oil Industry in Brazil

Mr. J. B. de M. Carvalho [a member of this Society] has recently been visiting the oil-mills in Northern Brazil on behalf of the Brazilian Government. In his report to the Minister of Agriculture, Mr. Carvalho recommends the establishment of an experimental station at Para, to serve the States of Amazonas, Maranhao and Piauhy, and another in Bahia. In all these States vegetable-oil seeds are abundant. He recommends, further, that particular attention be given to the hard-shelled babassu nut, which grows so plentifully, particularly in Maranhao and Piauhy, and which he thinks can now be crushed by a recently-invented crusher; and that experiments be conducted on the oiticica nut, which contains an excellent drying oil, and on the batiputa, which yields an edible oil. Mr. Carvalho is now making a survey of the vegetable-oil resources of the Southern States of Brazil.—(*Cotton Oil Press*, 5, 11, 1922.)

Nauli "Gum," a New Oleo-Resin

A sample of this "gum," yielded by a large tree that grows plentifully in the Solomon Islands, was examined at the Imperial Institute and found to consist of pale yellow, sticky lumps of a fairly soft oleo-resin with a strong odour of aniseed. Its percentage composition was: moisture 2·5; volatile oil 10·4; resin 8·18; matter soluble in water (largely anisic acid; no gummy matter was present) 3·7; matter insoluble in alcohol (mineral and vegetable impurities) 1·6 per cent. The "gum" is thus an oleo-resin that yields about 10 per cent. of a pale-yellow volatile oil which is quite unlike commercial turpentine oils, and apparently contains a relatively small quantity of terpenes and about 34 per cent. of anethole. Although the oil would be valueless as a turpentine substitute, it might be utilised as a source of anethole or as a substitute for anise oil. It only possesses about half the flavouring power of star anise oil, and would therefore not realise more than half its price. After removing the volatile oil, the residual resin was found to resemble gum dammar in certain respects, and to be suitable for making varnishes for mixing with colours immiscible with ordinary varnish. Being insoluble in caustic alkali, the resin could not be used in soap or size manufacture; it would probably sell at the same price as ordinary rosin of the same colour. It is suggested that the best method of exploiting Nauli "gum" would be to distil it locally or in Australia, and to market the oil and resin separately.—(*Bull. Imp. Inst.*, XIX, 4, 1921.)

PERSONALIA

Assistant-Professor K. N. Moss has been appointed to the chair of coal and metal mining in the University of Birmingham.

Prof. Lindet has been elected president of the Association des Chimistes de Sucrerie et de Distillerie de France et des Colonies.

Mr. Ernest A. Smith has resigned the secretaryship of the British Non-Ferrous Metals Research Association and accepted the appointment of research metallurgist to the Sheffield Smelting Co., Ltd.

The Salters' Institute of Industrial Chemistry has awarded fellowships for post-graduate study to Messrs. O. G. Harris, W. S. Martin, J. H. Oliver and W. Randerson, and has renewed the fellowship of Mr. F. Raymond Jones.

Dr. W. H. Nichols is to represent the chemical industry of the United States on a joint committee of the Society for the Promotion of Engineering Education and of the National Industrial Conference Board, which has been appointed to consider the problem of training in engineering.

The following appointments are announced from Germany:—Prof. R. O. Neumann has become director of the Institute of Hygiene of Hamburg University in succession to the late Prof. W. Dunbar; Dr. H. Lecher has succeeded Prof. Freudenberg in the chair of organic chemistry at Freiburg University; and Prof. Wilke has accepted he chair of technical organic chemistry in the Stuttgart Technical *Hochschule* vacated by Prof. Gutbier.

* * *

Prof. A. Smith, head of the chemistry department of Columbia University, has died in Edinburgh.

The death is reported of Armand Vivien, the author of numerous papers on problems of the sugar industry.

We record with regret the death, at Meran, of Prof. E. Noelting, a well-known worker in the sphere of dyestuff chemistry, and formerly director of the school of chemistry in Mülhausen.

The memorial tablet to the late Sir William Ramsay will be unveiled in Westminster Abbey on Friday, November 3, at noon, by H.R.H. the Prince of Wales, who is patron of the Ramsay Memorial Fund.

From Austria the deaths are announced of Dr. F. Kretschmer-Forstburg, formerly professor of chemistry in the University of Vienna, aged 80 years; and of Dr. Th. Panzer, professor of physiological chemistry in the veterinary *Hochschule* of Vienna, aged 50 years.

The following deaths are announced from Germany:—Dr. H. Rubens, director of the Physical Institute of Berlin; Prof. E. Bergmann, director of the Chemisch-Technische Reichsanstalt of Berlin; R. G. A. Loibl, technical director of the Ratibor sugar factory.

Corrigendum.—In the issue for July 31, p. 312 R, ol. i, three lines from the bottom, for "16 ounces f platinum metals" read "0·16 oz. of the platinum roup of metals."

REPORTS

British Empire Patent Conference, 1922. *Report of the Conference held at the Patent Office, London, June, 1922. Pp.* 28. *H.M. Stationery Office*, 1922. *Price* 1*s.*

A committee of the recent Conference of Prime Ministers and Representatives of the United Kingdom, Dominions and India recommended that a conference of representatives of the Patent Offices of His Majesty's Dominions should be held in London to consider the practicability of instituting a system of granting patents which should be valid throughout the British Empire. This Report is the result of the recommendation.

The United Kingdom, Canada, Australia, New Zealand, South Africa and India were represented at the Conference and there was also present one representative for the several Colonies and Protectorates. No evidence was taken.

At least 46 separate applications for protection are at present necessary for obtaining monopoly throughout the Empire, at a cost of about £300. If patents or their equivalents are granted, they are taxed to an extent amounting, for the whole Empire, to about £1200 during their life.

This was considered unsatisfactory by the Conference and it was resolved that a British Empire patent would be desirable as a means of cheapening the cost and simplifying procedure, provided that the autonomy of the Dominions and India were preserved.

Of the schemes considered for putting the resolution into effect, that involving abolition of local Patent Offices and the establishment of an Imperial Patent Office was rejected owing to practical difficulties and the necessity for preserving the right of the inventor to obtain a local patent. Another scheme by which the same search into novelty should be made by each local Patent Office and the locally granted patent should be operative throughout the Empire, was also rejected as too costly. Nor was the proposal acceptable that searching should be conducted solely by the United Kingdom.

The scheme preferred provides for retention of the local Patent Offices and their systems of granting local patents, and the establishment of a Central Patent Office for examining applications and granting patents, which may extend to as many territories as the applicant may desire, the application being open to opposition. The search to be co-extensive with that made at present in the United Kingdom, the Dominions and India. The main advantage of the scheme would be that the applicant would have to make only one application.

The cost of establishing a Central Office forbad the recommendation, at present, of this scheme and it was agreed to advise the adoption of a provisional scheme by which the patent granted under existing conditions in the United Kingdom should be extended to any of the territories desired by the applicant on payment of a simple registration fee, but the grant in that territory to be subject to the local objections and to local opp[illegible]ition; nevertheless, the specification accepted in the United Kingdom should be held to be in conformity with local requirements as to sufficiency of description and claims. In the Colonies and Protectorates, where examination of applications is non-existent or perfunctory, registration of the United Kingdom patent should follow as a matter of course.

The Conference further recommended that whether or not any scheme for a British Empire Patent be found practicable, steps should be taken to render patent legislation uniform throughout the Empire.

Extracts from the Annual Report of the Ministry of Health for 1921-1922 and Abstract of Reports of Public Analysts for the Year 1921. Sale of Food and Drugs Acts. *Pp.* 16. *H.M. Stationery Office*, 1922. *Price* 1*s.* 6*d.*

The total number of samples purchased under the Acts in 1921 was 113,664; of these 7582 were reported against, showing a decrease from 7·1 per cent. in 1920 to 6·7 per cent. in 1921.

Of the above samples, 61,439 were samples of milk, of which 8·6 per cent. was adulterated or not up to standard. In London 678 samples of milk (5·1 per cent.) were reported against, 357 contained extraneous water, the remainder being chiefly samples deficient in fat; only 10 samples contained preservative (generally boric acid). Excluding London the proportion of adulterated samples was 9·6 per cent.

Out of 984 samples of ordinary cream, 315 contained preservative, and 86 out of 707 samples of preserved cream contained preservative (boric acid in all cases) in excess of the permitted amount, or otherwise failed to satisfy the Regulations. One informal sample of cream taken at Burnley contained 0·59 per cent. of boric acid and a later formal sample from the same source 0·36 per cent.

Over 10,000 samples of butter were examined and 245 were reported against; of these 129 contained foreign fats, generally in large proportions, and 96 contained an excess of water. In one case a fine of £40 was inflicted for the sale as butter of a mixture containing 25 per cent. of margarine; 31 out of 4296 samples of margarine were reported against, 21 of these containing water in excess of 16 per cent. Only 5 out of 3490 samples of lard were reported against, but 41 out of 692 samples of dripping or cooking fats were reported as adulterated; one sample of dripping contained 40 per cent. of cottonseed oil, and 15 per cent. of rice flour was present in a sample of chopped suet.

The adulteration of flour was again small; 507 samples of ordinary flour were examined, 16 contained persulphate "improver" and one was a self-raising flour; only 7 out of 806 samples of self-raising flour were reported against. Deficiency in available carbon dioxide was the chief defect in baking powders; 45 samples out of 1210 were condemned.

The presence of copper salts in preserved peas still persists; 73 out of 168 samples contained copper salts, and a fine of £20 was inflicted for spinach containing 6·8 grains per lb. of copper sulphate.

A sample of "raspberry syrup" examined consisted of sugar solution acidulated with phosphoric acid and coloured with coal-tar dye; a penalty of £[illegible] was inflicted.

In Surrey large fines—in one case £30—were inflicted for the sale of effervescing solutions of sugar acidulated with phosphoric acid as "lemon squash" or "lemonade." Of 5500 samples of drugs examined, [illegible]·7 per cent. was reported against.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for August 24, 31, and September 7)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials.	Reference Number
Australia	Crockery, glassware	204
"	Sodium acetate (tender for)	9320/E.D./C.P.
Bolivia	Glass, glassware, pottery ..	225/73/F.G./M.C.
Brazil	Paper	242
British East Africa	Oils, grease, soap, aluminium ware	205
British India ..	Antimony, brass, sheets of copper, lead and zinc ..	3701/8/T.G.
Bulgaria	Copper, brass (tender for) ..	8988/F.E./E.P.
Colombia	Dry colours	224
Denmark	Metals, crude rubber ..	220
"	Iron and steel, tinplate, black sheets	221
"	Tinplate, black plate ..	222
Dominican Republic	Drugs, perfumery	216
Finland	Tinplate, tinned sheet ..	210
France	Tinplate	16664/F.W./E.C.
Mexico	Glass, glassware, pottery ..	225/47/F.G./M.C.
Netherlands ..	Technical rubber goods ..	231
New Zealand ..	Copper wire	9405/E.D./E.P.
" " ..	China, earthenware, glassware	218
" " ..	Newsprint paper	9467/E.D.
Norway	Artificial leather	234
Poland	Edible oils, fats	255
Spain	Superphosphate of lime ..	6555/F.L./C.C.
Sweden	Essential oils, essences, food colours, caramel	239
"	Dyes, tanning extracts, heavy chemicals, drugs	256
Switzerland ..	Gum kauri, gum copal, steel, tinplate	259
United States ..	Steel	16559/F.W./E.C.
" " ..	Glass, glassware	225/4/F.G./M.C./A.

TARIFF CUSTOMS EXCISE

Angola.—Particulars of the revised scale of export duties are given in the issue for September 7.

Barbados.—Amendments to the customs tariff affect potable, non-potable, and perfumed spirits.

Ceylon.—Cocaine or its derivatives may not be imported without a certificate that the drug is required solely for scientific or medicinal purposes and that the Government approves the importation of the quantity specified.

Dominica.—Kerosene oil of 110° fire test and under may not be imported.

Germany.—The importation, except under licence, is prohibited of cocoa and cocoa products. From September 3 the duties on goods exported under licence have been increased in general by 60 per cent., but in some cases by 30 per cent. only.

Iraq.—Schedules of import and export duties are given in the issue for August 24. Many of the duties on chemicals range from 11 to 20 per cent. *ad valorem.*

Italy.—The manufacturing tax on national sugar nd the surtax on imported sugar have been inreased from 245 to 300 lire per 100 kg. of sugar hich yields over 94 per cent. on refining, and from 40 to 288 lire per 100 kg. on other sugar. Inreased duties are to be levied on goods imported rom countries which differentiate against Italian oods.

New Zealand.—The prohibition of the import and xport of tungsten and its alloys, compounds, and res has been revoked.

Peru.—The export duty on petroleum and its erivatives has been fixed at 3·50 soles per metric on.

Poland.—Goods which may not be exported inlude sugar, bone manures, hides, mineral, sperm nd cylinder oil, potassium salts, ores, minerals, crap iron and steel, and cellulose.

South Africa.—Until June 30, 1923, the importaion of sugar is prohibited, save under permit issued y the customs authorities. A law has been passed roviding for the inspection and grading of coal roduced in the Union and intended for export or or bunkering steamers.

Tunis.—The prohibition of the export of coal, oke, hides and skins has been withdrawn.

Yugoslavia.—The export duties on certain animal ats and oleaginous seeds have been increased, and ew export duties have been applied to edible oils.

TRADE NOTES

FOREIGN

lsatian Potash

The Commercial Secretary at Paris has forwarded o the Department of Overseas Trade an extract rom the *Bulletin Quotidien de l'Agence Téléraphique Radio*, which states that a French deleation, headed by Monsieur Louis Mercier, vicepresident of the "Comité des Forges," is now ngaged at the Hague in an endeavour to re-establish the group formed by the producers of potash in Alsace and in Germany, which before the war possessed the world monopoly of this product.

Chemical Exports from the United States

The Chemical Division of the Bureau of Foreign and Domestic Commerce has issued an analysis of the exports of chemicals and allied products for the fiscal year ended June 30, 1922, based upon preliminary returns. The figures show a decline of over 50 per cent. in the value of the total export trade ($100,518,943 compared with $220,000,000 for 1920-21), but this does not signify a corresponding decline in quantity; there were important increases as well as marked decreases in exports of the more important chemicals. The following table gives approximate figures for the exports of certain chemical products in 1921-22, together with rough indications of the increases and decreases in quantity over the previous fiscal year:—

Material	Quantity 1,000's of Short Tons	Value $	Gain or Loss in Quantity
Acetate of lime	13·80	587,174	+50%
lycerin	1·81	508,807	+50%
austic soda	61·50	4,660,815	+20%
orax	5·05	545,601	+150%
odium silicate	13·02	279,041	(small gain)
opper sulphate	2·41	227,019	(small gain)
leaching powder	15·22	502,870	—30%
oda ash	16·50	757,684	—71%

The expanded classification of chemical exports, which was initiated in January last, indicates important trade in several articles which were not previously mentioned separately; thus in the six months to June 30, 1922, there were exported (short tons): dextrin 3862, potassium dichromate 1858·4, aluminium sulphate 5993·1, ammonia and ammonium compounds (excluding ammonium sulphate) 1286·8, and boric acid 417·3.

The value of the foreign trade in coal-tar dyes, colours and stains, except lake colours, decreased from $13,577,788 in the fiscal year 1921, to $3,805,917 in 1922; and the exports of pigments, paints and varnishes decreased by about 50 per cent. to $10,069,211, the decline being mainly due to the reduced exportation of white lead (8700 short tons in 1921, 4500t. in 1922). During the first 6 months of 1922 there were exported 954·5 short tons of lithopone, 507·2 t. of bone black, and 5093·5 t. of carbon and lamp black. Exportation of medicinal and pharmaceutical preparations decreased in value during 1921-22 by nearly two-thirds to $5,383,399. Among fertilisers, exports of ammonium sulphate rose by nearly 100 per cent. to 168,077 long tons, valued at $8,720,775, but those of phosphate rock declined. Shipments of prepared fertilisers in the period Jan.-June, 1922, amounted to only 9204 long tons valued at $469,366.

In 1921-22 exports of rosin from naval stores increased from 877,109 barrels to 1,403,921 barrels, but declined in value from more than $10,000,000 to $6,623,499; foreign shipments of turpentine increased slightly in quantity to 10,786,280 gallons (U.S.), but diminished in value by $3,000,000.—(*U.S. Com. Rep., Aug.* 14, 1922.)

BRITISH

British Guiana in 1921

The sugar crop amounted to 110,985 tons, which compares with 104,069 t., the average yield of the previous 10 years, and 108,270 t. of sugar was exported. Successful experiments on the production of motor fuel from waste molasses have been made, and a sugar company is preparing to manufacture power alcohol on an industrial scale; the Government is assisting the undertaking by exempting the industry temporarily from taxation. Cacao was grown on a smaller area (1176 acres), but the acreage under Para rubber remained unchanged; shortage of labour for tapping and the leaf disease are the main factors that prevent the area under Para rubber from extending. Coconuts are now grown on 26,321 acres and 15,648,646 nuts were used locally as food or for making oil and 2,760,000 nuts, 39 t. of copra and 15,934 gallons of coconut oil was exported. The cultivation of limes increased slightly and the Government factory continued to work. Exports of lime products included 439 cwt. of citrate of lime, 4175 galls. of lime-juice, and 544 galls. of essential oil of limes. The output of diamonds rose from 233,456 stones, weighing 39,362 carats, in 1920, to 507,200 stones, weighing 102,604 carats, in 1921.

Imports declined in value by £1,691,878 to £3,487,608, and exports by £2,718,508 to £3,424,490. Of the aggregate trade of the [illegible]ony, the United Kingdom took 52·82 per cent., Canada 24·22 per cent. and the United States 13·49 per cent. Prospects for British trade are promising.—(*Col. Rep.-Ann., No.* 1123, 1922.)

REVIEWS

Technical Records of Explosives Supply, 1915—1918. No. 5. Manufacture of Sulphuric Acid by the Contact Process. *Pp.* 128. *Ministry of Munitions and Department of Scientific and Industrial Research. London: H.M. Stationery Office,* 1921. *Price* 26*s.*

This volume, containing results of scientific and industrial value obtained in the national factories during the war, maintains the high standard of excellence established by the four previous publications. Indeed, it is no exaggeration to say that the volume will be regarded as a classic, to which works chemists and technicians will have frequent recourse, not only for operating details, but for information concerning chemical control, thermal values and efficiencies, methods of calculation, platinisation, recovery and purification of platinum from old contact mass, and other such valuable data. The Ministry and Mr. Macnab are to be congratulated on the signal success which has attended their efforts.

The book is divided into two sections. One deals with the Mannheim oleum plant, the distinctive feature of which is that conversion of the sulphur dioxide into trioxide is effected in two stages, viz., by using ferric oxide and platinum as the catalytic media; the other section is assigned to the Grillo oleum plant, where platinum alone serves as the catalyst. Three excellent appendices complete the book, the value of which is enhanced by the scale drawings, graphs, and other illustrations, several of which are unique.

The first section commences with a general outline and description of the Mannheim plant, and is followed by commendably clear descriptive details of the several parts constituting the integral unit. The whole gamut is traversed: nothing apparently is omitted. With equal lucidity and detail is indicated the operation of the various parts of this plant, and valuable notes are furnished (pp. 11—37) on the working and control of the plant and the experiments which have been conducted from time to time to determine the conditions calculated to promote greater uniformity and higher efficiencies at all stages of the operation. Section 2 follows much the same arrangement as the preceding section, although supplementary information is afforded in relation to the production of the magnesium-sulphate mass, chemical control, thermal values and efficiencies, etc. The completeness of the thermal data is significant, and adds materially to the outstanding merit and value of the book. Indeed, the methods used and the data afforded will doubtless serve as a guide for calculations of a cognate nature covering a wide range of chemical operations. An equally prominent feature of this section is to be found in the calculations involved in the design of the plant, etc. These are given in considerable detail and are invaluable from many points of view. They are typical of the meticulous care and attention to detail which characterised Quinan's design of chemical and explosives plants.

It is known that certain oleum installations, outside the Ministry's control, proved a woeful failure owing to imperfect design of the purification section, and to faulty preparation of the catalyst. These imperfections could hardly have arisen had this volume been in the hands of those responsible for the design of the plants in question.

Very little further comment is called for, or indeed is possible within the limits of this review. It is noted that the name and characteristics of the pyrites ore are not given in connexion with the experiments cited relative to the working of pyrites lump burners. Manifestly they have an important bearing. Some well-known pyrites ores are notorious for the ease with which they decrepitate, a disability which contributes to the formation of clinker and, incidentally, to an abnormal sulphur-content of the burnt ore.

Experience suggests that the Herreshoff mechanical burner is peculiarly responsive to the slightest irregularities of feed and air-admission, the temperature of the beds fluctuating appreciably, unless the most constant conditions are maintained. The Wedge burner, which has a greater throughput, has been found to be free from some of these disabilities. It is unfortunate that mechanical sulphur-burners were not installed at one or other of the factories of the Ministry of Munitions, as it would have been interesting to contrast the results of the operation of, say, the Tromblee and Paul continuous, mechanical sulphur-burner with the results known to be obtained with the hand-operated sulphur-burners described on page 49.

The book is printed in clear type, and its cost places it within the reach of all. It is an eminently practical contribution, and in the phraseology of Bacon needs "to be chewed and digested"; in other words, it is essentially a work to be studied.

P. Parrish.

Iron Ore (*Summary of Information as to the Present and Prospective Iron-ore Supplies of the World*). **Part 1, United Kingdom** (*pp.* 237, 6*s.*); **Pt. 2, British Africa** (*pp.* 76, 3*s.*); **Pt. 3, British America** (*pp.* 115, 3*s.* 6*d.*); **Pt. 4, British Asia** (*pp.* 65, 2*s.* 6*d.*); **Pt. 5, Australia and New Zealand** (*pp.* 106, 4*s.*). *Imperial Mineral Resources Bureau. London: H.M. Stationery Office,* 1922.

The above five parts deal with the statistics, production and iron-ore resources of the British Empire. As is well known, the Imperial Mineral Resources Bureau has been issuing an important series of publications on the mineral industry of the British Empire and foreign countries, with statistics of production, during the war period, 1913-1919, when most official statistics were in abeyance. With regard to iron ore, the National Federation of Iron and Steel Manufacturers felt that something more was required, and they offered their assistance, both personal and financial, in order to enable the Bureau to produce a work not merely dealing with production but summarising the known and prospective iron-ore resources of the world. This information is particularly valuable to British iron-masters, as the British iron industry relies more than that of any other country, with the exception perhaps of Belgium, upon imported iron ores.

The work before us gives evidence of much care and painstaking research into the vast mass of information that exists scattered in many places upon the subject of iron-ore resources. Part 1 is naturally little more than an abstract of the publication of the Geological Survey on British iron ores, but in addition it contains a number of important statistical tables showing production, imports, exports, domestic consumption, etc. of iron ore and of the chief products of iron and steel manufacture. The information upon which the other parts is based has been for the most part obtained from the geological survey departments of the respective countries, some of which, notably the Geological Survey of Canada, have long devoted much attention to economic questions. It is self-evident that anything like a review of the immense mass of detailed information collected in these five volumes is out of the question. It can only be said that they cover very fully the intended ground, and constitute as complete and accurate a survey of the iron-ore resources of the British Empire as it is possible to compile at the present day.

H. Louis.

First Report of the Adhesives Research Committee. *Department of Scientific and Industrial Research. Pp. 129. London: H. M. Stationery Office, 1922. Price 4s.*

The Adhesives Research Committee was appointed by the Advisory Committee of the Privy Council for Scientific and Industrial Research in December, 1919, to continue the work of the Adhesives Committee of the Conjoint Board of Scientific Societies. The present report includes the unpublished work of the latter committee, thus making a comprehensive summary of the work done from 1918 to the end of 1921. Two appendices are added, viz.: (1) a descriptive bibliography of gelatin prepared and revised by Dr. T. Slater Price, and (2) an account of the recent work of Prof. J. W. McBain on the nature of soap solutions and gels. The volume may be very highly recommended to all interested in glue, gelatin and other nitrogenous adhesives. The work done, however, appears to be almost entirely connected with nitrogenous adhesives, and the title "Adhesives Research Committee" is somewhat incorrect and misleading. Starch adhesives, which for many purposes have entirely replaced glue, are not even mentioned. A few experiments on casein cements are recorded, and the possibility of utilising the proteins of castor bean as a substitute for casein has also been demonstrated.

The necessity for the work arose during the war owing to a threatened shortage of the raw materials necessary for the manufacture of glues and casein cements. Hence, at first, conservation of materials and more economical methods of manufacture were more important than purely scientific investigations. The early work of the Committee was therefore chiefly empirical and confined to (*a*) the differentiation of good and bad glues by mechanical tests, (*b*) an attempt to discover the substances (and their properties) which give glue its adhesive power, (*c*) the prevention of waste of raw material during manufacture, and (*d*) the investigation of the adhesive power of substances obtained from material other than bone, hide, or casein. Later on, empirical inquiry gave place to systematic scientific investigation. In dealing with the mechanical tests of glues, reference is made to Major Robertson's work described in the "Report on the Materials of Construction used in Aircraft and Air Engines," published by H.M. Stationery Office at 21s. It is a pity that a detailed description of the test employed was not included in the present report.

It is unfortunate, but perhaps unavoidable, that a Research Committee should have to spend so much time rediscovering what is already known to many chemists who work upon glue or gelatin. Thus on page 16 five general conclusions of the investigations are stated. Four of these are already quite well understood, and could have been ascertained by inquiry, with the saving of much time and trouble. The fifth conclusion is that gelatin can be made from undecalcified ground bones of $\frac{1}{32}$ inch diameter at temperatures below 100° C. The reviewer studied this question more than ten years ago, and has an experimental plant with which he prepared a high-grade gelatin from undecalcified bones and brought the method to the notice of a large manufacturer. Of course, it may be desirable to restate the simple principles of manufacture, but it can hardly be necessary for a Research Committee to carry out experiments to rediscover such facts as the deterioration of glue solutions at high or even on prolonged heating at low temperatures.

Under "Classification of Glues" a useful summary of various known tests is given. To these is added an important new one, viz., the "diffusible-nitrogen test," which is fully described. It is shown that the tensile strength of a glue is roughly inversely proportional to its diffusible nitrogen content. Valuable work, though with negative results, has also been carried out in the determination of the "Hausmann numbers" of different types of glue. These numbers are the percentages of nitrogen existing as "amide," "humin," "diamino," and "other" nitrogen. Similarly, the percentages of free amino-acids and phosphorus have been studied, but, like the Hausmann numbers, they appear to have but little relation to the tensile strength of a glue. The opinion is expressed that, as a general rule, a gelatin or glue which forms a poor gel is not a good adhesive. In the experience of the reviewer, this is only true when dealing with any particular type of glue, and even then only serves as a measure of efficiency of the processes. One of the difficult things to explain is that certain glues, which will not gel, still have excellent adhesive properties, unless hydrolysis has proceeded far enough to reduce their viscosity seriously. For some purposes glues with a low jelly-strength are actually preferred, provided that they possess what the report terms the "optimum viscosity" which is necessary for the particular class of material to be glued.

In carrying out the study of the formation of gelatin, the rate of extraction of gelatin from both bones and skin has been studied, and in the case of ossein reduced to a mathematical formula. The effects of the presence of acids or alkalis in the extraction fluid and of prolonged heating are also here described.

The last 77 pages of the report, dealing with the descriptive bibliography of gelatin and the bearing of the results obtained in recent investigations of soap solutions upon the structure of gels, are a valuable addition. Altogether the report may be regarded as the first volume of a much-needed treatise upon a hitherto neglected subject.

S. R. Trotman.

Distillation Principles and Processes. *By* Dr. Sydney Young, and Collaborators. *Pp. xiii. + 509. London: Macmillan and Company*, 1922. *Price* 40*s. net.*

The general arrangement of the material in the first section of this book is satisfactorily consecutive, and, considered in conjunction with the literary style, it may be said that there are few technical books, published in this country, containing matter which may be read with such little effort.

Commencing with introductory notes, mainly dealing with general laboratory directions and descriptions of apparatus, the next chapter deals rather scantily with the boiling-points of pure liquids. Following this we have a discussion on the vapour pressure of mixed liquids, and the influence of chemical relationship, and molecular association, thereon. In this chapter (Chapter III), it is suggested that miscibility is a function of intermolecular attraction, so that the relationship suggested by D. Berthelot and by Galitzine holds good. If, however, we accept the supposition that the boiling-point of a pure substance is a function of the attraction between molecules, the above relationship imposes upon us the necessity of adopting the doctrine that the greater the difference in boiling-point between two liquids, the greater will be their tendency to yield a heterogeneous mixture. This point is brought to notice in view of the prominence accorded to the work of F. D. Brown, and to the use of this relationship as a basis for carrying out experimental investigations. Chapter IV deals with the boiling-points of homogeneous and heterogeneous liquid mixtures, the effect of pressure on the boiling-points, and the composition of azeotropic mixtures. A list of the boiling-points and composition of a very large number of azeotropic mixtures is also given.

The treatment of experimental determinations of the composition of liquid and corresponding vapour phases (Chapter V) is satisfactory. Concise descriptions are given of the apparatus and methods employed by F. D. Brown, Lehfeldt, Rosanoff, Zawidski, and others, together with notes on the errors likely to arise in work of this kind. It is questionable whether Linebarger's work should be dismissed without discussion. The subject is taken up from a "theoretical" standpoint in the following chapter, but the treatment appears to be inadequate.

In Chapter VII the author gives laboratory directions relating to fractional distillation.

After discussion of the composition of liquid and vapour phases (*cf. s.*), the theme passes on to the relations between the weight and composition, and between the boiling-points, of the residue and distillate (Chapters VIII and IX); whilst in the same connexion, an able and critical treatment of various types of still-heads comprises the following three chapters, followed by notes (Chapter XIII) on the continuous stills devised by Carveth and by Lord Rayleigh. Chapter XIV deals largely with results obtained with the Young and Thomas type of column.

A short general description of the plant necessary to effect distillation on the industrial scale, given in Chapter XV, forms an introduction to the specialised matter given in subsequent sections of the book.

On reading the four following chapters one feels that a subject has been reached to which all that has preceded forms merely an introduction. Professor Young has treated the subject of fractional distillation as a method of quantitative analysis in such a manner that one cannot but make the suggestion that this section should be published *per se.*

Section I concludes with a brief consideration of processes involving sublimation.

The subsequent sections of the book, devoted to industrial processes, include the manufacture of acetone and n-butyl alcohol, ethyl alcohol, the petroleum industry, distillation of coal tar, glycerin, and essential oils.

It is rather difficult to criticise without bias any technical matter written from a standpoint diametrically opposed to that which has formed the basis of one's training. However, in reviewing these sections of Prof. Young's treatise, we must bear in mind to what extent this work will benefit the technologist and chemical engineer who may specialise in such processes. This country has never become famous for the efficiency of its distillation plant; and, on reading through the sections devoted to the industrial aspect of the subject, one cannot but feel that we have not yet got away from the empirical and rule-of-thumb methods which have characterised such processes. A slight all-round improvement occurred during the war, with the advent of technical chemists from abroad; and, therefore, it is unfortunate that the latter sections of the book under review do not in any way illustrate the application of the theoretical side of the subject to the successful design of plant.

J. Brown.

PUBLICATIONS RECEIVED

Organo-magnesium Compounds in Synthetic Chemistry. *A Bibliography of the Grignard Reaction*, 1900—1921. *By* C. J. West *and* H. Gilman. *Reprint and Circular Series of the National Research Council. No.* 24. *Pp.* 103. *Washington: Government Printing Office*, 1922. *Price* $1.50.

Publications of the United States Bureau of Mines. *Department of the Interior: Washington: Government Printing Office*, 1922:—

Compressed-Air Illness and its Engineering Importance. *By* E. Levy. *Technical Paper* 285. *Price* 10 *cents.*

Coal-Mine Fatalities in the United States, 1921. *By* W. W. Adams. *Technical Paper* 302. *Price* 10 *cents.*

Production of Explosives in the United States during 1921. *By* W. W. Adams. *Technical Paper* 313. *Price* 5 *cents.*

Publications of the United States Bureau of Standards. *Department of Commerce. Washington: Government Printing Office*, 1922:—

Manufacture and Properties of Steel Plates containing Zirconium and Other Elements. *By* G. K. Burgess *and* R. W. Woodward. *Technologic Paper* 207. *Price* 20 *cents.*

Note on the Preparation of Mannose. *By* E. P. Clark. *Scientific Paper* 429. *Price* 5 *cents.*

Thermal Expansion of Nickel, Monel Metal, Stellite, Stainless Steel, and Aluminium. *By* W. H. Souder *and* P. Hidnert. *Scientific Paper* 426. *Price* 10 *cents.*

REVIEW

Vol. XLI] SEPTEMBER 30, 1922 [No. 18

SODIUM SILICATE AS AN ADHESIVE

REX FURNESS

THE First Report of the Adhesives Research Committee (*cf.* J., 1922, 379 R) has been criticised from many points of view in the technical Press; perhaps its most noteworthy omission is the consideration of commercial sodium silicate—" water glass " —as an adhesive, the advantages of which are becoming increasingly realised. In this country several firms are using upwards of a thousand tons of this adhesive yearly, whilst in the United States its use is even more favoured. Owing to shortage of animal and vegetable products during the war, silicate adhesives were used on a large scale in Germany, and their advantages have ensured continued use under post-war conditions.

Commercial sodium silicate possesses all the essential properties of an efficient adhesive, viz., (1) ease, suitability, flexibility, and general efficiency of application to the materials to be united; and (2) power of " setting " in a suitable manner and time, with the formation of a bond of desired strength.

(1) The physical characteristics of a sodium silicate solution can be predetermined by the manufacturer (*cf. i.*) so that it will penetrate into the surface pores or irregularities, whether these be of large or microscopic dimensions, of the materials to be united, without saturating or passing through such materials; in other words, its viscosity can be so adjusted that it is neither too thick nor too thin for a required purpose. The surface phenomena exhibited between silicate solutions and the various materials which may be united with its aid are not well understood, nor is the reason why a bond is formed at all (this applies to adhesives in general, since the precise physical or chemical property upon which adhesion depends is not definitely known); it must, therefore, suffice to state in this place that silicate solutions will " wet " the surfaces of such substances as paper and paper products, wood, and abrasive materials.

(2) The setting of a silicate adhesive may result from cooling, or from the evaporation or absorption of water, or from all these causes combined. A smaller abstraction of water is needed from concentrated silicate solutions than from many animal and vegetable glues, so that the speed of setting can be greatly increased, and with it the speed of the particular machine upon which the work is being effected. The bond is permanent and is not disturbed by warmth, as in the case of certain adhesives. The bond strength is perhaps not so high as that of animal glue, but it is superior to that of most other adhesives, and, what is far more important, the minimum bond is greater than the tearing strength of the materials with which it is used.

ADVANTAGES OF SILICATE ADHESIVES

Silicate adhesives may be prepared with any desired viscosity and setting time, and their composition can be varied to enable articles made with their aid to withstand any particular conditions of temperature and humidity. These adhesives do not putrefy or decay, they are immune from any form of bacterial activity, and they repel vermin. They are fireproof, and although not absolutely resistant to water the materials manufactured with their aid are damp-proof. The fact that they are odourless is of especial importance in the manufacture of built-up paper-board and corrugated containers for food products.

Again, silicate adhesives are cheap, both relatively as to the quantity required for uniting materials and absolutely. These facts, taken in conjunction with the important point that they are perhaps the easiest to use, as they do not require the application of heat, and may thus be kept ready for immediate use, must be regarded as constituting very substantial claims.

Let us compare briefly some of the above-mentioned properties of silicate adhesives with those of animal and vegetable products. Animal glue, for instance, is liable to deteriorate if not kept dry. Its solutions must contain disinfectants in order to prevent mould growth, and they are by no means odourless. Batches of glue solution must be freshly made at frequent intervals; and this adhesive is much more troublesome to apply than silicate adhesives, which are almost always applied cold and in the state in which they are received from the manufacturers. The organic constitution of glue and other popular adhesives renders them combustible, putrescible, and attractive to vermin.

Casein adhesives are troublesome in use as compared with the always available silicate solution, and in addition casein glues must be used very soon after the solution has been made. Even the patented and special types have a hardening period of a few hours only, and casein glues in general, like animal or gelatin glues, cannot be relied upon to afford constant and uniformly reproducible batches. Many influences have been traced which affect casein and render such irregularity inevitable. Silicate adhesives of a specified quality and composition can always be relied upon to give constant results, provided temperature, humidity of the workroom, and other variable factors are controlled. Starch and dextrin adhesives are relatively weak in bonding strength, and in spite of the numerous special and patented "modified" starch adhesives, they are troublesome to prepare for use.

SODIUM SILICATE SOLUTIONS

The large variety of silicate solutions has rendered possible their use in many manufactures. Thus, the built-up paper-board industry finds no better adhesive; the facing or lining of corrugated paper or board, the production of multi-ply veneer, the manufacture of "mandrel" paper articles for food containers, etc., the employment of silicate as a sealing agent for packages, cartons, etc., the binding of artificial or natural abrasives in the making of abrasive wheels, and so forth, may be cited as examples of the use of silicate adhesives.

It will be obvious that one definite adhesive solution cannot serve for more than a limited number of purposes. The great merit of silicate is that it can be made into a large number of solutions of varying viscosity, stickiness, etc., and the composition of the "silicate" itself (the word "silicate" covers a wide field in commerce) can be modified so as to confer almost any desired physical state upon its solutions. To gain an insight into the basis of this wide range of properties, some account must be given of the variations possible in the constitution of silicate glass itself, and of the inter-relations of its solutions.

SODIUM SILICATE AND ITS COLLOIDAL SOLUTIONS

Although the chemical compound Na_2SiO_3, Aq. can be isolated as a crystalline solid, it has little or no interest to the manufacturer or user of sodium silicate, since in solution it possesses none of those physical properties upon which most of the applications of "silicate" depend. The sodium silicate of commerce may be said, broadly, to consist of a colloidal solution of silica in Na_2O,SiO_2 or $Na_2O,2SiO_2$ (or both). Although not extensively applied in industry, the yellow and green silicate "glasses" are well-known to the chemist—the colours being due to iron compounds in the ferric and ferrous state respectively. The ordinary "water glass" of commerce is obtained from these "glasses" by dissolving them in water, allowing the aluminous and ferrous impurities to settle out, and evaporating the solution.

The ratio of sodium oxide to silica in commercial silicate solutions is usually calculated from percentage compositions, and is not expressed molecularly; it varies from about 1 : 1·5 to 1 : 4. Many changes occur as the proportion of alkali increases; the total possible solid content increases greatly, the solution becomes heavier, and the viscosity at a given specific gravity diminishes. To take the case of two silicate solutions in which the ratios are approximately 1 : 1·5 and 1 : 4, respectively. At a constant gravity, say about 70° Tw., the more alkaline silicate is a thin liquid, easily poured, whilst the product high in silica is jelly-like and stiff. Conversely, to obtain both silicate solutions in an approximately similar state of viscosity, the alkaline product must be concentrated to almost twice the above gravity.

At this commercial limiting concentration, there are differences in the physical properties of the two types of silicate solutions. The product high in silica is jelly-like, and can be moulded to some extent, but the highly alkaline silicate is a viscous and sticky liquid, which can be drawn into threads, and which easily absorbs water from the atmosphere, so that it "dries" badly in use.

Between these two chosen extremes of alkali-silica ratio lie the silicates of commerce, and it will be appreciated that all grades of viscosity, stickiness, setting time—dependent upon ease of "drying"—and total content of solids can be produced by altering the alkali-silica ratio, and working the gravity in correlation.

The facts may be summed up as follows: (1) When the specific gravity of the solution is kept constant, the viscosity and alkali content vary inversely; (2) if the viscosity be kept constant, the gravity and alkalinity vary directly.

Examples of solutions from large shipments may be quoted to illustrate this point:—

Gravity (°Tw.).	Ratio $Na_2O : SiO_2$.	Viscosity (at 20° C.).
(1) 85	1 : 3·26	21·9 C.G.S. units.
(2) 87·7	1 : 3·16	10·8 C.G.S. units.
(1) 71·6	1 : 3·53	3·1 C.G.S. units.
(2) 71·96	1 : 3·48	1·7 C.G.S. units.

Although the gravity is not quite constant in either of the two cases shown, it increases from (1) to (2) and should therefore, of itself, tend to *increase* the viscosity. Limits are, however, set to the indiscriminate extension of these variations. Thus, if the alkalinity of the solution be too high, a very slow-drying water absorbent silicate results; and there are other objections which will be discussed later.

Broadly speaking, the viscosity and stickiness of a silicate solution can be arranged by the producer so that it will fulfil all requirements from an adhesive standpoint and possess no disadvantageous qualities.

THE ALKALINITY OF SILICATE

Such an alkalinity as is represented by a 1 : 1·5 ratio would lead to discoloration of the paper or wood products with which silicate is chiefly used as an adhesive. Many paper-ard articles, *e.g.*, food containers, are vered with a facing paper or label printed in lours. Now many colours are affected by kali and labels printed in such dyes or inks come discoloured after long contact with a ckage of which the material has been built p with the aid of silicate adhesives of high kali content. Paper tubes, made from echanical woodpulp stock are " stuck " in the urse of making by means of silicate, and if is is too alkaline, a yellow colour develops the overlap. Further discussion of the fects of alkali in highly alkaline silicate lutions is unnecessary, as it has been stated at the chief use of silicate as an adhesive is r paper and wood products, which are readily sceptible to alkali attack. It should, howver, be pointed out that other factors influence taining, and that a thin " neutral " silicate ill stain a white board more than a thick ighly alkaline product, facility of surface bsorption and penetration having to be onsidered.

No one realises the significance of alkali ontent more than the manufacturer of silicate ; or this reason silicates are not made with a igh alkali content, and if the user will employ he adhesive as sparingly as possible—which s not difficult, as silicate spreads easily—no taining need be feared.

Labels printed in alkali-destructible colours ave been successfully pasted on to containers ith the aid of silicate of low alkali content, he labels being reasonably thick and not pread too thickly with the adhesive. In eneral, however, dyes affected by alkali should ot be used in labels or coloured outside rappings which are to be affixed by means of ilicate.

Excessive alkali in a silicate adhesive tends o make the material with which it is used omewhat hygroscopic, and to render it very ' slow " on the machine, *e.g.*, in paper-board nanufacture. An alkaline silicate can be made ticky enough to cause edges to adhere after short contact. Hence a balance must be truck between the various desirable qualities ; n this way only can an article be produced hich is sufficiently viscous and sticky, which as a convenient drying and setting rate, and hose alkali content is as low as is consistent ith the realisation of the other essentials.

Applications of Silicate Adhesives

Built-up paper-board, box-board, container-oard and the like are made by uniting several heets of paper-stock, not in themselves thick strong enough for use in making packages, od containers, etc. A four-ply board is a mmon article of manufacture, and is made uniting two " inners " of cheap mechanical oodpulp stock or chip stock, with two outers " of a suitably (resin) sized Manila or te stock. The " inners " are, say, 23 to 30 points " in thickness—a " point " represents a thousandth of an inch—whilst the " outers " range from 4 to 8 " points " in thickness. Silicate is applied by suitable spreading rollers to the " inners " only, the machine positions the " outers," and the potential board passes to pressure rollers, where the union is completed. A good adhesive has dried at this stage, so that the completed board can pass on immediately to the cutters and trimmers. The edges of the board do not become loose, and the loss by cutting and trimming is only a few per cent. even with the machine running at, say, 100 ft. per minute. A consumption of 35-40 lb. of silicate per 1000 sq. ft. of board made is a normal usage.

Several factors influence the efficiency of the machine, and of these temperature, humidity and quality of stock may be noted. In some factories the temperature is kept uniform by artificial means. It is obviously possible to use heated silicate adhesive, so that after application to the stock, the union takes place both by cooling—the silicate becoming more viscous—and by increased evaporation of the water. The stock should absorb the silicate as uniformly as possible, for if the " inners " are relatively more porous, it will be necessary to overload them in order to leave enough adhesive to make the bond with the uncoated " outers."

The production of wall-board, book-bindings, cloth-board, and in fact all kinds of built-up products made of wood or paper stock, requires no elaborate consideration, but it may be noted that mandrel-made articles—spiral or lap wound—are produced with silicate adhesives. The making of cylinders from plane sheets of strong board—the cylinders afterwards being cut into suitable sizes for food containers—presents difficulties which can be overcome. Thus, the " spring " of the board demands that a good " hold " at the overlap be quickly attained, otherwise the rate of manufacture is lowered. The alkali content of the adhesive must be watched, so that staining of the board shall not result, and, as above noted, the balance is struck between the various essentials.

Corrugated or crimped paper or board is often made into a three- or five-ply product. Thus, the latter consists of two corrugated sheets with a central, an outer and an inner liner or facing of suitable paper. This is affixed by smearing the tips of the ridges with silicate and pressing the liners upon them. The same qualities in the adhesive are again demanded, and the output of the machines is regulated by the speed of drying, the completion of the bond, etc. Silicates with 8·8 to 9·3 per cent. of sodium oxide and 28–29 per cent. of silica (76–81° Tw.), are found suitable but a compound with as much as 11 per cent. of sodium oxide has been tried; such silicates, however, are not as yet in general use.

The adhesives used in the production of built-up wood-board—veneers—are casein, alkaline starch, glue, etc., but silicate is finding increased application. A thinner silicate can be employed, since pressure is applied for some time after building up the composite product. A silicate of about 55° Tw., with a relatively low alkali content, is preferable. "Fillers" may be added.

As a final example, the bonding of natural or artificial abrasives for the manufacture of abrasive wheels may be indicated. A mixture of abrasive, clay, and silicate is moulded and subsequently baked. A strong bond is formed, possibly by interaction between the alkaline silicate and the aluminium hydrosilicate of the clay. Occasionally there is interaction between the alkaline silicate and a silicon carbide abrasive employed, but the addition of potassium permanganate, which reacts with the hydrogen otherwise evolved, has been claimed to prevent imperfections caused by liberated gas. Silicate adhesive is largely employed in abrasive-wheel manufacture, but dry silicate "glass" is perhaps more suitable than the solution, the "glass" being employed in the dry process of wheel construction.

FILLERS

Whiting, dry (but not baked) clay, etc. may be added to increase the viscosity of the adhesive. If a thicker and more quickly setting adhesive be required, the filler is added alone, up to an equal weight. If a thicker adhesive with no increased setting speed be demanded, dilution with water may be practised, whilst the addition of both filler and water in larger amount will provide a thicker adhesive with a diminished setting speed. The action and relations of silicate and various fillers require further study, and this field of research appears to offer great possibilities. Such problems as the increased difficulty of application, the less "handy" type of adhesive which is necessarily produced, the requirement of agitation devices for the adhesive trough at the machines, must be investigated before "filled" silicates can be employed to supplant plain silicate solutions. They are, however, finding increased application, for example, in uniting very porous materials or surfaces of unequal porosity.

CONCLUSIONS

Sodium silicate solutions can be prepared to meet all the requirements of a good adhesive; they are superior to animal and vegetable adhesives in that they are fire-resisting, do not become rancid, and are vermin-repellent. Silicate adhesives are quite odourless, and produce damp-proof articles, they have a relatively high bond strength, and their setting times can be varied over a wide range. They are ever-ready, requiring no heat before or during application, and they give consistent result[illegible] The apparatus required for their application to wood, paper, etc. is extremely simple.

TECHNICAL ASPECTS OF HYDROGENATION*

THE technical application of what would appear to be a comparatively simple catalytic reaction—if any catalytic reaction may be considered simple—has inspired the subject matter of some 300 patents. All of these have for their aim the production of substantially the same product by reaching the same chemical end-point.

Our sympathy must be given to any unfortunate investigator, who, desiring to take up the study of the subject at this stage, is faced with contradictory statements and complications out of all proportion in magnitude to the simple manipulation necessary to effect hydrogenation on a commercial scale. I would that I could lay before you some sound scheme for the reconstruction of Patent Law, as applied to chemical products, framed in such a way as to frustrate the registration of so many patents on the one subject, without in any way doing an injustice to the genuine research worker and without producing stagnation of enterprise. Let those who have a ready solution of this problem read the able words of Horatio Ballantyne† so that they may first learn where angels fear to tread.

Hydrogenation has two main effects—(1) To produce a hard solid fat from a liquid oil; (2) To remove certain impurities which are not removable by any other means, so rendering the oil of use for purposes for which it could not otherwise be adapted.

Passing over theoretical considerations, the process may be briefly described as the introduction of a comparatively small weight of hydrogen into the oil (only a few pounds per ton). This small weight of hydrogen, however, occupies as much as 1 cb. ft. per lb. of oil treated, and it is this comparatively great volume of hydrogen which raises the first difficulty on the commercial scale and brings before the manufacturer the necessity for making the first decision—namely, shall operations be conducted near a convenient supply of hydrogen or near the source of the oil?

The production of cheap hydrogen, free from carbon monoxide and oxygen and having as little nitrogen as possible, has grown with the hardening industry.

The most important methods of producing hydrogen are—(1) By electrolysis; or (2) By decomposition of water by alternate oxidation and reduction of iron with producer gas.

Of the electrolytic methods there are—(*a*) Direct electrolysis of water, in which operation oxygen is a valuable by-product or (*b*) electrolysis of salt, having for its main issue the production of caustic soda with chlorine as a by-product.

---

* A paper read by Mr. E. Richards Bolton to Section B (Chemistry) of the British Association, Hull, 1922.

† Lecture on "Chemists and the Patent Laws", published by the Institute of Chemistry, 1922 (*cf.* J., 1922, 121 B).

In both these cases hydrogen is directly obtained from water. Many other methods have been employed—such as the utilisation of the hydrogen of hydrocarbons and so forth. Of the possibilities of the future one must consider *hydrogen carriers,* where advantage is taken of the affinity of oil for hydrogen, in that oil, under the stimulus of the catalyst, can rob other compounds of their hydrogen; but whether a liquid, easily obtainable at a competitive price, can be found ready to give up its hydrogen to oil is one of the fascinating possibilities of the future, and one which might cause a readjustment of the whole hydrogen position.

In countries like Norway—providentially provided with water-power—production by electrolysis must, in the present state of our knowledge, hold the field; and it is only recent improvements that have allowed hydrogen, produced by other methods, to compete with the electrolytic product so as to permit the process of hardening to be carried out in a locality suitable to the oil supply.

I pass over the production of hydrogen thus ightly, not from want of realisation of its mportance, but rather to emphasise what has always received the least attention—namely, the *oil* itself. One reads of hydrogen poisons, of catalyst poisons, and of the extraordinary care taken in the preparation of products to free them from these poisons. One finds works where all this care is taken and yet a perfect catalyst together with the most ideally pure hydrogen is introduced into oil, which oil has received quite inadequate attention and is reeking with impurities many of which are easily removable.

I have always held the view that the economy and efficiency of the process lie in a careful attention to the purity of the oil, and I feel that workers have been led astray by the fact that hydrogenation purifies so effectively that very little treatment is necessary to begin with. For this reason they have let slip from their observation the fact that most impurities, easily removable before hydrogenation, if left in the oil are merely wasters of catalyst and spoilers of hydrogen, and that impurities, more economically removed by simple means, are being dealt with in a more costly manner at the expense of catalyst and hydrogen. If I may for a moment poach on the field of theory, I would aim at the mark arrived at from theoretical considerations—namely, that, given a chemically pure oil and chemically pure hydrogen and catalyst, then, under these hypothetical conditions, the catalyst should retain its activity for ever, and, while such a state of affairs is obviously impossible, it is surely sound policy to approach it as nearly as practicable.

Now, to pass on to the catalyst, the working of which has been so often explained and is still so little understood.

With a few exceptions nickel is the catalyst universally employed. Among the exceptions are platinum and palladium, which, whilst almost prohibitive in price and involving very refined methods of recovery, cannot hope to compete with nickel in spite of the small quantity which is necessary, unless it can be shown that their activity at low temperatures—in fact appreciable activity at room temperature—confers some benefit on the finished product, not otherwise obtainable, for example, the hardening of particular oils without the destruction of vitamins. Otherwise, unless these metals fall very considerably in price, nickel has the field to itself.

The catalyst problem consists of three parts—(1) The preparation of a suitable catalyst; (2) the maintenance of its catalytic activity for as long a period as possible; (3) the recovery and reactivation of spent catalyst.

For the preparation of the catalyst the methods are many, but those commonly employed are based on the preparation of nickel carbonate precipitated on a vehicle, such as kieselguhr, and, after drying, reduced in hydrogen either directly in powder form or actually in the oil. The oil-reduction method produces a very active catalyst of a colloidal nature, a nature which, as one might expect, renders it more susceptible to poisons, and, in common with colloids, liable to sudden coagulation. In fact cases have come to my notice in which a nickel catalyst has suddenly coagulated from oil, in quite large particles as big as lead shot, and sunk, leaving a clear oil. (Research in this direction might be recommended to the colloid chemist, for whom, incidentally, there is a large field in connexion with oils generally.)

Notwithstanding such occasional irregularities, I have visited works where the catalyst is prepared on this principle with the most excellent results.

The simplicity of the dry-reduction method doubtless explains its great popularity. When this method first came into use a diversity of results was obtained, which was due to lack of temperature control and uneven heating. The more consistent results now so generally obtained are due to a clear appreciation of the following facts—namely, that:—

Low temperature of reduction (250° C.) increases activity but renders the catalyst more susceptible to poisons; whereas high temperature of reduction (350° C.) lowers the activity of the catalyst but increases its life.

Catalysts may well be compared to horses: the low-temperature product is swift as a racehorse, and the high-temperature product is steady and slow as a cart horse. The first gets there more quickly, no doubt, but the canny manufacturer who has to drag a thousand tons a week through his factory will choose the Clydesdale every time.

Having chosen the method of preparing our catalyst the maintenance of its activity must receive very careful attention, for therein lies one of the great sources of profit or loss in the process.

I began by emphasising the great need of purifying the oil, and I would ask those who take so much laudable care in purifying hydrogen and catalyst to remember that as little impurity as 0·2 per cent. in the oil represents one-fifth of the weight of 1 per cent. of catalyst, and, should the impurity be one which forms a film on the catalyst, the result is obvious; whereas, if the impurity be moisture, hydrolysis will result and the fatty acid produced will tend to form a coating of metallic soap.

All workers know how often a failure to hydrogenate effectually is associated with a rise of acidity. Hydrogenation is essentially a problem for those experienced in the properties of oil rather than for metallurgists and gas chemists.

The greatest solicitude that science can pay to the catalyst does not prevent the havoc of age, and, sooner or later, the time comes when the question of recovery and re-activation arises. In the early days the process of hydrogenation was so profitable that residues consisting of approximately 1 part of nickel, 1 part of kieselguhr and 2 parts of oil were discarded. The proportion of oil was subsequently somewhat reduced, but ere long recovery of nickel became essential to economic working.

Attempts to extract the oil by solvents from press residues have met with partial success, though, owing to the extreme fineness of the nickel, this is attended with some difficulty. A simpler method is to roast the residues or boil them out with caustic soda and roast the settled sludge. In some cases it may be sufficient to pass air over the ignited mass in a roaster, and, after displacing the air by CO_2, reduce at 250°–300° C. by hydrogen. A catalyst recovered in this way does not regain its original activity, so that when working with fish and other low-grade oils the ignited nickel residue is dissolved in acid, preferably nitric acid, and re-precipitated. In the latter case it is important not to introduce impurities by the solution of other metals contained as impurities in the kieselguhr.

Processes have recently been suggested whereby both the oil and the nickel are recovered from residues in a condition suitable for immediate re-use, and these will, no doubt, come into general use in the future. The successful operation of such processes really means that the catalyst becomes a capital charge, in fact, a part of the plant, and such a revolutionary change is likely to lead to a complete alteration in the whole procedure of hydrogenation.

A most extraordinary amount of engineering skill has been directed to the designing of all kinds of mechanical devices aimed at violent agitation and intimate admixture. The advancement of the art, however, is in no way commensurate with the skill and energy expended. The engineers—to use an Americanism—have been "barking up the wrong tree" when they have aimed at such violent methods; whereas, to the simple-minded, who have not been led into mystic paths of theory, it seems obvious that once the catalyst has become impregnated with oil, hydrogen can only reach it by penetrating through the oil—and to get through the oil, it must be in solution in the oil.

Once this is clearly understood it is easy to explain why such excellent results are obtainable with a gentle circulation of hydrogen-saturated oil. All that is really necessary is to remove the hardened oil from the surface of the catalyst in order to make access to fresh material.

The main types of plant devised may be briefly summarised under three headings:—

(1) A vessel nearly full of oil containing catalyst in suspension, through which hydrogen is circulated by mechanical means; possibly also with circulation of oil to maintain suspension of catalyst;

(2) A vessel full of hydrogen into which an intimate mixture of oil and catalyst is sprayed;

(3) Vessels containing stationary catalyst, through which oil and hydrogen are circulated.

Each of these three methods has fallen in for its share of elaboration, and it is unfortunate that, sometimes, the aim seems more the securing of a patent at any price than any real improvement of the processes.

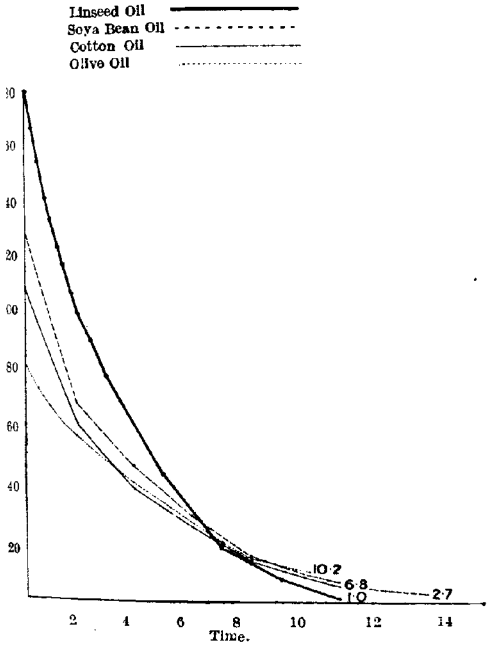
After considering all these complications and elaborate devices it seems absurd to find that the very simple method which I use in my laboratory for testing samples of oil as to their suitability for hydrogenation, should achieve the same result just as well.

Activated nickel wire is lightly pressed into a test-tube and covered with the oil to be treated. A slow stream of hydrogen is bubbled through the oil, the test-tube and its contents being maintained at 180° C. Hydrogenation then takes place evenly, and the operation may be continued in this simple apparatus until the iodine value of the oil is reduced to nothing. The oil is poured away from the catalyst and is clear without filtration.

Practical experiments have proved to me that this laboratory method can be extended in its simplicity to a works scale.

It has been suggested that poisoning of a catalyst by sulphur obtained from impure oils is proportional to the mass of catalyst, whilst hydrogenation is a function of surface only. This suggestion has received experimental support in the work of Dr. Maxted on the action of sulphuretted hydrogen on palladium.* This being so it would be expected that a catalyst with relatively large mass in proportion to its surface would hydrogenate oils containing small quantities of poisons almost independently of these poisons—that is, as shown by Dr. E. F. Armstrong, the velocity-time curve would be a straight line.

I have here some curves to show the results of hydrogenating oils by means of nickel wool which lend some support to this view. Though when we consider, for example in the case of linseed oil, the different chemical substances present — triglycerides of highly unsaturated fatty acids with three double linkages, hydrogenated down to olein and finally to pure tristearin—the fact that no break is shown in the curve may mean that the physical factors of contact, etc., are overwhelming the chemical side of the reaction altogether.



In conclusion, it is pleasant to think that the ideal at which we should aim—namely, a continuous process with a fixed catalyst capable of revivification *in situ* delivering oil without appreciable loss of catalyst—is really not out of sight. An added refinement is the possibility of setting an indicator to deliver automatically a continuous stream of oil of any desired degree of hydrogenation; that is to say, a self-operating mechanical control to alter the conditions necessary to compensate variations in the speed of the process.

POST-WAR PROGRESS IN THE FIXATION OF NITROGEN*

THE ARC PROCESS

THE arc process of fixing atmospheric nitrogen was put into commercial operation in Norway as long ago as 1904, and has now reached an enormous development. It was pointed out in the Report of the Nitrogen Products Committee (*cf.* J., 1920, 25 R) that although the power requirements of the process are very large, it nevertheless affords the cheapest known method for the manufacture of nitric acid.

It has not been sufficiently recognised that the arc process in its industrial form owes its initiation in a very great measure to scientific researches carried out mainly by British investigators. When, during the war, the writer was privileged to see the whole of the developments at Notodden, also the much larger and newer plants at Rjukan, officials of the Norsk Hydro Company told him that Prof. Birkeland used to recognise frankly that his inspiration to found an industrial process was derived from the famous British Association address of Sir William Crookes, and especially from the quantitative experimental work of the late Lord Rayleigh. At Notodden plant is now installed to utilise about 45,000 kilowatts, and in the two great works at Rjukan there are furnaces employing in all over 200,000 kw., or 270,000 continuous horse-power, this energy being generated at what is almost certainly the cheapest hydro-electric plant in the world. At Rjukan II. a 15,000 kilowatt steam-operated set has now been added to utilise waste steam raised in the boilers employed in the cooling of the process gases, which leave the furnaces at about 1000° C. During the later war period almost the whole output of these enormous works came to France and England for munition purposes.

Though the arc process has now reached the stage of a magnificent engineering achievement, it must be remembered that less than 2 per cent. of the electrical or heat energy expended in the average arc furnace is absorbed as chemical energy in the initial oxidation of the nitrogen. The concentration of nitric oxide in the gases leaving the furnace averages only about 1·2 per cent., and therefore it is not surprising that many suggestions have been made to improve the efficiency of the process, and all kinds of alternative forms of furnace plant have been proposed. Some of these have been tried during the war, and about fourteen arc plants of various types, mostly of small output, are now distributed throughout the world.

One of the more important variants of the original process depends on the use of enriched air, instead of common air. This has been used on a considerable scale by a company operating works in Switzerland and in Germany. The oxygen content of the air utilised is increased to 50 per cent., and to prevent loss of oxygen the whole operation is carried out in a closed circuit. The product, instead of being absorbed in towers, is generally removed by cooling, as liquid nitrogen peroxide. Although under certain conditions the increase in yield of fixed nitrogen obtained from the enriched gas was considerable, and though many tons of liquid nitrogen peroxide were made by the process, certain serious difficulties were encountered, and several explosions have recently occurred in these plants.

---

* Chem. Soc. T., 1919, 115, 1050.

* The substance of a paper read by Dr. J. A. Harker, F.R.S., before Section B (Chemistry) of the British Association, Hull, 1922.

The nitric-acid works on the Birkeland-Eyde system, erected during the war in France, are now closed, in order that the power may be used for its original purpose—viz., railway electrification.

SYNTHETIC AMMONIA PROCESSES

Originally worked out by Haber and his colleagues, among whom I should specially mention Dr. Le Rossignol, who is an Englishman born in Jersey, and Dr. H. C. Greenwood, the brilliant young investigator whose death three years ago we all deplore, the process was translated into a technical success by the Badische company, and is now employed on a huge scale in its works at Oppau, on the Rhine, and in the much larger works only recently completed at Merseburg, in Saxony.

But to day this is by no means the only process for the manufacture of ammonia from its elements. The accompanying table shows that there are now quite a number of other synthetic-ammonia processes, and summarises the more important facts regarding their individual characteristics.

The original German process operates at 200 atmospheres, now considered only a moderate pressure. In order to secure autothermic working, very large units are employed and the gas velocity is kept low, the reaction vessels being enormous flanged tubes of steel, nearly 40 ft. long and over 3 ft. external diameter, with walls 6 in. thick. The gases are preheated before being passed over the catalyst, and are recirculated through the system, after removal of the ammonia they contain.

In the process worked out independently during the war in the research laboratory of the Nitrogen Products Committee, at University College, London, much higher gas velocities were employed. It was found that under these conditions the yield of ammonia from a given quantity of good catalyst material can be increased enormously, and in the technical plant which was designed it was planned to obtain about 5 kg. of ammonia per hour for each litre of space filled with catalyst, instead of about 400 g. as in the original German system.

In the plant to produce 11,000 tons of nitrogen annually in the form of ammonium nitrate, erected at Sheffield, Alabama, by the U.S. Government in 1917–18, and working on lines not greatly differing from the German process, activated sodamide was used as catalyst material. This was difficult to prepare in bulk, and its activity, though at first fairly high, was permanently destroyed even by small quantities of water vapour. Therefore it was not surprising that this plant did not reach the stage of commercial operation. But, profiting by the lessons of this comparative failure, an American company, formed by the General Chemical Co. and

Forms of the Synthetic Ammonia Process

Country and Date	Process	Operating pressure Atms.	Approx. space-time-yield kg. lit. cat. hr.	Approx. percentage conc. NH_3	Method of removing NH_3	Source of hydrogen	Remarks
Germany (1913)	Haber - Bosch (Badische Co.)	200	0·3 to 0·5	7–8	(*a*) Cooling (*b*) Solution in water	Water gas catalytic process	Very large units, low gas velocity, circulation. Pre-heating. Process in large-scale operation.
England (1917)	Ministry of Munitions (Greenwood and associates)	150	5–20	2–4	Solution with temp. cycle	do.	Much higher gas velocity; some electric heating. Experimental scale only.
„ (1921)	Synthetic Ammonia and Nitrates, Ltd., Brunner Mond & Co., Billingham	—	—	—	—	—	Experimental works plant working 2 tons per day.
U.S.A. (1918)	General Chemical Co. (Sheffield, Alabama)	under 100	about 0·4	8	Cooling to 30° or 40° C.	Water gas catalytic process	U.S. Govt. Works, designed for 11,000 tons N annually. Not now in operation.
„ (1920)	Atm. Nit. Corp. Solvay Process Co., Syracuse	—	—	—	—	—	Working on a scale of 10 tons NH_3 per day. Circulation.
France (1920)	Claude	900–1000	about 5	25	Condensation at atm. temp.	Various	Working on scale of 5 tons a day. Three stages in series. No circulation.
Italy (1922)	Casale (Soc. Idros Terni)	about 500	—	—	Solution	Electrolytic	Working on a scale of about 4 tons per day. Circulation.
„ (1922)	Pfauser	—	—	—	Solution	Electrolytic	—
Norway (1921)	Cederberg	—	—	—	—	—	—

the Solvay Process Co., has erected near New York an improved plant on lines not dissimilar to those followed at Sheffield. For over a year this has now been producing liquid ammonia for the refrigerator industry at the rate of 10 tons per day.

The process invented by M. Claude, the special characteristic of which is that it operates at a very high pressure (about seven tons to the square inch), has been described in detail both by Claude himself and more recently by J. H. West (*cf.* J., 1921, 420 R). It differs mainly from the older Haber process in that under the very high working pressure adopted (about 900 atms.) the percentage combination attained in the gases after a single passage is about 40 instead of 10–11, giving about 25 per cent. of ammonia in the issuing stream. The yield of ammonia per litre of catalyst per hour in technical operation reaches the high value of about 5 kg. Multiple-stage working is adopted instead of recirculation of the gas, and the dimensions of a full-sized unit plant giving a technical output of 5 tons per day appear almost absurdly small in comparison with the monumental structures employed in the German process. M. Claude is now using a new form of catalyst tube, made by a well-known firm of steelmakers in Sheffield, of a new material having very remarkable properties at high temperatures. These tubes stand up extremely well to the trying conditions, and promise to give a safe industrial life much longer than anything previously attained. In the Badische process the cost of preparing and purifying the hydrogen used amounts to from 65–70 per cent. of that of the ammonia produced. It is therefore evident that hydrogen production is of paramount importance, and it is to the preparation of cheap hydrogen by a new process from the gases of the coke ovens at Bethune that Claude is at present devoting his attention.

In the Casale process, as now running at Terni, near Rome, the hydrogen is obtained electrolytically from large cells of a new type operated by hydro-electric current obtained from the great waterfalls near by. Some of this hydrogen is burnt with air, and thereby the required mixture of hydrogen and nitrogen is produced. Much attention is now being given to the question of the bulk generation of electrolytic hydrogen. New types of cell of large capacity have been worked out by inventors in this country and in Switzerland, Italy, and America.

Several proposals are on foot in different parts of the world to use electrolytic plants on a very large scale for producing hydrogen required in the manufacture of synthetic ammonia. There is good reason to believe that under existing conditions, and with coke at its present price, hydrogen produced in bulk at a favourable site from cheap hydro-electric power will easily be able to compete with that obtained by other methods. To ensure this, however, the type of cell employed requires to be much cheaper than previously, in order to keep down the capital cost of the electrolytic plant, which otherwise would be almost prohibitively large.

CYANAMIDE PROCESS

The cyanamide process, which, though stated by many authorities to be obsolete, or at any rate obsolescent, had at the end of the war an aggregate capacity in tons of nitrogen distinctly greater than that of any other method of fixation. It is quite true that since the armistice many of the works erected or enlarged during the war period have been closed. In some cases their situation was unfavourable for post-war commercial operation, and some of those whose output was used as a source of ammonia for munition purposes are unable, under present conditions of cost of labour and raw materials, to operate for the commercial manufacture of fertiliser.

The largest cyanamide works in the world, capable of producing about 200,000 tons annually, and erected during 1918 by the American Government at Muscle Shoals, in the wilds of the cotton-growing district in Alabama, is one of these. We in England used sometimes to say, five years ago, that Uncle Sam was rather slow in making up his mind to come into the war, but there is no doubt that when he did come in he put his hands into both pockets and spent money like water. The American nitrogen programme, including the expenditure on unfinished plant, scrapped at the time of the armistice, cost no less than $140,000,000. Muscle Shoals alone, exclusive of the hydro-electric scheme now being proceeded with, cost nearly twice as much as Gretna. During the past two years all sorts of proposals have been made as to its future, and at present it is still uncertain whether the Government will lease it to Henry Ford or some other private interest, or will keep it, and the synthetic plant at Sheffield, wrapped up in cotton wool, ready for the next war.

So far as can be ascertained, there has been no new development of outstanding importance in the manufacture of cyanamide itself, although detailed improvements have been made; but, nevertheless, even under the present difficult conditions, cyanamide is still almost certainly the cheapest form of combined nitrogen. In Germany, notwithstanding the recent big synthetic-ammonia developments, plans are now on foot for an immediate approximate doubling of the capacity of the great cyanamide plants at Presteritz, belonging to Messrs. Frank and Caro. Though the German nation cannot pay its just debts, there appears to be still plenty of money for private enterprise.

But cyanamide, when made, is at best an unsatisfactory fertiliser for many soils. When, in the course of an investigation a few weeks ago, the writer had an analysis made of what was probably a rather old sample of cyanamide, to his surprise he found that the nitrogen content was practically all in the form of dicyanodiamide. If such transformation is common, it is no wonder that the action in the soil is sometimes found to be injurious, rather than beneficial. Many efforts have been made within the last few years to find some process by which cyanamide nitrogen can cheaply be transformed into some other compound. As pointed out in the Report of the Nitrogen Products Committee, to transform it to ammonium sulphate is a relatively expensive process. Until lately the researches to this end made in many different laboratories have met with but small success.

An American company is now manufacturing from cyanamide, for export, a concentrated mixed fertiliser in the form of mono-ammonium phosphate, sold under the trade name of "Ammophos." This would appear to be a promising material, but is too costly for many applications. But within this last year independent investigators in Sweden and Switzerland, working along parallel lines, have succeeded in perfecting processes whereby, by the action of carbonic acid, free cyanamide is first prepared from a solution of calcium cyanamide, and subsequently transformed to urea. In the Swiss form of the process, excess of the sulphuric acid employed in the second stage of the transformation is afterwards used to act upon phosphate rock, which is changed to mono-calcium phosphate. The final product is a neutral body known in France and Switzerland as "Phosphazote," having its nitrogen content as urea, and its phosphorus in the water-soluble form. The cost of its manufacture is stated to be by no means high, and, unlike cyanamide, the substance has no deleterious action on the skin or on the bags in which it is packed. It has now been manufactured in Switzerland on a fair scale for about six months, the product going mostly to France for vine culture. The relation of the two constituents can be varied within limits, but the usual form in which the fertiliser is sent out contains 11–12 per cent. of nitrogen as urea and 11–12 per cent. of available phosphoric anhydride. These two new processes, which apparently are in course of rapid development, may prove to be a means of habilitating cyanamide as a product of fixation, and hence may shortly assume considerable importance.

CYANIDE PROCESS

It is only possible to refer very briefly to the cyanide process, by far the oldest practical fixation method, which still attracts many investigators. A British company is continuing its experiments at Birmingham, and in America cyanide is now being made on a considerable scale from cyanamide as a source of hydrocyanic acid for use in plant fumigation. In the opinion of some American experts the costs of producing cyanide by existing methods, such as the Bucher process, are excessive, and the cyanide process is not likely to be competitiv until further research is carried out on the fundamental reactions involved in the preparation of sodium cyanide. These have never been properly studied, and are more complex than was formerly supposed. Investigations with this object are being undertaken by the Fixed Nitrogen Research Laboratory of the American Government.

AMMONIUM NITRATE

After the Oppau explosion mixed salts containing ammonium nitrate will probably be under the ban of many fertiliser dealers, although the substances may nevertheless be perfectly safe, if their possessors are not sufficiently careless or foolish to attempt to remove them by the stimulus of a big blasting cartridge.

THE POSITION IN GERMANY

In 1913 Germany consumed about 200,00 tons of nitrogen, of which about 110,000 tons was imported in the form of Chilean nitrate. The bulk of this large consumption was used in agriculture for the intensive cultivation of crops. Prof. Matignon, of the Collège de France, states that from May 1, 1921, to April 30 of this year, the smaller Germany of to-day consumed 290,000 tons, or 45 per cent. more than in 1913, without the demands of her agriculturalists being entirely met. Furthermore, the whole of this increased total was produced within the country from the fixation and by-product industries.

Even that is not the whole story. The limit of capacity of production of the German works was far from being attained in 1921. Although the German Government pleads bankruptcy, the Badische company appears to have had little difficulty in finding money to repair the enormous damage caused by the great explosion at Oppau last September. It is stated that the works is now on the point of being ready to produce again at full capacity.

At the end of the present year Germany will have at her disposal an internal capacity for the production of fixed nitrogen of about 500,000 tons annually, a total so colossal that she will be entirely independent of all importation. In case of another war, she will thus be assured of the basic materials for a gigantic production of munitions, together with enough fertiliser to enable her to grow a very large share of her own food. It may be justifiable for the Allies to allow our late enemies to put themselves so soon after the war into so strong a position; but, on the other hand, it may be that those whose function it is to see to it that some, at any rate, of the provisions of the Peace Treaty are carried out, are unaware of what is now happening.

Let them beware that whilst Gretna and almost all our own munitions works are calmly being dismantled, the world is not caught napping a second time.

THE BRITISH ASSOCIATION

THE ninetieth meeting of the British Association, held in Hull from September 6 to 13, will be remembered as one of the most pleasant and useful in the long history of the Association. The arrangements were excellently planned, and the attendance of 1730 must be regarded as very satisfactory, particularly in view of the refusal of the railway companies to extend to members the same facilities that are given to race-goers and other pleasure-seekers.

Since the meeting in Edinburgh last year, the Association has received a most generous gift of £10,000 from the Hon. Sir Charles Parsons, and a legacy of £450 from Mr. T. W. Backhouse. Sir Charles Parsons has also financed the production and publication of "A Retrospect, 1831-1921," compiled by the Secretary, Mr. O. J. R. Howarth (*cf.* J., 1922, 272 R). With these welcome aids to its somewhat slender financial resources, the Association should soon be in a position to increase the grants to research committees, and to extend the scheme of exhibitions to students enabling them to attend the meetings, which was initiated during the past year. Sir Edward Thorpe, the retiring president, has drawn the attention of the Council to the hardship inflicted on students of science by the greatly increased cost of text-books, and to alleviate the difficulty Sir Robert Hadfield has given a donation of £50 per annum for three years. The Council has decided to allot the money to necessitous students of the poorer provincial universities and technical institutions.

Prof. H. H. Turner, Savilian Professor of Astronomy in the University of Oxford, has retired from the office of General Secretary, and Mr. F. E. Smith, F.R.S., Director of Scientific Research at the Admiralty, has been elected to fill the vacancy so created. Sir Robert Hadfield and Prof. W. A. Bone have retired from the Council, but Chemistry remains well represented by Sir William Pope, Dr. E. F. Armstrong and Prof. A. Smithells.

Arrangements are well in hand for next year's meeting in Liverpool (September 9 to 16), where Sir Ernest Rutherford will preside, and Dr. A. Holt, Mr. Edwin Thompson and the Town Clerk will act as Local Secretaries. Everything points to a very successful meeting, including several departures from precedent which should add to the convenience of members. The invitation to hold the 1924 meeting in Toronto has been definitely accepted ; the Dominion Government has voted the sum of approximately £11,000 to assist visitors from Great Britain ; and the meeting will probably be held during the first week of September, after members have had an opportunity of travelling around.

The only change in the organisation of the Sections is the introduction of Forestry as a sub-section of Section K (Botany).

Sir Charles Sherrington's presidential address, entitled "Some Aspects of Animal Mechanism," dealt mainly with recent advances in the physiology of the nervous system and the time-honoured problem of ontology. Although we can now explain the *how* of the mechanism of some aspects of animal life, we are still as far off as ever from understanding the nature of the connexion between nervous processes and the corresponding phenomena of consciousness. In an Evening Discourse, entitled "The Atoms of Matter : their Size, Number and Construction," Dr. F. W. Aston described in simple language the results of, and inferences from, recent work in the prolific field of radio-activity, and refreshed us all by giving two new illustrations of the dimension and speed of molecules. He said that if a hole were made in an evacuated electric-lamp bulb of a size to allow the molecules present in air to enter at the rate of one million per second, one hundred million years would elapse before the bulb was full. Again, if a tumblerful of water were distributed throughout all the waters on the globe, then each tumblerful taken from these waters would contain 2000 molecules of the original tumblerful.

CHEMISTRY

Although the meetings of Section B, in common with those of most other sections, did not attract such large audiences as did last year's meetings in Edinburgh, the attendance was nevertheless very good, and there is no doubt that the programme arranged by the Recorder, Prof. C. H. Desch, with the help of the Organising Committee, was much appreciated. The success of the gatherings was due in no small degree to the ability and geniality of the President, Principal Irvine, who, moreover, set a very high standard in his presidential address ; the Section does not often hear such a masterly account of new researches of great scientific, as well as of potentially industrial, importance.

General regret was felt at the unavoidable absence of Prof. A. F. Holleman, who was to have read a paper on "The Rule of the Conservation of Substitution-Type in the Benzene Nucleus," but in place of this a valuable pioneer paper, not previously announced, on "Solid Disperse Systems in Air" was read by Dr. R. Whytlaw-Gray of Eton College. The papers of Prof. J. W. McBain, Dr. J. S. Owen and of Principal Irvine's co-workers also dealt with the results of original research. The joint discussion with Section K (Botany) on Photosynthesis was well staged, and though it brought out prominently the somewhat widely differing outlook of chemists and biologists, it doubtless proved as useful to the protagonists as it was interesting and stimulating to the large audience. Very useful papers were contributed to the discussion on the Nitrogen Industry, and that by Dr. J. A.

Harker obtained very wide publicity in the daily papers. In contrast to this, the discussion on "Valency and Polarity in Organic Compounds," to which Prof. R. Robinson and Dr. J. Kenner made weighty contributions, was somewhat too abstruse for many of those present; but no criticism of this kind could apply to the very lucid expositions on the "Hydrogenation of Fats" given by Dr. E. F. Armstrong and Mr. E. R. Bolton. Reports were presented by the Committees on Colloids, Fuel Economy, and Absorption Spectra, but none of these was discussed.

Hull is a very favoured locality from the point of view of chemical industry, and the excursions to works, organised by Mr. A. R. Tankard, local secretary to the Section, proved very popular. The special thanks of the Section are due to the directors of the following companies for their generous hospitality: The British Oil and Cake Mills, Ltd. (seed-crushing and solvent extraction, soap, margarine); G. & T. Earle, Ltd. and the Humber Portland Cement Co.; Reckitt & Sons, Ltd. (ultramarine, starch, metal polishes, etc.), and the Frodingham Iron and Steel Co., Scunthorpe.

We give below further abstracts of papers presented, together with a *résumé* of a paper on the resistance to fire of concrete, read before Section G (Engineering) by Prof. F. C. Lea and Dr. R. E. Stradling of Birmingham University, and some remarks from the joint discussion on Vitamins held by Sections I and M (Physiology and Agriculture).

The Composition of Esparto Cellulose

By E. L. Hirst

Esparto grass, after removal of waxes, lignins, etc. in the ordinary course of paper-making, gives a material which is homogeneous and similar in appearance to cotton cellulose, but differs markedly from it in giving on distillation with 12 per cent. aqueous hydrochloric acid an amount of furfural corresponding to the presence of 18—20 per cent. of a pentosan.

Esparto cellulose is not acetylated so readily as cotton cellulose, but by slightly modifying Barnett's method, in which sulphuryl chloride is used as catalyst, almost quantitative yields of acetates have been obtained without appreciable loss of the pentose-content as shown by furfural estimations. This acetate mixture has been subjected to the action of acid methyl alcohol in sealed tubes at 130° C., when it is found that after prolonged digestion practically the whole of the material dissolves and the solution then contains methylglucoside together with a proportion of a methyl pentoside. That the pentose is identical with xylose has been confirmed by isolating from esparto cellulose a pentosan which on hydrolysis is converted into a reducing sugar identical with ordinary xylose. In the course of quantitative experiments esparto cellulose has thus been converted into methylglucoside and methylxyloside in such a manner that 90 per cent. of the whole material can be accounted for. The analytical results indicate that the over-all yield of methylglucoside is 95 per cent. and that of methylxyloside 68·5 per cent. of the theoretical amount, calculated on the assumption that only glucose and xylose residues are present. The loss in yield, as indicated by the results of control experiments, is due to the destruction of pentose owing to furfural formation during the digestion in the sealed tubes.

The evidence therefore points to esparto cellulose being, to the extent of 90 per cent. at least, a definite chemical substance composed of glucose residues and xylose residues present together in the proportions of 80 per cent. and 20 per cent. respectively.

Determination of Compressibilities up to High Pressure and Applications to High-Pressure Chemistry

By E. D. Williamson

A new form of pyknometer has given satisfactory results, particularly in determining compressibilities at the lower end of the pressure range. By means of a movable electrical contact, the instrument allows of continuous readings without removal from the pressure chamber.

In the study of the chemical effects of pressure on systems of more than one component, it is necessary to know the compressibility of each solution in order to compute the volume changes on which these effects depend. The volume changes can be readily calculated from the slopes of the density-composition curves. Even in the case of a simple system, such as a salt and water, it is necessary to make a number of other measurements in addition to those of compressibility. For instance, good density-composition data must be obtained at atmospheric pressure. Also, some form of equilibrium determinations, such as those of vapour pressure or EMF, must be made in order to calculate the initial differences in "free energy" (used in the same sense as by G. N. Lewis) between the solid salt and salt in solution. For the case of H_2O—NaCl almost all the necessary data for the complete elucidation of the system under pressure have been obtained, and a beginning has been made with some others.

Hydrogenation of Fats

This discussion was opened with an address by Dr. E. F. Armstrong, who said that fat-hardening presented problems which brought in almost every aspect of the chemist's work and nearly every trick of his art. Fat-hardening was discovered in theory by Sabatier and in practice by Dr. Normann whose small-scale experiments paved the way for the elaboration of the process on an industrial scale in England. The enormous number of patents, very few of which were of any value, which had resulted was typical of chemical industry, and he regarded this as one of the drags upon the wheels of progress which ought to be removed. Fat-hardening had been much delayed by the difficulties experienced in manufacturing hydrogen, but many of these had now been overcome. Inventors of processes for making hydrogen seldom took into consideration all three factors involved, viz., the capital cost of the plant, operating costs, and the cost of maintenance and repairs. In localities where cheap power was available, there was no difficulty in making cheap hydrogen by the electrolytic method, and he understood that it was being produced on the continent with the aid of cheap water power at 2s. 6d. per 1000 cb. ft. The process adopted by the Badische company was preferable when hydrogen was required in very large quantities, but the ordinary catalytic process was best for small plants. Dr. Armstrong then described the preparation of the nickel catalyst used in hydrogenation and emphasised the points that the efficiency of the catalyst depended upon the existence of maximum surface, and that the oil to be hydrogenated must be clean. The remainder of the address was devoted to an explanation of the manner in which the catalyst brings about the hydrogenation, viz., by the intermediate formation of an unstable additive compound of the nickel and the fat. (*Cf.* J., 1920, 249 R; 1922, 67 R, 304 R.)

Aerosols, or Solid Disperse Systems in Air

By R. Whytlaw-Gray and J. B. Speakman

Dilute smokes analogous to the solid-liquid systems of colloidal solutions can be formed, (*a*) by heating substances of high boiling-point in a rapid air stream (paraffin wax, acetanilide, *ortho*-phthalic acid, and diphenylamine disperse readily); (*b*) by the arc discharge from metallic electrodes in an air current, forming with most metals an oxide dispersoid, and with silver, gold, and platinum a metallic one; (*c*) by chemical interaction between highly diluted vapours or gases, *i.e.*, zinc ethyl and air or ammonia and hydrogen chloride. An ultramicroscopic method has been developed of counting the number of particles in a given volume of these smokes and by working with a large volume of dispersoid (1 cb. m.) the changes that take place have been followed and shown to be due to aggregation. Different substances form aggregates or complexes of various structures, those of zinc and cadmium oxides giving irregular flexible threads in which the particles appear as beads on a string and exhibit remarkable Brownian motion.

The curves obtained by plotting the number of particles per c.c. against time showed in all cases a steep initial drop corresponding with the period of most rapid aggregation.

The weight of the particles in a given volume was found by filtration through asbestos and weighing the small filter on a micro-balance sensitive to 0·0002 mg. and the resulting weight-time curves showed that the weight falls off much more slowly than the number of particles. By combining the two sets of curves it was possible to calculate the sizes of the particles: these were found to increase with time and then become constant.

Liquid and solid disperse systems are produced in a large number of chemical operations, such as the passage of gases through liquids and the decomposition of solids by heat, and this possible source of error in measurements of high accuracy does not seem to have been considered.

The Study of Soap Solutions

By Prof. J. W. McBain

In view of the large number of current theories which are irreconcilable with the conclusions to which the study of soap solutions has led it is necessary very carefully to prove the evidence for the existence of the ionic micelle.

1. The following methods agree in showing that hydroxyl ion is only a minor constituent of soap solutions (about 0·001*N*):—Electromotive force with hydrogen electrode; catalysis; conductivity; ultra-filtration with direct analysis of the filtrate.

2. The osmotic activity is about half that of a salt. Trustworthy measurements have been obtained by the following methods:—Freezing-point; dew-point; minimum pressure required for ultra-filtration; vapour pressure.

3. The conductivity is that of a salt; this is indicated by hundreds of concordant measurements with many kinds of soap.

4. Half the conductivity must be ascribed to a constituent of very high equivalent conductivity but of negligible osmotic pressure, the ionic micelle. Its conductivity is several-fold that of all the fatty ions contained in it.

5. By ultra-filtration the ionic micelle is found to be colloidal, and, in addition, the undissociated neutral colloid, consisting of still larger particles, may be separated from the ionic micelle. Sodium and potassium electrodes confirm the concentrations of sodium and potassium ions assumed. Migration determinations are also in agreement. Hydrolysis is impossible in the case of cetyl sulphonic acid, whose behaviour is closely similar.

6. An important result is the theory of gel structure. The only differences between a transparent jelly and a sol are mechanical—elasticity and rigidity. The colloidal particles in both are identical in nature and amount, but in the gel they are arranged in ultra-microscopic filaments or aggregates. The equilibria and the resistance to the passage of the electric current are unaltered on gelatinisation.

7. "Electrical endosmosis" and "cataphoresis" in a transparent soap jelly are quantitatively identical with electrolytic migration in the corresponding soap sol.

8. The theoretical conclusions are of general applicability to very large groups of organic and inorganic solutions in aqueous and non-aqueous solution.

Raw Materials for Synthetic Ammonia: The Manufacture of Hydrogen and Nitrogen

By J. H. West

There are two main sources of commercial hydrogen—coal and water. Electrolytic hydrogen is very pure, but owing to the high capital cost of the plant and the great consumption of electric energy, the cost of production is prohibitive unless cheap water-power is available. Many coals contain about 5 per cent. by weight of hydrogen, equivalent to about 21,000 cb. ft. per ton of coal, but only about one-quarter of this amount is set free on distillation of the coal in retorts or coke ovens. Coke-oven gas, where available, is an excellent source of hydrogen, when the latter is separated from the other gases by Claude's liquefaction process. The interaction of steam and hot coke gives water gas containing about 50 per cent. of hydrogen and 42 per cent. of carbon monoxide, the yield being about 55,000 cb. ft. of gas per ton of coke. The carbon monoxide in water gas may be caused to react with steam, giving carbon dioxide and hydrogen.

The process devised by Dr. A. Jaques and the author combines the distillation of coal in a retort, the formation of water gas from the resulting coke, and the conversion of the carbon monoxide produced in these two operations into carbon dioxide and hydrogen by reaction with steam in presence of a catalyst, in one apparatus, thus giving a maximum yield of hydrogen. Nearly all the hydrogen in the coal is liberated by passing the crude coal gas through a hot zone in the producer, so that all tar, oils, and hydrocarbons, such as methane, are cracked or split up into hydrogen and carbon, the carbon reacting with steam to form water gas. The process is carried out in a modified form of Tully complete-gasification plant, and the only products are gas and ashes.

Nitrogen can be made in an ordinary liquid-air plant, the separation from oxygen being effected by fractional distillation. Another method is to burn out the oxygen of air with hydrogen. In other words, a measured quantity of air is added to the hydrogen and the mixture is passed over a catalyst, so that combustion takes place quietly, and a mixture of hydrogen and nitrogen in the desired proportions results.

In the Haber process water gas is mixed with air producer gas, so that sufficient nitrogen remains in the mixture after treatment for conversion of the carbon monoxide, the final adjustment to the exact proportions being made by adding a little pure nitrogen obtained from liquid air.

The Häusser Process of Nitrogen Fixation

By C. J. Goodwin

The commercial success of the manufacture of synthetic ammonia in conjunction with the Ostwald process of obtaining nitric oxides and nitric acid by combustion of the ammonia, has created the impression that in the near future such ammonia will be the principal raw material for nitric-acid manufacture. Colour is lent to this view by the economic failure of the arc process, except under exceptionally favourable conditions, and by the price conditions obtaining in the markets for nitrate of soda and sulphuric acid. Economically, and on general principles, such an assumption seems unsound provided there is an assured output for all the synthetic ammonia produced, because, even if the loss on conversion is small, it would be irrational to make ammonia in plant involving high capital costs if nitric acid could be made directly in cheaper plant at the same cost. Recent developments in the Häusser process have brought the commercial realisation of this statement within sight. The details of Häusser's researches and trials were recently communicated to this *Journal* (1922, 253—259 R). The normal development of this method of nitrogen fixation was suspended during the war, and in this country the Nitrogen Products Committee in its final report (publication of which was delayed until 1920) rightly concluded that other processes would give more immediate and satisfactory results.

In the present paper it is shown that the impending trials with a 1200 to 1500 litre bomb are likely to lead to commercial yields. Modern alloys and unstainable steel have assisted in overcoming difficulties in wear and corrosion, and the volume of the absorption tower system has been reduced to one-sixtieth of the normal by absorption under 2½ to 4 atmospheres pressure in chromium-nickel-steel or silicon-iron towers. A yield of 150 grams of nitric acid per cubic metre of coke-oven gas is anticipated. The plant requires no external energy for driving compressors, etc. It is possible that by using a special gas engine or a kind of Humphrey pump, a greater proportion of the calorific power of the gases or liquid fuels might be converted into useful energy, but such a plant would necessarily be more complicated. Finally the importance of using gases of high calorific value as giving higher temperatures and yields is emphasised, and methods are indicated by which coke-oven and similar gases can be enriched to meet these conditions. It is suggested that Häusser plants can be usefully developed either as adjuncts to synthetic ammonia plants, at coke-oven plants, or in places where liquid fuel is cheap and the cost of making nitric acid is relatively high. Such plants can be relatively small, whereas other methods involve production on a very large scale to render them commercially successful.

Some Aspects of the Relationship between Water-Power and Nitrogen Fixation

By E. B. Maxted

The fixation of nitrogen by any of the three principal processes, namely as nitric oxide in the high-tension arc, as cyanamide, and as synthetic ammonia, involves in each case two economic factors, which may conveniently be grouped under the heading of power and of materials respectively. On the predominance of the one or of the other of these two classes will depend the practicability of any one of the processes under given geographical conditions. From this standpoint, the arc process is necessarily confined to countries suitable for the development of cheap hydro-electric power, whilst the production of cyanamide, by reason of the balance between the material and the power factors, is capable of establishment either at the source of cheap power or at the site of the necessary raw materials.

The synthesis of ammonia, by virtue of its low power-factor, possesses the unique advantage of being independent of peculiar geographical conditions, provided that the hydrogen utilised is made from fuel. It is, however, of interest to regard the synthesis of ammonia as a possible outlet for water-power, the hydrogen being in this case made electrolytically, and from this standpoint to obtain data concerning the relationship of electrolytic hydrogen produced from water power to hydrogen produced from fuel; further, to see what economic advantage, if any, is obtained by applying water power to the synthesis of ammonia in this way, rather than for the fixation of nitrogen in another form, such as calcium cyanamide, in each case under the conditions which exist in Great Britain.

The potential resources of water-power in this country have recently been surveyed by the Water Power Resources Committee of the Board of Trade. In the course of this survey, water resources estimated to be capable of producing about 250,000 kw. were examined in detail. This figure is not exhaustive, and is exclusive of the Severn Estuary scheme. By far the larger proportion of potential water power sites of any considerable magnitude are located in Scotland. An important factor in the present case consists in the maximum power available at a given site. Of the ten Scottish loch and ver sites reported on favourably by the engineers tained by the above committee, only one was timated to produce over 30,000 kw., and only two er 20,000 kw., the average power of the ten sites ing about 10,000 kw. In Wales, of the five sites ported on, only one was estimated to have a otential output greater than 5000 kw.

On the basis of the above survey, it would appear hat water-power on a considerable scale could be eveloped in Great Britain and that, under pre- ent conditions, it should be possible to produce ydro-electric energy from several of the more suit- ble sites for about £4—£5 per kilowatt-year, the reater part of this cost representing interest on he capital cost of the installation. If a power con- umption of 135 kw.-hr. per 1000 cb. ft. of hydrogen roduced by electrolysis be assumed—a figure which onforms to the results obtained in practice—the ost of power should be about 1s. 7d. per 1000 cb. ft. f hydrogen, the value of the oxygen being disre- arded. This figure does not compare unfavourably ith the cost of hydrogen made from fuel. The rincipal disadvantage of the electrolytic process onsists in the relatively large floor space required, nd in the multiplicity of cells necessary. This is eing met to a certain degree by the gradual intro- luction of large unit cells; and the extent to which this enlargement is practicable, together with the ven more important desirability of a relatively high operating current-density, will probably deter- mine the industrial future of electrolytic hydrogen, t any rate for cases in which the oxygen is not tilised. The utilisation of relatively large supplies f cheap oxygen in chemical industry presents, oreover, in this connexion an important field for esearch.

The problem may also be considered from a lightly different standpoint. Let it be assumed hat power of a given magnitude, for instance, 0,000 kw., is available at a given site; and let this ower be utilised completely, firstly for the syn- hesis of ammonia (the hydrogen being generated lectrolytically), and, secondly, for the production, or instance, of calcium cyanamide. In the first ase, some 5000—5500 tons of nitrogen per annum ould be fixed as ammonia, about 7500—8000 of the 0,000 kw. available being used for electrolysis. If, n the other hand, the 10,000 kw. were used for the xation of nitrogen as cyanamide, the weight of itrogen fixed per annum would be about the same, he important difference being, however, that, in he case of synthetic ammonia, about 33,000 cb. ft. er hour of waste oxygen would be available from he hydrogen and nitrogen plants—assuming the tter gas to be made from air by a process of low emperature separation—whereas, in the case of yanamide, the whole of the anthracite and lime equired would have to be brought to the site of the actory and there handled. This would be balanced o a certain degree by the greater simplicity of the yanamide method, and by the necessity for fixing he ammonia by means of an acid.

Consideration of the nitrogen problem from the bove standpoint is of interest in that it brings the ynthesis of ammonia into line with the other pro- esses of nitrogen fixation in regard to a choice etween fuel and water-power for their operation. lthough the presentation of the matter in this ght is not intended as a definite argument for the referential manufacture of such large quantities of ydrogen by electrolysis, it would appear that the utilisation in Great Britain of hydro-electric power for such purposes is not impossible.

The Resistance to Fire of Concrete and Reinforced Concrete

By F. C. Lea and R. E. Stradling

The authors considered the problem under two headings, viz., the possibility of making a concrete which shall retain its strength after exposure to high temperature, and the possibility of preventing steel from reaching such a temperature that its strength is reduced to or below that required to carry the loads. In testing the action of fire on concrete, the authors experimented on the expansion of quartz and set cement, and found that at about 575° C. quartz changes to the β form and undergoes a linear expansion of about 0·4 per cent. The expansion of set cement is normal, and approximately equal to that of steel, up to 93° C.; between 100° C. and 491° C. it contracts, but expands again above the latter temperature. The authors conclude that water is continually driven off throughout the heat treatment, but at different rates for different temperature ranges, the greatest being between 98° and 102° C. Between 300° and 500° C. the rate is fairly constant, but falls off after the higher temperature has been passed. At temperatures above 400° C. the calcium hydrate is dissociated into quicklime and water.

Experiments were also carried out on the reduction in strength of sand-cement mortars and concrete, under the application of heat. Various mortars composed of Leighton Buzzard sand and cement were used, and it was found that with a 1:1 mixture for temperatures below 400° C. there was a gain in the tensile strength of the specimen, the maximum gain being about 22 per cent. at 100° C. Increase in temperature above 400° C. led to loss in strength, and at 830° C. this loss amounted to 91·1 per cent. With mixtures containing more sand, the range of temperature within which a gain of strength occurred was less, and the loss of strength was more rapid at higher temperatures. Concrete made of ground brick and cement was found to gain in strength between 0° and 650° C.; above the latter temperature there was a loss in strength, which, however, did not take place so rapidly as in the sand-cement mortar, being only 55 per cent. at 1030° C. The authors also found that if the specimens after heat-treatment were exposed to the atmosphere for some time they lost strength quite out of proportion to the amount of heating; that cracks would appear on the surface; and that the block might crumble to pieces. This is attributed to hydration of the quicklime, formed during heating, by atmospheric moisture.

Concrete fails owing to the relative movement of the sand grains and the cement, brought about by the different coefficients of expansion, and this type of failure can be partially obviated by using rather different materials. When this is done the failure on heating is due to breaking down of the cement itself. In reinforced concrete, when the temperature is raised above 100° C., contraction occurs in the concrete whilst the steel reinforcements expand. This tends to break down the adhesion between the concrete and the steel, either by the complete sliding of the steel through the concrete or by the cracking of the concrete itself.

The authors make several suggestions for overcoming this defect, but state that large-scale experiments would be required to test them.

Vitamins

Prof. J. C. Drummond pointed out that plants were to be regarded not only as machines for storing solar energy, but as laboratories in which certain substances were prepared that the animal body was unable to make for itself. We knew the constitution of some of these substances, *e.g.*, the amino-acids, tryptophane, and cystine, but there were others, the identity of which was still obscure, commonly known as vitamins A, B, and C. Whereas two of these were produced only by green plants, it appeared that the third could be manufactured by such low forms as yeasts and bacteria growing in culture media. On the other hand, the recent studies which showed that rickets could be cured not only by vitamin A, but also by exposure to sunlight or ultra-violet light, suggested the possibility of a synthesis of vitamin A by animal tissues. Prof. Drummond uttered a warning with reference to the food of the industrial population of this country. The consumption of milk per head was much lower than that of other countries, and the use of margarine had largely replaced that of butter; the most dangerous feature of all was the widespread neglect of fresh green foods.

Captain J. Golding described experiments in which the importance of vitamin A was demonstrated in the rearing of pigs. Under the experimental conditions it was found that the limitation of growth and development of the young pig was dependent on the amount of the vitamin which had been transferred from the mother during suckling. It was evident that if this amount was in excess of immediate requirements, it could be stored in the fat of the young pig, and no signs of deficiency followed a deficient diet until this store was exhausted. Further results were given showing that prolonged deficiency of the factor A might do irreparable harm in the matter of reproduction. Whilst in practice the danger of vitamin deficiency was largely confined to sty-fed pigs, it also occurred in others. During last summer (1921) a big herd of young pigs kept on a dry upland pasture was found to be suffering from failure of growth and joint trouble. The pigs were at once cured by bringing them to a fresh green pasture or by giving them lucerne. Agriculturists were warned against artificial foodstuffs advertised as containing vitamins, for these were generally a cloak for a lack of nutrient materials. Apart from cod-liver oil, the farmer should look to his natural foods to supply vitamins.

Among other papers presented to the meeting were:—*Section A (Mathematical and Physical Science):* X-Rays and Beta Rays: M. le Duc de Broglie; The Law of Distribution of Particles in a Colloid Suspension: Prof. A. W. Porter; X-Ray Electrons: Prof. R. Whiddington. *Section D (Zoology):* Presidential address by Dr. E. J. Allen on The Progression of Life in the Sea (including observations on the production of Vitamin A by plankton diatoms); The Hydrogen-Ion Concentration of Soils and Natural Waters in relation to Animal Distribution: Dr. W. R. G. Atkins; Fresh-Water Fauna of Aberystwyth Area in relation to Lead Pollution: Miss K. Carpenter. *Section F (Economic Science and Statistics):* The Future of Unemployment Insurance: J. L. Cohen; Equal Pay to Men and Women for Equal Work (presidential address): Prof. F. J. Edgeworth. *Section G (Engineering):* Home-produced Oil Fuel: Dr. C. H. Lander. *Section I (Physiology):* The Efficiency of Man and the Factors which Influence (presidential address): Prof. E. P. Cathcart; An Estimation of the Practical Agricultural Importance of Vitamin A in Feeding Pigs: Capt. J. Golding; Further Studies on the Isolation of the Antineuritic Vitamins: Dr. A. Seidell. *Section J (Psychology):* Industrial Psychology and the Efficiency Engineer: Dr. C. S. Myers. *Section K (Botany):* On the Transport of Organic Substances in Plants (presidential address): Prof. H. H. Dixon. *Section L (Education):* Educational and School Science (presidential address): Sir R. A. Gregory. *Section M (Agriculture):* The Use of Lime in the North of England: J. A. Hanley; The Limitations of Laboratory Methods of Lime-Requirement Determination: N. M. Comber.

The presidential addresses have been published in a separate volume by John Murray (price 6s. net).

APPEAL ON BEHALF OF RUSSIAN MEN OF SCIENCE

THE following is the text of a letter, dated September 30, addressed by Sir James Walker, President of the Chemical Society, to its Fellows. We reproduce it here in the hope that it will evoke a response among members of the Society of Chemical Industry and among other readers of this *Journal.*

In September of last year, in consequence of the information received as to the deplorable conditions under which Russian men of science were placed, I issued an appeal to the Fellows of the Chemical Society to assist in the alleviation of the acute distress prevailing amongst their colleagues in Russia.

I have to announce with great satisfaction that in response to this appeal the sum of £214 2s. 7d. was received, besides numerous valuable parcels of clothing, underclothing, boots, and books. Of this sum £170 has been devoted to the purchase of clothing, which has been distributed amongst our colleagues in Ekaterinburg, Moscow, and Petrograd. In addition to this, three cases containing clothing and books have been despatched to Moscow and Petrograd.

The difficulty with which we were confronted, namely the uncertainty as to whether parcels sent from England would reach their proper destinations, has now happily been overcome, definite proof having been received in every case that the goods have reached those for whom they were intended.

In a letter written by one of the workers of the European Student Relief Society to the Friends' Relief Committee, the following passage occurs:—

"The Chemical Society in England recently sent out some scientific journals, etc. through the Friends. They have been entrusted to me for distribution, and when I told some of the Moscow professors of their arrival, their eagerness to see them was like the eagerness of the children in the famine areas to get bread. You can assure all donors that every journal will be properly circulated in the faculty concerned and be retained in the library."

It will be seen from this how urgent the need still is for scientific books; and from information received from the Committee of Russian Men of Science (a member of which visited this country last spring) the need for every kind of scientific apparatus appears to be equally pressing.

Notwithstanding the useful work that has been accomplished by the different organisations formed to relieve the wants of men of science in Russia, there remains much to be done, for there is every reason to fear that the necessity will be no less acute during the coming winter than it was last year. I therefore issue this appeal to Fellows of the Chemical Society and to British chemists generally to render every assistance within their power, in a confident hope that a generous response will be forthcoming.

In addition to donations of money to be devoted to purchasing requisite articles, gifts of clothing (which, if used, must be in good condition), and recent chemical literature, will be welcome. The Chemical Society will continue to act as the receiving depôt, and cheques (made payable to Mr. S. E. Carr, and crossed "Russian Fund"), together with parcels of clothing, boots, books, etc., should be addressed to the Assistant Secretary, The Chemical Society, Burlington House, Piccadilly, W. 1.

JAMES WALKER,
President.

CORRESPONDENCE

THE TRAINING OF THE CHEMICAL ENGINEER

Sir,—I have read with much interest the reports of Dr. Ruttan's address on the training of the chemical engineer (*cf.* J., 1922, 282 R, 323 R). I am, I believe, the only person in England at the present time who has taken the course of study, which he describes, at the Massachusetts Institute of Technology, so that perhaps my remarks may interest your readers.

I expected great things of the course when I entered upon it; but as the weeks passed, with industry after industry expounded to us, principle after principle elucidated, I was amazed at the value of it all. It could do no less than introduce the students to the seven industries embraced by it: actually, owing to the method of our study, *i.e.*, by "unit operations," it prepared us, not merely for those seven, but for *all* the industries in which chemistry is involved.

The course started just before the United States entered the war, and was broken off in the middle of its first session. After the war it was restarted, in a slightly modified form. In its first post-war year, some of the co-operating companies merely tolerated the students. When I took the course, in its second post-war year (1921), they received us with open arms, a sure sign that our presence was to their advantage as well as to ours.

I understand that English colleges teach chemical engineering by "providing the student with plant and demonstrating to him processes on a semi-large scale," which, Dr. Ruttan says, has not been successful (*loc. cit.* 282 R). Having experienced the other method, that of teaching by "unit operations," with factories as laboratory and classroom, I humbly and fervently commend that method to our English professors. A good general outline of the idea is given in two valuable articles by W. K. Lewis and R. T. Haslam (the guiding spirits of the course), in the *Journal of Industrial and Engineering Chemistry*, 1921, 13, 465, and 1922, 14, 647.—I am, Sir, etc.,

GEOFFREY J. GREENFIELD.

Langley Park Coke Works Co.,
Durham.
September 10, 1922.

PERSONALIA

Dr. L. Birkenbach, of Munich, has been appointed to succeed Prof. Wilke-Dörfurt in the chair of chemistry at the School of Mines (*Bergakademie*), Clausthal.

Mr. Charles Crowther, the new Principal of the Harper-Adams Agricultural College, Newport, Salop, was for many years lecturer and then for six years professor of agricultural chemistry in the University of Leeds.

Following the death of Prof. W. Wislicenus, Prof. Wieland of Freiburg i/B has assumed the editorship of *Liebigs Annalen der Chemie*. The publication committee consists of Professors A. Wallach, Groebe, Zincke, Willstätter and the editor.

Among those who received the degree of D.Sc. (*honoris causa*) of the University of Leeds, on the occasion of the meeting of the British Association in Hull, were Prof. Sir Charles Sherrington, the Duc de Broglie, Institut d'Optique, Paris, and Prof. P. Weiss, director of the Institut de Physique, Strasbourg.

Prof. R. T. Haslam has been appointed director of the research laboratory of applied chemistry in the Massachusetts Institute of Technology in succession to Mr. R. E. Wilson, who has joined the research staff of the Standard Oil Co., of Indiana. Dr. G. B. Waterhouse has been appointed to succeed Prof. H. O. Hofman as head of the department of metallurgy in the same institution.

Dr. R. C. Farmer has been invited to take up the position of Deputy Director of Explosives Research at the War Office Research Department, and will commence duty in October. Dr. Farmer was formerly Chemical Adviser to the Explosives Department under Lord Moulton, and was a member of the Nitrogen Products Committee and the Chemical Committee of the Munitions Inventions Department. Since the armistice he has been a director of Messrs. W. J. Bush and Co., Ltd., and is now resigning this position.

* * *

Prof. Alfred Getz, professor of mining in the Norwegian Technical High School, Trondhjem, died in August, aged 60 years.

We record with great regret the death, on September 12, of Dr. William Kellner, formerly Chemist to the War Department, and a member of this Society since 1885.

NEWS AND NOTES

FRANCE

Proposed Franco-German Potash Monopoly

The special correspondent of the *Observer* in Paris announces the failure of the negotiations that have recently been taking place between the French owners of the Alsatian potash mines and the German Potash Syndicate which were undertaken to re-establish the world-monopoly that existed before the war, when all the mines were in German territory. It is pointed out that the failure was almost inevitable owing to the enormous advantage that the low exchange-rate of the mark would confer on the German producers.

Industrial Notes

Chemical Industry.—The failure of the negotiations between the representatives of the Alsatian potash mines and those of the Potash Syndicate is apparently due to the fact that the German producers offered only a one-tenth share in the monopoly, on the ground that the German mines have a productive capacity twenty times that of the French. This offer is unacceptable to the French, who contend that they have considerably increased their output and secured important markets abroad. The German representatives naturally will not give way, as German potash is selling at 132·30 francs per metric ton f.o.r. at the mine, whereas the French price is 450 fr.

Investigations have recently been carried out on the production of alloys to withstand the high temperatures and pressures used in the Claude synthetic-ammonia process. It has been found that a steel of the following composition will resist the conditions mentioned for 4000 hours:—Ni 60, Mn 2, Cr 12, C 0·5, and Fe 25·5 per cent.

Metallurgy.—At present the metallurgical outlook is very good. The dissolution of the Comptoir des Fontes Hématites has again raised the question of the utility of such organisations. The general opinion is that they are useful if they confine themselves to regulating production and distribution, but harmful if they develop into trusts that attempt to control markets. It is also felt that "comptoirs" might extend their activities to the export trade, provided that in tendering for contracts they would act as promptly as individual firms, and that similar organisations exist abroad. Considerations of this kind suggest the need for an international agreement between the leading metallurgical countries and for more efficient co-ordination of their efforts to meet the world's requirements.

During the first seven months of 1922, 2,689,132 metric tons of pig iron and 2,413,170 t. of steel were produced in France.

Coal.—The state of the coal market continues good, and although the end of the coal strike in the United States will mean renewed competition from British coal, the approach of winter, the high exchange value of the pound sterling, and the greater industrial activity in France, are factors that strongly favour the French coal industry.

Saar coal, which contains about 33 per cent. of volatile matter, yields brittle coke unsuitable for metallurgical use, and the question of surmounting this difficulty has been receiving attention in order to make France less dependent on supplies from the Ruhr district. Experiments have shown that the brittleness of the coke can be overcome by coking the raw coal with coal that has been partly distilled in a special retort so as to reduce the content of volatile matter to 12 per cent. It is not intended to use this process at the mines, as this would mean costly additions to existing plants, but to explain it to the iron and steel manufacturers, who mostly produce their own coke. The successful application of this process would lead to extensive development of the Saar coalmines.

La Societe de Chimie Industrielle

This society held its Second Congress in Marseille during the first week of July. The attendance numbered about 400, and among the foreign guests were Dr. Emil Mond, Prof. W. A. Noyes, Prof. A. C. Langmuir, Dr. C. L. Parsons and Senator Paternò. Monsieur H. Giraud, president of the Marseille Chamber of Commerce, took the chair at the opening meeting, when addresses were delivered by M. Paul Kestner, president of the Society; M. A. Gardair, chairman of the organising committee; Prof. Cavalier; M. H. Giraud; and by M. Deschiens, who in reading the annual report mentioned some of the results of work done during the year. At the instance of the Society the exportation of radio-active minerals from Madagascar to foreign countries was prohibited; the Customs classification of fats was revised; the suggestion that coke ovens should be heated with producer gas instead of with town's gas was referred to the Central Committee of French Coalmines; and representations concerning the mobilisation of technical men in wartime were favourably received by the Minister of War. A striking address was delivered by Prof. C. Matignon on the present state of the German nitrogen industry (*cf.* *i.*), and M. Sabatier was presented with the Society's gold medal. Many papers were read before the fifteen technical groups into which the congress was divided, and visits were made to local works and to the exhibition of French colonial products.—(*Chim. et Ind., Aug.*, 1922.)

AUSTRALIA

The White-Lead Industry

The manufacture of white lead in Australia has made great progress, for, whereas practically the whole of the requirements was imported seven years ago, now production almost meets the demand. This advance is largely due to the establishment of a branch factory of Lewis Berger and Sons, Ltd., manufacturers of paint and varnish, in Rhodes, near Sidney, in 1916, and which now employs 350 workers. The Dutch process is used and the raw material is lead of 99·9 per cent. purity from Broken Hill. The capacity of the works is 9000 tons per annum.

NEW ZEALAND

Discovery of Franklinite

Great interest has been aroused by the discovery of franklinite, hitherto not known to occur in New Zealand, in the fiord country of Southland. The Government mineralogist has confirmed the identification of the mineral. Franklinite contains about 67 per cent. of iron oxide, 17 per cent. manganese dioxide and 16 per cent. of zinc oxide, and is named after the Franklin district of New Jersey, where it is mined and shipped to Pennsylvania for the production of zinc and spiegeleisen. Commercial utilisation is only possible if the ore is readily accessible and available in large quantity.—(*Ind. Austr., June* 8, 1922.)

UNITED STATES

Annual Prize of 25,000 Dollars

At a council meeting of the American Chemical Society, held during the Society's recent meeting in Pittsburgh, a letter was read from Dr. W. H. Nichols to Dr. Edgar F. Smith (president) offering on behalf of the Allied Chemical and Dye Corporation a prize of $25,000 to be awarded annually to the chemist residing in the United States who, in the opinion of a special jury appointed by the Society, has contributed most to the benefit of chemical science and the world. The scheme will come into effect on January 1, 1923.

"Journal of Physical Chemistry"

At the same meeting of the above-named council, it was resolved that the *Journal of Physical Chemistry* shall in future be published under the joint auspices of the American Chemical Society, the Chemical Society of London, and the Faraday Society. The arrangements were made on the occasion of a recent visit of Dr. C. L. Parsons to London. It has been agreed that the management of the journal shall be left entirely to a board of eight members, who will be nominated by the societies concerned, and who will elect the editor-in-chief and probably also a managing editor. Members of the board will be appointed for a term of two years, one-half will retire each year, and no member shall serve continuously for more than four years. The societies will incur no financial liability, and their members or Fellows will be offered the journal at a reduced subscription rate. Mr. Francis P. Garvan, president of the Chemical Foundation, has guaranteed the payment of $10,000 per annum for five years to assist the publication.

CANADA

Soapstone in Ontario

The Mines Branch of the Canadian Department of Mines has issued a preliminary account of a large deposit of a mineral resembling soapstone which occurs at Wabigoon, near Dryden, Ontario, and in close proximity to the Canadian Pacific Railway. This deposit, which is stated to be the most promising of its kind in Canada, consists of two well-defined bands of mineral, separated by 100 ft. of hard grit rock, and the smaller of the two has a proved length of 500 ft. and a width of 35 ft. The rock is dark greenish grey, soft, homogeneous, but not greasy to the touch. Its percentage composition has been found to vary within the following limits:—SiO_2 41·94—51·44; FeO 7·24—7·71; Fe_2O_3 2·05—3·68; Al_2O_3 4·79—7·57; MgO 25·39—26·43; CO_2 0·11—5·09; H_2O (above 105° C.) 6·56—6·71. Crushing strength ranges from 10·269 to 12·140 lb. per sq. in.; modulus of rupture from 1827 to 1920 lb. per sq. in.; fusion temperature 1400° C. It is suggested that the mineral might be suitable for making refractory bricks for the smelting furnaces of sulphate pulp (kraft) mills; at present, although the consumption is large, all the soapstone bricks required are imported from the United States. The stone might also be used for making baking-oven bricks, foot warmers, griddles, etc.

BRITISH INDIA

The Rubber Plantation Industry

In 1921 there were 1016 rubber plantations in British India which covered an area of 196,990 acres and produced 4043 tons of rubber, nearly all of which was of the Hevea kind. The chief producing areas are situated in Southern India, Burma, and Assam. In 1920 the production was 6156 t., and the decline in 1921 is ascribed to low prices and the Moplah rebellion. The exports by sea declined by 21 per cent. to 4917 t., of which the United Kingdom took 63, Ceylon 21, the United States 9, and the Straits Settlements 6 per cent. Imports of rubber were very small.—(*Ind. Tr. J., Aug.* 17, 1922.)

SOUTH AFRICA

The Whaling Industry in Natal, 1921

According to a report of the Durban Chamber of Commerce, the whaling industry of Natal is seriously affected by the prevailing financial depression, the price of whale oil having declined by 65·3 per cent. to £31 5s. per ton in August, 1921. Whale oil was in but small demand in Europe, although exports to the United States continued, and unless the cost of production can be considerably reduced many of the whaling companies may not resume operations. The 1071 whales captured during 1921 yielded 6255 tons of oil (£155,000), 2447 t. of fertilisers (£25,000), and 1045 t. of boiled bone (£8000).—(*U.S. Com. Rep., Aug.* 14, 1922.)

GERMANY

Hydrogenation of Oils in Presence of Oxygen

In the *Berichte* (1922, pp. 2193–97), Dr. W. Normann criticises the assertion that the presence of oxygen is essential in fat-hardening. His experiments with nickel cyanide, nickel chloride on kieselguhr, powdered nickel, and palladium chloride show that hydrogenation proceeds in the total absence of oxygen, and that the presence of even a few tenths of one per cent. of oxygen is distinctly harmful.

Ammonium Bicarbonate as Fertiliser

The production of ammonium sulphate for use as a fertiliser involves the consumption of large quantities of imported sulphuric acid. The cost of the acid makes the price of the fertiliser high; the acid itself possesses no fertilising value, but tends to increase the acidity of the soil. Ammonium bicarbonate is now recommended as an alternative nitrogenous fertiliser, the production of which only requires ammonia, water, and carbon dioxide, a cheap by-product. The cost of this product should thus be low compared with that of ammonium sulphate. Tests made at the Research and Control Station of the Oldenburg Board of Agriculture have given favourable results both on sandy and on acid moorland soils.

New Applications of Schoop's Metal-spraying Process

Strongly adherent, homogeneous coatings of lead, tin, zinc, aluminium, brass or copper can now be sprayed without the use of compressed oxygen, a small pointed flame of acetylene and compressed air being sufficient. Not only is the cost of transport and hire of cylinders obviated, but the process is more economical than the older one. For many years coatings of enamel, quartz or glass have been produced by Schoop's process and recently very hard, chemically resistant coatings of a mixture of metal and glass enamel or similar substances have been successfully obtained. Another new application of the process is in the production of coatings of "stainless" steel on metallic objects whereby they may be made non-rusting as well as hard; and further experiments are now in hand which, if successful, will result in the production of machine tools having an outer skin of hard alloy ("stainless" or tungsten steel) on a body of other suitable softer metal.—(*Chem.-Z., Sept.* 2, 1922.)

The Nitrogen-Products Industry in Germany

In a long article published in the July issue of *Chimie et Industrie*, Prof. C. Matignon discusses the present situation of the German nitrogen industry, in which over one milliard marks are invested. But for this industry, in 1921 Germany would have had to import 1,500,000 metric tons of Chilean nitrate, worth 27 milliards of paper marks; and although this quantity corresponds to an output of 230,000 t. of nitrogen, the total productive capacity of the German factories is far from being attained. By the end of 1922 the total capacity will be 500,000 t. of combined nitrogen, of which 300,000 t. will be produced by the Badische synthetic-ammonia factories, so that, assuming that the coke ovens and cyanamide factories work at only half capacity, the German output of fixed nitrogen will then be at least 400,000 t., *i.e.*, more than half the world's pre-war consumption of 692,000 t. In time, therefore, Germany will be able not only to meet the increasing needs of her own agriculture but also to export nitrogenous fertilisers, which, favoured by the low value of the mark, will compete easily with Chilean nitrate.

GENERAL

The Society's Annual Dinner in London

The Second Annual Dinner in London will be held in the Connaught Rooms, Great Queen Street, W.C., on Friday, October 13, at 7 for 7.30 p.m., and it is hoped that a large number of members and their friends will be present. Ladies may be invited, and the cost of tickets, obtainable from the General Secretary, is 10s. 6d. each, exclusive of wines.

The Society's General Council for Canada

The following constitute the General Council for Canada for the year 1922–23:—Chairman: Prof. R. F. Ruttan; representatives of the Local Sections: Toronto, M. L. Davies, L. E. Westman; Montreal, A. R. MacLean, H. W. Matheson; Ottawa, F. J. Hambly, A. E. McRae; Canadian Pacific, A. E. Archibald, J. A. Dawson; Shawinigan Falls, R. A. Witherspoon, F. E. Dickie. The Secretary is Mr. Alfred Burton, whose address is 114, Bedford Road, Toronto, Ont., Canada.

Generation and Utilisation of Cold

This subject will be discussed at a joint meeting of the Faraday Society and the British Cold Storage and Ice Association on Monday, October 16, in the Institution of Electrical Engineers, Victoria Embankment, W.C. 2. The Council of the Faraday Society has extended a special invitation to members of the London Section of the Society of Chemical Industry to attend the meeting, the detailed programme of which is given elsewhere in this issue.

Proposed Institute of Paint and Varnish Technologists

It is intended to inaugurate a society bearing this title and with aims similar to those of the sister society in the United States. The functions of the proposed Institute will be to disseminate practical and scientific knowledge by reading and discussing papers to be published in a journal, to improve technical education, to form a technical library, to maintain close contact with Government departments, public and other bodies interested in the products and problems of the industry, and to promote research. Support has already been promised by a number of scientific and technical workers in this field, and members of allied organisations are invited to become members. Those who desire to attend the inaugural dinner, to be held shortly in London, or to assist in forming the Institute are asked to communicate with Mr. H. D. Bradford, 42, Ribblesdale Road, London, S.W. 16.

An International Scientific Congress in Utrecht

Under this title the *Chemiker-Zeitung* (Aug. 26, 1922) describes a meeting, held on June 21—23, of chemists hailing from England (3), United States (3), Austria (8), Germany (9), Holland (8), Denmark (4), Czechoslovakia (2), Latvia (1), Switzerland (1) and Russia (1). According to *Science* (Sept. 6, 1922), the meeting was planned not only to promote the interests of chemistry but to renew old friendships and form new ones between men and nations recently at war. Fourteen short papers on chemical topics were read and of these a paper on "Free Radicals," by Prof. P. Walden, was of especial interest. The social functions included a reception by the Dutch Chemical Society, at which an address was given by Prof. Wendt, president of the Royal Academy of Sciences, and replied to by Prof. W. A. Noyes (U.S.A.). The idea of holding the meeting was conceived by Prof. F. G. Donnan and Prof. Ernst Cohen (Utrecht); the organisation was in the hands of the last-named and two Dutch colleagues and the guests were very hospitably entertained. It is suggested that the time is now ripe for greater international co-operation among men of science.

Medicinal Plants in the Malay Peninsula

In a work on the "Minor Forest Products of the Malay Peninsula," published by permission of the Federated Malay States Government, Dr. F. W. Foxworthy, Forest Research Officer, gives lists of poisonous and medicinal plants. Large numbers of the local plants, he states, are used in native medicine, but only a few are recognised in European pharmacy. Some of the species included in the list of poisonous plants are also of medicinal value.

The list of the principal plants used locally for medicinal purposes contains no less than 343 names, and is taken mainly from an official bulletin entitled "Malay Drugs" published by Mr. H. N. Ridley in 1906. The table gives the family to which each plant belongs, the botanical name, the common name (usually the name given by the Malays), the part used, and the diseases, etc. for which the extract from the plant is used. Occasionally some plant acquires prominence because of fraudulent claims as to its curative properties. This seems to have been the case some years ago with *Combretum sundaicum*, Miq., which was asserted to be a cure for the opium habit. A careful examination of the plant failed to reveal any just grounds for this claim.

Among the native plants of actual or potential use are the following:—

Brucea sumatrana, Roxb. (Fam. *Simarubaceæ*).—Kosum is well known as a plant useful in the treatment of certain types of dysentery.

Taraktogenos Kurzii, King (Fam. *Flacourticeæ*).—The seeds yield Chaulmoogra oil, which is so useful for treating leprosy. This species has not yet been found in the Peninsula, but occurs in Siam and Burma. The Malay species of *Taraktogenos* and of the related genus *Hydnocarpus* are worth investigating to see if they can be used in the same way.

Strychnos spp.—Several species are found as climbers, although none is so valuable as *Strychnos Nux-vomica*; but two of them, *S. ovalfolia*, Wall., and *S. quadrangularis*, A. W. Hill, are used as constituents of a Sakia dart poison. Fourteen species of this genus are recorded from the Peninsula.

Strophanthus spp.—These are coarse shrubs or climbers, some of which may contain strophanthin or an allied glucoside; apparently they are not used at present.

Dr. Foxworthy's publication also contains references to tanning materials, oleo resins and wood oils, fruit or seed oils, essential oils, and dye plants and dye woods. It is the second part of a work dealing with the forest products of British Malaya, the first having been devoted to trees and timbers.

Water-Hyacinth Ash as a Source of Potash

In many tropical regions the water-hyacinth (*Eichornia crassipes*) is a troublesome weed, and as removal is often necessary it has been suggested that the plants might be burned and the ashes used as a source of potash or as a fertiliser. Previous analyses of ash from India and Burma have shown the following variations in percentage composition:—K_2O 11·3—34·1; CaO 7·8—12·8; Cl 5·7—21·0; SiO_2 20·7—49·4; P_2O_5 1·4—8·2. Thus the potash content varies greatly. A sample of ash prepared in Burma was examined at the Imperial Institute and found to contain much extraneous mineral matter. About 11 per cent. of the crude ash was soluble in water, and the chief constituents of value, calculated as percentages of the original ash, were as follows:—Soluble portion: KCl 7·54; NaCl 0·51; Na_2SO_4 1·56; insoluble portion: K_2O 1·51; $MgCO_3$ 4·16; $Ca_3(PO_4)_2$ 8·20. Ash similar to this sample would be suitable for local use as a potash fertiliser, the small content of phosphoric acid adding slightly to its manurial value. About 75 per cent. of the water-soluble matter consisted of potassium chloride, but extraction, though probably easy, would hardly pay, as 14 tons of ash yield only 1 ton of 80 per cent. KCl.—(*Imp. Inst. Bull.*, XIX, 4.)

Amalgamation of Tartaric-Acid Manufacturers in Italy

With the co-operation of the Banco di Credito, the three chief producers of tartaric acid in Italy, viz., the Società Anonima Appula, of Bari, the Società Industria Acido Tartarico, of Milan and Casale Monferrato, and the Società Italiana dei Derivati della Cellulosa, of Milan, have amalgamated to form a new company with a capital of 25 million lire.—(*Chem. Ind., Aug.* 21, 1922.)

Belgian Trade in Artificial Silk

The production of artificial silk in Belgium averaged 2700 metric tons per annum before the war, one-half of the output being exported to Germany, which was the source of many of the raw materials and chemicals required, and only 5 per cent. consumed in the country. In recent years the exports have gone largely to the United Kingdom and Switzerland, as will be seen from the following figures of imports and exports of artificial silk and waste-silk yarn in 1920 and 1921:—

	Imports		Exports	
	1920.	1921	1920.	1921
	Metric tons		Metric tons	
Germany	0·3	1·1	9·0	1·3
Spain	—	—	1·5	0·6
France	2·9	1·4	—	1·9
United Kingdom	1·4	1·1	7·8	29·4
Switzerland	1·4	1·0	5·3	111·5
Other countries	0·05	0·001	4·7	9·0
Totals	6·02	4·7	28·4	152·7

The demand from Spain, Portugal, Switzerland and Japan is stated to be brisk, and some large orders have been received from the United States. Competition is feared from Japan, as that country can export articles manufactured from imported artificial silk at prices 40 to 50 per cent. less than those of other countries. One Belgian firm is contemplating the establishment of a factory in Japan on account of the cheapness of Japanese labour, and another company is to build a factory in France for manufacturing acetylcellulose silk under a contract made with a British cellulose company and covering Belgium, France, England and Poland.—(*U.S. Com. Rep., July* 3, 1922.)

The Italian Beet-Sugar Industry

The area planted to sugar-beet in Italy during the spring shows a large increase as compared with the area planted last year, and this increase, together with the proposals to remove restrictions on trading in sugar and the reduction in the customs tariff on sugar, provides evidence that production now covers home requirements. Details of the area planted to sugar-beet, crop returns, and sugar output since 1913–14 are set out below:—

Season	Area planted	Yield of beets	Output of sugar
	Acres	Metric tons	
1913–14	203,402	2,749,907	305,564
1914–15	96,051	1,319,140	150,216
1915–16	127,761	1,457,571	150,396
1916–17	108,994	1,313,690	144,870
1917–18	111,504	883,038	92,624
1918–19	104,525	1,117,743	108,431
1919–20	145,075	1,800,917	167,767
1920–21	126,163	1,267,815	124,392
1921–22	180,310	1,685,000	217,532

No great extension of sugar-beet cultivation is possible in Italy, as the area of suitable land is limited and economic factors favour the production of cereals. Imports during the last six years have averaged 60,000 t. per annum (97,000 t. in 1921) and judging from the export in 1913–14, when 35,000 t. was exported out of a production of 305,000 t., from the present large population and the increased consumption, it seems unlikely that Italy will attain importance in the export trade in sugar for some time.—(*U.S. Com. Rep., June* 19, 1922.)

Consumption of Fertilisers in Italy

During the war the consumption of fertilisers in Italy declined greatly, but improved after the armistice, as will be seen from the following figures, showing the consumption in pre-war years, in 1919, and in 1921:—

	Annual average 1909–1913 Metric tons	1919 Metric tons	1921 Metric tons
Superphosphate	978,000	600,000	850,000†
Basic slag	118,000	2,600	2,600†
Potash fertilisers	13,690	*nil*	1,405†
Sodium nitrate	45,250	18,000	32,000
Ammonium sulphate	29,783	13,700	22,000
Calcium cyanamide	8,583	20,000	16,000
Calcium nitrate	710*	*nil*	2,500†

* 1913 only. † 1920 only.

The consumption of ammonium nitrate rose from 2000 t. in 1919 to 14,000 in 1920.—(*U.S. Com. Rep., Aug.* 14, 1922.)

The Java Sugar Crop in 1922

The production of sugar in Java during the current season is estimated at 1,712,500 tons (932,500 t. white and 780,000 t. brown sugar), which compares with the realised production of 1,627,000 t. (900,000 t. white and 780,000 t. brown sugar) in the previous season. From this season's crop 434,500 t. of white sugar and 345,000 t. of brown were delivered during the four months April to July, 1922.—(*Ind. Tr. J., Aug.* 24, 1922.)

Beet-Sugar Industry in Rumania

Prior to the war the nine beet-sugar factories in Rumania had an average production of 70,000 metric tons per annum, but in 1921 their output fell to 29,000 t., on account of the state of the factories and the reduced area under beet. It is estimated that, if transport facilities and fuel can be provided, the sugar-beet crop for 1922-23 will amount to 45,000 t. Producers state that the present market price in Rumania does not cover the cost of production.—(*U.S. Com. Rep., Aug.* 14, 1922.)

The Petroleum Industry in Trinidad

During the past year this industry has been very active. There was a considerable increase in the footage drilled by the various companies, and a consequent large increase in production of crude oil; in fact, production in 1921 was the greatest in the history of the Colony—viz., 82,395,595 gallons, as compared with 72,905,947 galls. in 1920 and 64,436,632 galls. in 1919. The number of new wells drilled was 84, an increase of 17 over the previous year. In 42 of these wells oil was struck. At the close of the year 1921 twenty companies were actively engaged in the winning of oil, as against 22 at the end of 1920. The Admiralty continues to purchase considerable quantities of oil fuel; both crude oil and refined products are shipped to private firms in the United Kingdom and there is a considerable trade with the other West Indian islands.

Coca Production in Java

The cultivation of coca was introduced into Java in 1880 and the crop is now grown on 63 estates over an area of 6000 acres, usually interplanted with coffee, rubber and cacao. The first leaves may be gathered when the plants are 8 months old and mature shrubs yield 700 to 850 lb. of leaves per acre. Javanese coca has approximately the same content of alkaloid as the Peruvian product, but the basic alkaloid of the former is cinnamylcocaine, whereas that of the latter is cocaine. The export in 1920 totalled 3,755,400 lb., of which the bulk was shipped to Amsterdam, 649,000 lb. going to Japan and 24,000 lb. to the United States.—(*U.S. Com. Rep., May* 22, 1922.)

Manufacture of Chlorate in Norway

Work was resumed at the Vadheim chlorate factory in Norway a few weeks ago and it is anticipated that the output will be from 600 to 800 metric tons of chlorate per annum. It is also intended to produce metallic sodium.—(*Chem. Ind., Aug.* 28, 1922.)

Pine-Tar, Resin and Turpentine in Portugal

The Portuguese output of resin is estimated at 4000 metric tons per annum and of this 750 t. is consumed in the country, mainly for making paper (250 t.), printing-ink (100 t.), varnish, colours, etc. (50 t.), dyes (250 t.), pharmaceutical and other products (100 t.). Turpentine of good quality is produced in large amounts. The production of pine-tar and turpentine since 1916 has been as follows:—

	Tar Metric tons	Turpentine Metric tons
1916–1917	3,000	950
1917–1918	4,000	4,200
1918–1919	6,000	2,000
1919–1920	6,300	1,800
1920–1921	12,400	3,600

During the 1919–20 season the production of resin was 9000 t., which yielded 6300 t. of tar and 1800 t. of turpentine.

Esparto Cellulose in Spain

A large factory is being erected in Benalua de Guadix, Granada, at a cost of 9 million pesetas, to manufacture esparto paper and powder. Power will be obtained from the River Dilar by means of hydro-electric generators developing 4400 h.-p. It is hoped that the entire production of esparto grass in Spain will be utilised shortly in the country and not exported, as it has been, largely to England, in which case the importation of cotton for manufacturing powder would be unnecessary.—(*Raw Materials Rev., July*, 1922.)

LEGAL INTELLIGENCE

Nuisance Committed by Smell from a Fertiliser Factory. *The Attorney General* v. *The Elstree Chemical Works* (1922), *Ltd.*

In the Vacation Court on August 30, Mr. Justice Swift heard a motion by the Attorney General at the relation of the Barnet Rural District Council for an injunction to restrain, until trial of the action, the Elstree Chemical Works (1922), Ltd. from committing a nuisance by emitting smells.

For the relators it was stated that the defendant company manufactured fertilisers from leather, wool and felt waste at a works in Elstree, and that this manufacture gave rise to a strong odour which caused a public nuisance. On behalf of the defendant company, the nuisance was not denied, but a request was made for time in which to abate it, as the business had only been carried on by the company since March and several attempts had been made to avoid producing the smell.

The injunction was granted, but its operation was suspended for one month to enable the defendant company to abate the nuisance. The parties then agreed to treat the motion as the trial of the action, the injunction being made perpetual, subject to the suspension for a month, and the defendant company agreeing to pay the costs.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for September 14 *and* 21)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
Australia	Sheets and rods of ebonite and brass (tender for) ..	†
"	Sheet steel	290
Brazil	Cement, earthenware piping	6657/F.L./ E.C.
"	Steel	317
British India ..	Cement (tender for)	**
British West Indies, British Guiana ..	Galvanised goods, iron and steel, copper, fireclay goods	264
Canada	Chinaware	*
Egypt	Oil, paint, varnish, soap, lamp glasses (tender for) ..	9008/F.E./ G.P.
Finland	Iron, steel, copper, brass, tin, lead, zinc	6122/F.R./ E.C.
France and Belgium	Calcined magnesite, white spirit, manganese dioxide, ammonium chloride, acetone, carbon tetrachloride, yacca gum ..	301
Italy	Tinplate	270
"	Chemicals, colours, varnish, soap, perfumery, vegetable oils	302
Kenya Colony ..	Glass, glassware, pottery ..	225/25/T.G./ M.C.
Mexico	Semi-porcelain	319
Netherlands ..	Lubricating oils	272
" ..	Paper, porcelain	273
" ..	Iron and steel	275
" ..	Copper, phosphor-bronze ..	277
" ..	Oilseeds	303
" ..	Earthenware and fireclay goods	307
Rumania	Crucible tool steel	9000/N.E./ E.P.
Siam	Iron, steel, lead, brass, copper	8944/F.E./ E.C.
Switzerland ..	Caustic potash, sodium sulphate, sodium phosphate, sodium carbonate, potassium silicate,liquid ammonia, formic acid, olein, textile chemicals	283
" ..	Emery, elemi resin, copal, tragacanth and other gums, Chinese wood-oil, rare metals and salts, wolfram ..	285
United States ..	Keene's cement, firebricks ..	312
" " ..	Scrap metals	313
Uruguay	Electrical cable, lubricating oils, (tender for)	6666/F.L./ E.P.

† Supply Officer (Room 101), Australia House, Strand, London, W.C.2.

* High Commissioner for Canada, 19, Victoria St., London, S.W.1

** Director General, India Store Department, Belvedere Road, Lambeth, S.E.1.

TARIFF CUSTOMS EXCISE

Australia.—The text of a Memorandum explaining the provisions of the Customs Tariff (Industries Preservation) Act, 1921, designed to prevent "dumping," is reprinted in the issue for September 14.

France.—The import duty on ammonium sulphate has been suspended.

French Togoland.—The importation and sale are prohibited of "trade" spirits and harmful essences and chemicals such as star-anise oil, benzaldehyde, salicylic ether, hyssop, and absinth, but not of pharmaceutical alcohol for medical or scientific use.

Germany.—New monopoly taxes have been applied to imported spirits, ether and its products. An Act has been passed authorising the German Government to increase the import duties or impose new import duties if the economic necessity arises, and to reduce or withdraw duties that have been increased or imposed under the new law.

Gold Coast.—The export duty on cocoa has been reduced from ½d. to ¼d. per lb.

Hungary.—Special permits are required for imports of oleic and stearic acids, dégras, pitch, resin, cement, coal-tar oils, indiarubber, certain wares of glass and enamel, zinc white, zinc gray, sal-ammoniac, liquid ammonia, sodium sulphate, sodium carbonate, and certain colours. Phosphates no longer require an import licence.

Lithuania.—A translation of the new export tariff may be consulted at the Department of Overseas Trade.

Malta.—Opium and certain other drugs may not be imported from the United Kingdom unless for legitimate scientific and medical purposes.

Palestine.—Import duties at the rate of 4 per cent. *ad valorem* have been imposed on timber, constructional iron and steel, ordinary window glass, hollow bricks, Portland, Roman, Keene's and similar cement, asbestos sheeting, but not on plaster of Paris and patent plasters having a lime basis. Samples of patent medicines may be imported free of duty.

Papua.—The duty on exports of copra has been reduced from 25s. to 15s. per ton.

Portugal.—The import duty on newsprint paper has been reduced to 0·1 milavo per kg. A law has been passed authorising the introduction of a new customs tariff comprising "maximum" and "minimum" rates.

Solomon Islands.—Revised schedules of import duties and free goods may be consulted at the Department.

South Africa.—Ferrosilicon rods are duty-free under the British preferential tariff, but pay a duty of 3 per cent. *ad. valorem* under the general tariff.

Sweden.—An import duty of 1·50 öre per kg. has been applied to imported soft rubber tyres and outer covers.

United States.—A copy of the Tariff Revision Bill as passed by the Senate may be consulted at the Department.

Venezuela.—Salts of potassium and sodium, but not potassium or sodium hydroxides, have been placed on the duty-free list. The import duty on paper has been increased.

Yugoslavia.—The monopoly tax on petroleum has been increased to 400 dinars per 100 kg.

Appointment of Committee on Safety in Mines.—The following have been appointed to serve on a committee, under the direction of the Safety in Mines Research Board, to investigate the causes of, and the means of preventing, the ignition of firedamp and coal dust arising from the firing of permitted explosives:—Col. Sir F. Nathan (chairman), Mr. W. Rintoul, Dr. G. Rotter, Mr. H. Walker, and Prof. R. V. Wheeler.

REPORTS

FIFTH REPORT OF THE COMMITTEE APPOINTED FOR THE INVESTIGATION OF FUEL ECONOMY, THE UTILISATION OF COAL, AND SMOKE PREVENTION. *Pp.* 17. *London: The British Association for the Advancement of Science*, 1922.

Since the publication of the last report the fuel situation has been dominated by the effects of the coal crisis of 1921, and this is illustrated by reference to the present position of the iron and steel industry which, better than any other, reflects the effects of coal prices upon production. The production of pig iron in the United Kingdom fell from 8,034,700 tons in 1920 to 2,611,400 in 1921, and that of steel from 9,067,300 t. in 1920 to 3,625,800 t. in 1921. It is particularly unsatisfactory from a fuel-economy standpoint that the present prices of coking coals and of coke offer little inducement to iron- and steel-makers to start up the coke ovens attached to their own works.

Oil Fuel Supplies.—Statistics relative to the importation of petroleum products into this country during the past five years are collected, and it is shown that whilst the home production of shale oil is very small, increasing quantities of fuel oil are being imported almost entirely from countries outside the Empire. The possible production of benzol in the gas and coking industries is relatively small, and owing to the low present cash value of benzol as a heating agent in coal gas it does not pay to extract it for use as a motor spirit. The development of a satisfactory low-temperature carbonisation process is therefore greatly to be desired. Although it is still problematical whether it would be more profitable to carbonise coal at 600° C. or at slightly higher temperatures, large-scale trials have shown that at 600° C. suitable coals will yield 7·5 per cent. of tar and 2·5 galls. of motor spirit, together with 3500 cb. ft. of rich gas per ton of coal (*cf.* Fuel Research Board Report, J., 1922, 270 R). The future of this industry depends upon the suitability of the solid residue for domestic use, and from this point of view the recent suggestions of Sutcliffe and Evans (*cf.* J., 1922, 196 T) deserve further investigation both from the technical and commercial standpoints.

During recent years there has been marked progress in the design of burners for fuel oil; the consumption of air or steam by the burners has been reduced and heavy oils can now be sprayed into furnaces under pressure alone. Research is also being directed towards rendering internal-combustion engines capable of burning even the heaviest oils. The outstanding question to-day is how to adapt heavy fuel oil for use in low-compression internal-combustion engines, so that it may replace motor spirit.

The Chemistry of Coal.—The problem of the constitution of coal continues to attract the attention of investigators notwithstanding its magnitude and complexity. The absence of a recognised nomenclature for the various coal fractions is leading to confusion, and it is felt that the time has come when chemists should agree upon this matter in conference.

Attention is drawn to the economic importance of the brown coal deposits at Morwell in Australia, and to the possibility of concentrating such fuels by a preliminary heat treatment (*cf.* Bone, J., 1921, 499 A).

Domestic Heating and Cooking Appliances.—The radiant efficiency of a modern gas fire is about 50 per cent., based on the *net* calorific value of the gas. It has been proved at South Kensington that, within wide limits, this efficiency is independent of the chemical composition and calorific value of the gas burnt, provided that the rate of heat development by combustion is kept suitably constant for a given size of fire. The recent work of Fishenden (*cf.* J., 1922, 13 R) and of Barker on the efficiency of domestic appliances is reviewed, and it is recommended that the design of types of domestic appliances using solid fuel should be reconsidered with a view to determining whether greater fuel economy can be secured without sacrifice of convenience or unreasonable increase in capital expenditure. In existing kitchen-ranges a large excess of air is passed up the flue and means should be taken to reduce this by enclosing the fire except when it is required for kitchen heating. Other improvements which should be considered are the lagging of the oven door and the provision of a separately fired boiler for the hot-water supply. In an appendix to the report Mr. A. H. Barker describes methods of determining the thermal efficiency of cooking appliances.

Steam Raising.—With a view to improving boiler practice throughout the country the attention of manufacturers and of public education authorities is called to the need for better supervision and education of boiler-house staffs. Fuel economy would also be promoted if more detailed financial and technical data relative to the production of electric power were published by the Electricity Commissioners.

Smoke Abatement.—It is concluded that abatement of atmospheric pollution would be best secured by the institution by the Ministry of Health of a national Smoke Inspectorate on similar lines to the existing Alkali Inspectorate, which has admittedly worked with beneficial results to the industry concerned (*cf.* Report of Departmental Committee of the Ministry of Health, J., 1922, 1 R).

REPORT ON THE INDUSTRIAL, COMMERCIAL AND ECONOMIC SITUATION OF POLAND, DATED FEBRUARY, 1922. *By* R. E. KIMENS, *H.M. Commercial Secretary, Warsaw. Department of Overseas Trade. Pp.* 48. *H.M. Stationery Office*, 1922. *Price* 1s. 3*d*.

During 1921 internal trade in Poland was decontrolled, export restrictions were reduced, protective tariffs were introduced, and measures were passed for developing agriculture. Poland has acquired extensive forest areas under the Riga Treaty, and has obtained rich mining, metallurgical, engineering, and chemical industries by the incorporation of Upper Silesia that should eventually enable the country to rank among the chief industrial States of Europe. Although agriculture has not yet fully recovered, production is increasing, and given good harvests, machinery and imported fertilisers, a large quantity of produce will be available for export in future.

The output of coal during the first eleven months of 1921 was 6,865,289 t., or 7·2 per cent. more than the total output in 1920; imports from Upper Silesia were 1,931,300 t., so that in future there will probably be a surplus for export. There were no changes in the lead, copper, potash and sulphur industries, but deposits of pyrites containing 34 to 38 per cent. sulphur are being mined. Although statistics for the whole year are not available, it is probable that the output of iron ore, salt, and zinc has increased. Owing to Government control and high prices there has been no development in the petroleum industry, but the export of crude and refined products increased; about 53 per cent. of the capital invested in the industry is French and 14 per cent. British.

Many industries are gradually becoming self-supporting, and this may in time greatly affect the foreign trade. During the year the textile industry made a great recovery, about 75 per cent. of the plant being in working order at the end of 1921. In the metallurgical industry the output was only 20 per cent. of the pre-war production owing to lack of capital, shortage of fuel and food, and transport difficulties. All the coke required has to be imported from Teschen, as Upper Silesian coke is too poor to be used in blast furnaces. The production of pig iron was about 130,000 tons and of iron products 250,000 t.

Satisfactory progress was made by the chemical industry and production increased generally. Importation of heavy chemicals is decreasing and will be further reduced when Upper Silesia is incorporated. Foreign competition in pharmaceutical chemicals and dyes will be more difficult in future, as dye manufacture is progressing, and supplies of intermediates will be available in Upper Silesia; in certain branches local dyes competed successfully with British and German products. Nitric acid is made in two factories, the demand for hydrochloric acid is met by local production, and the output of sulphuric acid increased, although certain quantites were imported from Upper Silesia for making superphosphates. Reliable statistics for the chemical industry are not available at present, but are being compiled by certain branches of the industry. Sufficient soap is produced to supply the home market; there was no export in 1921 and importation is impossible owing to the low price of the local product. The glue and bone industry did well and attempts are being to export glue to Great Britain. Conditions in the tanning industry improved until October, but afterwards declined and stocks accumulated; a certain quantity of leather was imported from Great Britain, but this trade will probably not increase as the demand, except for high-class leathers, is more than met by local production. There is a good market for dry quebracho extract, the only tanning extract now imported. Trade depression affected the cement, ceramic, tile and brick factories. The glass industry is developing, although the quality of the products is usually very poor. Little advance was made by the starch industry, the output being still only 12·3 per cent. of the pre-war amount. The production of alcohol was slightly in excess of requirements and the sugar crop increased; it is probable that both sugar and alcohol will take an important place in the export trade in future.

The export trade during the first half of 1921 was over four times larger in volume than in the same period of 1920, mainly on account of increased exports of timber and petroleum. No official statistics of value are published, but it is believed that during the first half of 1921 the value of the exports was about 10·5 per cent. of the value of the imports. The volume of exports to Great Britain increased by nearly 500 per cent. during the first half of 1921, compared with the same period in 1920, but the volume of imports from Great Britain has remained stationary since the beginning of 1920. The superior quality of British goods makes them popular in Poland, and they would be preferred if prices were lower and terms of payment more favourable.

REPORT ON THE ECONOMIC SITUATION OF DENMARK, TO MARCH, 1922. *By* R. M. TURNER, *H.M. Commercial Secretary, Copenhagen. Department of Overseas Trade. Pp.* 52. *H.M. Stationery Office*, 1922. *Price* 1*s*. 6*d*.

Although depression and unemployment were the outstanding features of the industrial situation in Denmark during 1921, agriculture was generally prosperous, except in the latter months of the year, when prices fell.

Nearly all the factories which were erected when prices of material and labour were high have disappeared or been absorbed in older establishments. The margarine industry, comprising 65 factories and employing 800 men and 250 women, probably suffered less than most. The output in 1920 was approximately normal at about 55,000 tons, but prices fell steadily, and exportation was small. Serious losses on stocks were incurred by the oil-crushing industry, and exports diminished, only 4700 t. of coconut oil and 5900 t. of soya oil being exported, compared with 9700 t. and 11,600 t. respectively in 1920. Vegetable oils were shipped to France and the Mediterranean, but exports to Germany decreased. Production of milk and cream was unprofitable, and both the conserving and the potato-flour industries suffered severely.

The sugar-beet harvest was not very satisfactory in 1921, and the 1920 crop yielded only 52,740 metric tons of sugar compared with 152,252 t. in 1914. Most branches of the metal industry were run at a loss, and the leather industry, which was built up during the war, had a most disastrous year largely owing to the failure of the export trade. Brick-making suffered from German competition, but the cement industry has begun to regain its former position, thanks to increased exports to South America (125,700 t. against 37,000 t. in 1920). The porcelain industry was fairly well employed, and the manufacture of technical porcelain, particularly for electrical materials, appears to be maintaining its position in the home market. Manufacturers of fertilisers suffered great losses owing to the fall in value of stocks, and other branches of the chemical industry were affected by the general depression and by acute competition from Germany.

The value of the export of chemical products fell from £397,196 in 1920 to £292,056 in 1921. The yeast and spirit industry is well organised under a single group; in 1920, 3900 t. of yeast and 3·4 mill. litres (nearly 900,000 galls.) of 100 per cent. spirit was produced. Paper manufacturers were badly hit by large importations from Germany and Finland.

Imports during 1921 were valued at £71,682,243, exports at £64,626,168, and the adverse trade balance was reduced from £63,084,112 (1920) to £7,056,075, largely owing to the decreased volume and value of the imports and an increase in the volume of many exports. The values, in Danish money, of some of the chief imports and exports (Danish produce) are given below (21·4 kroner = £1)

	Imports		Exports
	1000		kr.
Tallow, oil, rubber, resin, tar, etc ..	83,415	..	23,629
Goods of rubber, tallow, oil, etc. ..	17,240	..	1,562
Paper and articles thereof	25,179	..	1,236
Chemical, technical articles ..	20,194	..	6,250
Fertilisers	60,482	..	2,610
Mineral fuels	145,827	..	4
Minerals, raw or roughly worked ..	16,893	..	13,338
Goods of clay, stone and glass ..	29,104	..	2,990
Wrought iron and iron goods ..	118,118	..	10,781

The value of imports of fertilisers increased by 23 million kr. to 60 mill. kr., the chief items and the respective decreases or increases (shown in parentheses) being:—Phosphate, raw, 23,104 tons (−81,253 t.); superphosphate, 52,500 t. (−3000 t.); Norwegian saltpetre, 49,200 t. (−13,000 t.); Chile saltpetre, 55,600 t. (−12,300 t.); basic slag, 445 t. (−3400 t.); potash fertilisers, 14,200 t. (+9600 t.). During a large part of the year British firms found it impossible to meet German, and difficult to meet Belgian and Czechoslovak competition. The Danish Export Association has been reorganised, and its functions have been transferred to a great extent to the Trade Information Bureau belonging to the Ministry for Foreign Affairs.

TRADE NOTES

BRITISH

Annual Report on the Uganda Protectorate

This report, covering the period April 1 to December 31, 1920, states that the general improvement which was a feature of the year 1919–20 (*cf.* J., 1921, 396 B) was not maintained. The area under, and export of, cotton rose to 207,100 acres and 8517 tons, respectively, but only 1284 t. of coffee was exported, and cacao-planting has been practically abandoned. Cultivation of para rubber is increasing in spite of low prices; the output for the ten months was 140 t., valued at £23,767. The acreage under sugar-cane is extending, and experiments on the value of different varieties of cane and on the manufacture of "jaggree" are in progress. Flax has been grown experimentally, but it seems unlikely that the crop will give rise to an export trade. The use of elephant grass and papyrus for manufacturing paper and power alcohol is being investigated in England. A first consignment of timber was shipped in 1920 and a regular supply can now be obtained. The total value of domestic produce exported during the period covered by the report was £4,134,136, the increase of 125 per cent. over the value for the previous twelve months being due to the high price of cotton.—(*Col. Rep.-Ann.*, *No.* 112, 1922.)

FOREIGN

The Fertiliser Industry in France

There is a good demand for phosphatic fertilisers and several superphosphate factories have already sold most of their output, mainly to home agricultural syndicates and traders. Anticipating a rise in prices, farmers are attempting to cover their requirements for the approaching season, but buyers in southern France are at present holding back. Supplies of bone meal are still short as the demand far exceeds the supply. The demand for slag is strong and stocks are low; it is hoped that the steel-works will soon be able to supply it in large quantities and thus enable exportation to be resumed. Stocks of ammonium sulphate are exhausted and Great Britain is now the only source of importation.—(*Chem. Ind.*, *Aug.* 28, 1922.)

REVIEWS

Werkstoffe: Handwörterbuch der Technischen Waren und ihrer Bestandteile. *Unter mitwirkung Zahlreicher Fachwissenschaftlicher Mitarbeiter. Herausgegeben von* Prof. Dr. Paul Krais, *Erster Band A bis F. Zweiter Band G bis R. Dritter Band S bis Z. Leipzig: Johann Ambrosius Barth,* 1921. *Price,* £3 16*s.*

This compendious work owes its origin to Dr. Zschimmer, a former director of the well-known glass works of Schott and Co., in Jena, who had conceived the idea of bringing out a "Lexicon of Technical Materials." For some reason which does not appear, Dr. Zschimmer was unable to carry out this project, and on the advice of Prof. Dr. B. Rassow, the publisher entrusted its compilation to Dr. Paul Krais, of Dresden, who, with Dr. Groscheiff, is responsible for the plan of the work. In view of the wealth of material to be dealt with it was obviously desirable to form a clear definition of what was to be understood by the term "Werkstoff," and, for the purpose of the dictionary, this was defined to include "all natural or prepared technical substances constituting the material or material portion of a wholesale ware, no matter whether it is artificially produced or not." Edible, potable and medicinal substances were explicitly excluded, as were plants and animals, fertilisers and feeding stuffs, cosmetics and furniture, clothes and leather work, as well as jewellery and articles of virtu. Having regard to the nature of the work some objection may be taken to certain of the limitations, but it was absolutely necessary that a line should be drawn somewhere, and the projectors of the undertaking must be held to be the best judges where to draw it.

It might be supposed that a work of so comprehensive a nature had no special attractions for the chemist. Such a surmise is very far from the truth. It is significant of the mode in which chemistry and chemical facts enter into the nature, application and use of the most widely varied substances that the book resolves itself practically into a chemical dictionary with so much of chemical physics added as may be thought necessary to complete the account of the particular substance described. The method of treatment may be gleaned from the following highly condensed account of the scheme prepared by the editor and Dr. Groscheiff. Name of the substance in German: its etymology; its French and English equivalent; its chemical nature; its morphology; its thermal properties; its density; its mechanical-technical properties; its optical properties; its electrical and magnetical properties; its radio-active properties; its behaviour towards Röntgen and cathode rays; its acoustical properties; its chemical behaviour; its physiological action; its valuation by physical, chemical and technical proofs; its technological relations; its commercial applications, mode and extent of production, method of distribution and price, with information as to where it can be obtained in Germany.

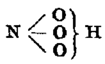
The book, as stated in the preface, is not a dictionary of technology in the usual sense. It enters into no details of manufacture, although here and there bibliographical references are made, usually to German sources, where such details may be found. As regards prices the data given are invariably prior to 1914; they seem of little value, either immediately or prospectively, and have at most a merely historical interest. The same is true of the statistics of production, which are only of relative importance.

The work, like so many similar undertakings, has suffered to a great extent by the war. Its publication has been much delayed, and much of its subject-matter is already out of date. It is, however, a useful production, and contains, in concise form, a wealth of information, although certain of e data are not very recent or the most authoritave. As is usual in German publications of this ind there is a tendency to restrict the information German sources, to the exclusion of foreign ork, even when this is more recent and more curate.

T. E. Thorpe.

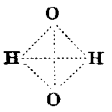
NORGANISCHE Chemie. *Ein Lehrbuch zum Weiterstudium und zum Handgebrauch.* By Prof. Fritz Ephraim. *Pp. viii.+727. Dresden and Leipzig: Theodor Steinkopff*, 1922. *Price* 21*s.* 6*d.* (*bound* 24*s.*)

Prof. Ephraim's textbook differs in many ways rom others of the same size. It is more compreensive, and the author is able by presupposing lementary knowledge, by an unusual arrangement f material, and by an admirable conciseness of style, cover a surprisingly wide field. Compounds of the rare" elements are considered in some detail, nd the tables of physical properties also make the ook valuable for reference. Recent advances, specially German, are included—even the Badische xplosion of 1921! The account of Werner's theory s notably clear and detailed, and the theory of isond hetero-polyacids of Miolati and Rosenheim eceives careful consideration. The introduction of hese conceptions lights up some obscure regions—s in the case of the constitution of such compounds s $18BaO$, V_2O_5, $3P_2O_5$, $60WO_3$, $150H_2O$, but in uch formulæ as



$N\left\langle\begin{matrix}O\\O\\O\end{matrix}\right\}H$

and



he extension of the valency conception seems lmost at its breaking limit.

The arrangement of the material under the *negative* radicals (oxides, sulphides, carbonates, etc.), although permitting of a concise treatment, is less suitable for elementary students, since the facts then become somewhat blurred. The present book, however, is specifically written for more advanced students, and these will find it very attractive and stimulating. The arrangement is not so new as the author seems to think; it was adopted by Sir William Ramsay in the "Systematic" part of his two small volumes on "Modern Chemistry," which are masterpieces of their kind.

Prof. Ephraim has carefully avoided loose generalisation, and although the experimental details are necessarily extremely brief, he makes little use of expressions such as "breaking rings," "splitting off water," and the like, which take the place of genuine descriptive language in some textbooks.

There are several typographical errors, and one or two very questionable statements were noted, but in a book covering so much ground these are surprisingly few. The reviewer can recommend this book to all chemists as both interesting and useful. Advanced students will find it of very great value: they will discover something new on nearly every page.

J. R. Partington.

Chemistry of the Non-Benzenoid Hydrocarbons and their Simple Derivatives. By Benjamin T. Brooks. *Pp.* 612. *New York: Chemical Catalog Co., Inc.*, 1922. *Price* $7 *net.*

Dr. Brooks has done well to assemble, in one volume and in systematic sequence, an orderly presentation of the non-benzenoid hydrocarbons, their properties, relationships and principal derivatives. It is a form of classification seldom adopted owing to the historically somewhat haphazard manner in which the material has been accumulated, and to the more customary, if illogical, practice of discussing the *cyclo*paraffins and essential-oil constituents after a survey of the aromatic series has been made. Thus a wholesome rearrangement of attitude towards organic chemistry is encouraged by a study of the treatise. Moreover, the somewhat monotonous aspect of paraffin hydrocarbons as considered in earlier books is now relieved by the importance of these materials from the standpoint of the rubber, petroleum and essential-oil industries. Accordingly, the opening chapters include interesting sections on the origin of petroleum oils, the details of cracking, and recent results of oxidation. A long chapter entitled "The Ethylene Bond" embraces the modern views of Lewis and of Langmuir as applied to the carbon atom, and of J. F. Thorpe in connexion with *spiro*-compounds, followed by the work of Harries on ozonides. Alicyclic unsaturated hydrocarbons are next assembled, whilst six chapters entitled "Cyclic Nonbenzenoid Hydrocarbons" deal respectively with the sub-hexyl, *cyclo*-hexane, *para*-menthane, *ortho*- and *meta*-menthane, bicyclic and tricyclic, and super-hexyl series. The concluding chapters deal with physical and physiological properties, the whole volume being well produced, agreeable to manipulate, and adequately enriched with references to recent literature.

M. O. Forster.

A Comprehensive Treatise on Inorganic and Theoretical Chemistry. By J. W. Mellor. *Vol. II.* F, Cl, Br, Li, Na, K, Rb, Cs. *Pp. vi.*+894. *London: Longmans, Green and Co.*, 1922. *Price* 63*s. net.*

The first volume of this treatise has been already reviewed very favourably (1922, 227 R), and there is no doubt that the second volume fulfils all the expectations raised by the first. In Chapter XVII, the history of the halogens, their occurrence, preparation and properties are dealt with very fully. In this and the succeeding chapters an immense mass of data is given. The language is terse, but the treatment is critical, and the author has been successful in writing a book which nowhere simulates a compilation of the dictionary type. In Chapter XVIII, in the same manner, there are described the compounds of the halogens with hydrogen; in Chapter XIX, the oxides and oxyacids of chlorine, bromine, and iodine; and in Chapter XX the alkali metals. One of the special characteristics of the book is the completeness of the references, which are given for every statement, and appear at the end of the chapters. The number of these probably explains the absence of an authors index which, with the comparative sparseness of the subject index, is the only poor feature of the book.

Dr. Mellor is to be congratulated on the plan of the treatise and on the excellence of the first two volumes. On completion the work will fully justify the designation of a comprehensive treatise and do much to stop the present unfortunate tendency to regard inorganic and the so-called physical chemistry as separate and distinct branches of the science. The author's "Introduction to Modern Inorganic Chemistry" and "Modern Inorganic Chemistry" will form with this "Comprehensive Treatise" a uniform series of books which is unique in this or any other language. The Treatise promises to outrival the well-known German works, and is likely to be for many years the standard book for use by advanced and research students.

Robert H. Pickard.

Potash. *By* Sidney J. Johnstone. *Monographs on Mineral Resources with Special Reference to the British Empire. Imperial Institute. Second Edition. Pp.* 122. *London: John Murray,* 1922. *Price* 6*s. net.*

This monograph on potash, like those on other mineral resources issued by the Imperial Institute, is admittedly and intentionally only a compilation. As such the monographs, when compiled with reasonable completeness and accuracy, have a very considerable value. Mr. Johnstone's monograph will take a high place in the series in this regard. He has materially added to the information contained in the first edition and produced for its size the most complete up-to-date summary of the world's resources of a material essential alike to the manufacturer, agriculturalist and chemist. Not only are the mineral resources of potash considered, but the yields resulting from animal and vegetable sources and as by-products of other industries, are also classified and discussed.

After a general statement of the world's output, the author devotes a chapter to the deposits of soluble potash minerals. His summarised account of these in Germany, France (Alsace), Spain, Abyssinia, Nigeria and Peru, to select only certain of the countries listed, is notably up to date. The succeeding chapter deals also with soluble potash, but refers to that extracted from brine, etc. from salt lakes and pans in America, Asia and Africa. Chapter IV deals with deposits of potassium nitrate of mineral origin, the South American, Rhodesian and Russian resources receiving full treatment. In Chapter VI the potassium nitrate deposits of organic origin, such as those contained in the soils of old village sites in India, South and Central America, Egypt and elsewhere, are recounted and the method of recovery described. The author advisedly devotes few words to the extraction of potash from sea-water, and passes on to the consideration of the insoluble potash minerals, alunite, felspars, leucite, etc. The reader is thus led naturally to the recovery of potash from the dust and gases of cement kilns and blast furnaces, where it has been volatilised from the clay, ore or fuel employed. The methods of recovery from insoluble minerals as well as flue-dust and gases are discussed, but not exhaustively, and it is perhaps not surprising to find certain notable omissions. In Chapter IX, vegetable sources of the alkali, such as seaweed, wood-ash, sunflower-stalks, bracken, and many others are described, but it is curious that the author should dismiss in a few lines the Russian supplies of carbonate which were of such extreme importance to this country and the United States of America during the war, especially for glass-manufacture and chemical needs. Residues from beet-sugar manufacture are discussed in Chapter X. An account of the animal sources of potash, such as wool-washings (suint) and karroo ash, is given in the final chapter, and the book concludes with a moderately full bibliography. The absence of an index in a compilation of this kind is unfortunate.

Finally, it may be observed that, whilst the author nowhere actually says so, and whilst he details all the adventitious sources of potash and describes the war-time expedients, he appears to regard the deposits of soluble potash salts as the mainstay of industry in the future—a point of view with which the reviewer cordially agrees.

P. G. H. Boswell.

PUBLICATIONS RECEIVED

American Fuels. *By* Dr. R. F. Bacon *and* W. A. Hamor. *Mellon Institute Technochemical Series. Vol. I. Pp.* 628. *Vol. II. Pp.* 629–1257. *London: McGraw-Hill Publishing Co., Ltd.,* 1922. *Price* 60*s.*

The Chemistry and Technology of Gelatin and Glue. *By* Dr. R. H. Bogue. *Mellon Institute Technochemical Series. Pp.* 644. *London: McGraw-Hill Publishing Co., Ltd.,* 1922. *Price* 30*s.*

Tested Methods of Non-Ferrous Metallurgical Analysis. *By* S. Pile and R. Johnston. *Pp.* 128. *London: H. F. and G. Witherby,* 1922. *Price* 7*s.* 6*d.*

Grundlegende Operationen der Farbenchemie. *By* Prof. H. E. Fierz-David. *Second edition, revised. Pp.* 266. *Berlin: Julius Springer,* 1922. *Price, bound,* 12*s.*

Vanadium, 1913—1919. *The Mineral Industry of the British Empire and Foreign Countries. War Period. Imperial Mineral Resources Bureau. Pp.* 19. *H.M. Stationery Office,* 1922. *Price* 6*d.*

Fourth Report on Colloid Chemistry and its General and Industrial Applications. *British Association for the Advancement of Science and Department of Scientific and Industrial Research. Pp.* 382. *H.M. Stationery Office,* 1922. *Price* 5*s.* 6*d.*

First Report of the Committee on Contact Catalysis. *By* Wilder D. Bancroft. *Pp.* 43. *Reprinted from the Journal of Industrial and Engineering Chemistry, Vol.* 14, *No.* 7, *April–July,* 1922.

REVIEW

Vol. XLI] OCTOBER 16, 1922 [No. 17

THE STRUCTURE OF STEELS FROM THE STANDPOINT OF COLLOID CHEMISTRY

F. C. A. H. LANTSBERRY

WOLFGANG OSTWALD has shown that there are eight possible varieties of the colloidal state :—

(1) Solid + Solid.
(2) Solid + Liquid.
(3) Solid + Gas.
(4) Liquid + Solid (suspensoid).
(5) Liquid + Liquid (emulsoid).
(6) Liquid + Gas.
(7) Gas + Solid (smoke).
(8) Gas + Liquid (fog).

Since the great bulk of metals and alloys are originally produced in the molten state it is possible for them to be obtained in the form of a molecular solution and ultimately to exist in six of the possible forms of the colloidal state.

It is well known that molten metals dissolve gases which are evolved both before and after solidification. Metals and alloys also contain slag and other enclosures, some of which become liquid below the fusion-point of the metal, whilst others remain solid well above the temperature of fusion.

Some very interesting facts are known about the solubility of gases in metals. The familiar instance of steel may be quoted, which at the moment of solidification evolves the bulk of the dissolved gas and gives rise to unsound castings. Fortunately, however, the addition of silicon in small quantities to the molten metal increases the solvent power for gases, and results in the production of sounder castings. This is quite on a par with the protective action of certain colloids. This view is confirmed by the fact that elements, such as silicon, titanium, and aluminium, whose compounds show a distinct tendency towards assuming the colloidal state, have the greatest effect in promoting soundness in steel.

The existence of non-metallic enclosures in steel is of great importance, and provides a subject about which very little is really understood. For the purpose of this note these enclosures may be divided into two classes :

(1) Those which are solid above the temperature of fusion of the steel (certain slags and alumina).

(2) Those which have a melting-point below that of the steel (sulphides).

Confining our attention for the moment to the liquid state, it is fairly certain that at some temperature the materials of the first class will become molten, so that whatever is said of the second class will be true of the first up to the point at which solidification of the enclosures commences. In any case the quantity of slag existing in steel is very minute and might almost be neglected entirely for the purpose of this note.

The influence of sulphides, however, is of very great importance, so much so that sulphur has been a nightmare to the steelmaker for generations. It is known that sulphur in excess of 0·08 per cent. tends to make steel "hot short." Another interesting fact is the change in character of the enclosures when even a small quantity of manganese is added to the steel. In an alloy containing no manganese the sulphide exists as a yellowish enclosure, but the presence of 0·2 per cent. of manganese changes the colour to a pale bluish-gray. It is fairly certain that in a steel containing no manganese the sulphur exists as ferrous sulphide, but that in a steel containing 0·5 per cent. manganese and 99 per cent. iron the sulphur should exist as manganese sulphide (MnS) is very difficult for the chemist to understand. But whatever may be the exact composition of these sulphide enclosures, it is quite certain that they may give rise to troubles in manufacture quite apart from the "red shortness" about which there is considerable exaggeration, because bars containing over 0·1 per cent. sulphur can be hot-rolled into quite small bars. The sulphide areas when segregated into large masses may cause considerable wear of tools in machining operations. This is illustrated in Figs. 1 & 2, which represent steels that are not materially different in sulphur-content, but whereas the steel illustrated in Fig. 1 caused so much wear of the tools as to be practically unmachinable, that illustrated in Fig. 2 machined quite sweetly and produced articles showing an excellent finish. The essential difference between the two lies in the size of the sulphide enclosures. In passing it may be remarked that this is the main difference between English and American machining steels. It would therefore appear to be of considerable technical importance and of extreme scientific interest. In the first place it is known that the sulphides are insoluble in steel below its melting-point, or at least that the solubility is not greater than required to fulfil the theoretical concept that complete insolubility is impossible. It is also certain that there is no tendency for the sulphide enclosures to segregate at temperatures below the melting-point of the steel. Our knowledge of the behaviour above the melting-point of the steel when both constituents are liquid, is not even so extensive. At temperatures immediately above the melting-point of the steel we know that there is little or no mutual solubility, a point which is proved by the tendency towards segregation in the casting of large masses. At the same time we have the fact of the enormous variation in size of the sulphide enclosures in steels of various origin. This is undoubtedly brought about to a considerable extent by the extreme agitation which occurs during the various processes of manufacture.

But we have no knowledge of the solubility relationships of steel and sulphides in the liquid state. In the case of phenol and water we know that at the ordinary temperature these two materials are practically insoluble, but as the temperature is increased so the mutual solubility increases until at a certain temperature (depending upon the relative proportions of the constituents) complete solution occurs. On cooling complete solubility persists until the same critical temperature is reached, when the mixture becomes opalescent. At this point it can easily be proved that the phenol has assumed the colloidal state, but as the temperature is lowered coagulation occurs, until finally the mixture separates into two distinct layers. It is quite possible that at high temperatures steel and the sulphides show a similar behaviour, and if this be correct we have at hand a possible means of controlling the size of the sulphide enclosures and so rendering them innocuous. It is true that we cannot apply the ultramicroscope to the study of these problems, but during the last few years methods have been developed of studying the electrical conductivity and viscosity of molten metals and alloys, and this gives us a ready mode of attack, for both these properties show very definite characteristics when the colloidal state is attained.

The relations existing between carbon and iron are very interesting when regarded from the colloid point of view. Carbon exists in steel as a carbide of iron, Fe_3C, known as cementite. At all temperatures below 680° C. the limiting solubility of this cementite in iron, known metallographically as ferrite, corresponds to about 0·04 per cent. carbon. On heating, no change takes place in these solubility relationships until a temperature of 700° C. is attained, when the cementite suddenly goes into solution in the ferrite. At this temperature the solution occurs in the pearlitic portions of the steel, and as the temperature is increased the solid solution produced dissolves either ferrite or cementite according as one or other constituent is in excess. If ferrite is in excess the concentration of the solid solution decreases with increase of temperature, but when cementite is in excess the concentration increases until a maximum is attained at a concentration of 1·7 per cent. carbon and a temperature of 1135° C. We see, therefore, that in steels the stable condition at high temperatures is that of a solid solution, whilst at low temperatures this solid solution has split up into its constituents, the ultimate stable condition in the cold being undoubtedly iron and graphite. During this splitting up the solid solution passes through several very definite transition stages which can be trapped and subjected to microscopic examination. The solid solution austenite is shown in Fig. 2. Apart from the polygonal outlines which are characteristic of single-phase alloys, the material is structureless. In pure carbon steels it is exceedingly difficult to obtain this structure, but by etching at high temperatures the structure has been developed. (Fig. 3.)

The normal structure obtained by properly quenching steel is shown in Fig. 4. This characteristic structure is known to metallographists as martensite, and its peculiar appearance has been ascribed to surface stress marks by some authorities and by others to the effects of twinning along the octahedral planes. By less drastic quenching or by reheating at about 400°C., a very dark etching constituent appears known as troostite (Fig. 5), whilst still less drastic quenching or more tempering gives sorbite (Fig. 6).

If the quenching be omitted and slow cooling adopted pearlite is obtained; the structure of this material is shown in Fig. 7. By very slow cooling indeed the two constituents segregate completely and cementite and ferrite are obtained side by side (Fig. 7). Examined from the point of view of the colloid chemist these changes may be explained as follows:—

Cementite is regarded as the dispersed phase and ferrite as the dispersion medium. At high temperatures the degree of dispersion is great enough to produce the molecular solution austenite. As the material cools a temperature is reached at which the dispersed phase assumes the colloidal state and troostite is obtained. Troostite shows a maximum solubility in acids and is irresolvable even under the highest powers of the microscope. Troostite may, therefore, be rightly regarded as a colloidal solution in which cementite is the dispersed phase. As the temperature falls the phenomenon of coagulation occurs and sorbite is produced. Examination of sorbite under the

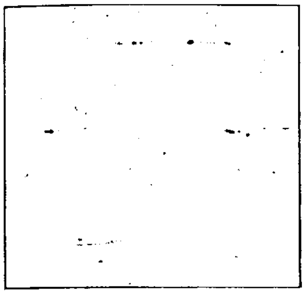


FIG. 1.

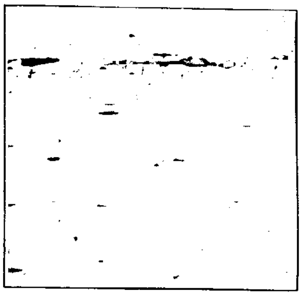


FIG. 2.

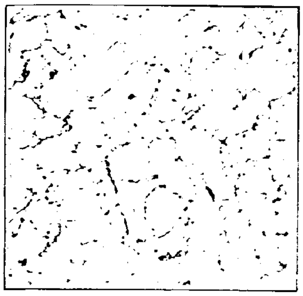


FIG. 3.

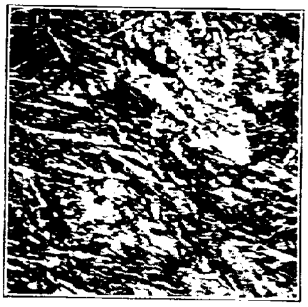


FIG. 4.

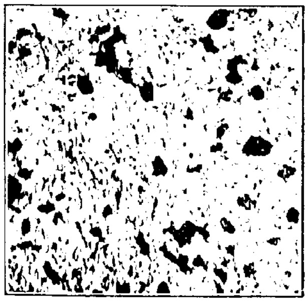


FIG. 5.

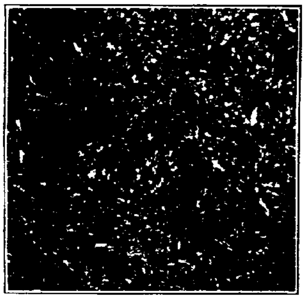


FIG. 6.

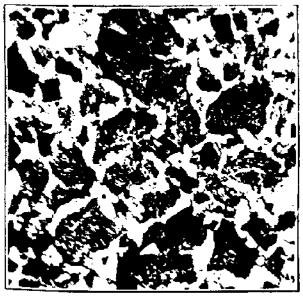


FIG. 7.

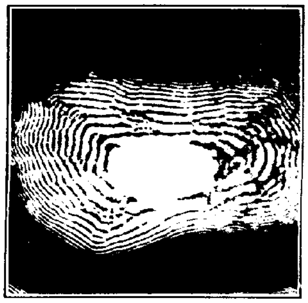


FIG. 8.

Journal of the Society of Chemical Industry. To face page 410 R, 1922.

microscope indicates that it has the structure of a suspensoid. On still slower cooling pearlite is obtained and the structure recalls very strongly the phenomenon of periodic precipitation. Fig. 8 shows the Liesegang rings obtained by the precipitation of silver chromate in gelatin. These recall the appearance of pearlite in a very striking manner. We see, therefore, that colloidal chemistry gives an explanation of the reason for the peculiar laminated structure of pearlite, an explanation which will hold good for all other eutectics. It is unfortunate that the ultramicroscope does not lend itself to the study of alloys, but as pointed out earlier, other methods are available, and no doubt advantage will be taken of them in time to find out if that which at the present time is merely conjecture can be demonstrated by experiment.

THE "THERM" SYSTEM OF CHARGING FOR GAS

SIR WILLIAM POPE

As the result of a view expressed by the Fuel Research Board some years ago, the Gas Companies now sell gas by the "therm"; the consumer is thus charged at a fixed rate for each 100,000 British Thermal Units obtainable by burning the gas. Since coal gas is used as a source of energy, it seems but just that it should be sold on an energy basis, and that its cost should be fixed by reference to the amount of some form of energy, such as heat, obtainable from it; the heat unit of a therm is quite a suitable one to use.

The new method of charging for gas replaces the former one in which a charge per 1000 cubic feet was made; to charge for gas by volume, without defining its heating value, is just as reasonable as it would be to sell milk by the pint without limiting the amount of water which might be added to it before the sale. That it is more rational to charge for gas by the therm than by the 1000 cubic feet is not to be doubted. To-day, however, the daily Press—and notably the *Daily Mail*—is said to be inundated with complaints to the effect that the new mode of charging for gas has resulted in an increase in the gas bills and in an illegitimate profit to the producing companies.

Whilst entirely agreeing that to charge by the therm marks a distinct advance, I am inclined to think that the gas undertakings have made a most unfortunate choice of the time at which to make the change. The rising coal market and the heavy expense caused to the gas-making industry by the coal strike of last year greatly increased manufacturing costs. Whilst the selling price of gas is now undoubtedly falling throughout the country, it is fairly certain that in most cases the price is higher to-day than it should be; the consumer of gas, who often understands neither the volume nor the energy unit, will not be content until the sum total of his gas bill *in money* approximates more nearly to pre-war figures.

The attempts which have been made to popularise the therm by public advertisement have probably not served their purpose because the announcements are couched in terms incomprehensible to those who have not received the rudiments of a scientific education. It has been stated recently in the literature of gas technology that modifications are now being made in the existing gas-meter register so that the gas user may read his consumption directly in therms; this will be better appreciated than long dissertations explanatory of the therm. It might even be well if, until this modified register is universally installed, gas undertakings were to indicate upon their gas bills the consumption not only in therms but also in cubic feet, so that the public could make direct comparisons with their gas accounts of previous quarters; this would obviate the need for a calculation the nature of which is not universally understood. Naturally, it should be insisted that equal prominence is given to the number of therms and of cubic feet, and to the cost of each of the two units, the therm and the 1000 cubic feet.

Gas legislation of 1920 may have been faulty in defining the methods by which standard basic prices, dividends permissible, etc. are to be fixed, but upon this aspect of the question I am not prepared to write. It is of the greatest importance, however, that the progress made by the Fuel Research Board, in instituting the sale of gas upon a heat basis, should not be prejudiced by extraneous factors; it seems highly desirable that the Board of Trade should call for an inquiry into the question for the purpose of defining the nature of those factors which have arisen fortuitously but which undoubtedly operate against the popularity of a distinct advance, that, namely, of securing by legislative action the merchanting of gas on the basis, not of its bulk, but of its usefulness to the consumer.

* * *

In a letter to *The Times* of October 7, Sir George Beilby, Director of Research to the Fuel Research Board, explains the reasons which induced the Board, after devoting a year and a half to the study of the question, to recommend the adoption of the thermal system of evaluating coal gas. He states that there are two other matters of importance to the consumer which have not been sufficiently considered, viz., the need of a calorimeter, now available, to record continuously and automatically the heating quality of the gas, and the necessity for securing that the consumer shall burn his gas in the most economical manner. For this purpose it was recommended that the gas companies should readjust consumers' burners free of charge, whenever the calorific value of the gas was changed.

GENERATION OF STEAM BY ELECTRICITY*

F. T. KAELIN†

THE purpose of this paper is to bring before the engineering profession the conversion of electric energy into heat energy by means of an improved and inexpensive apparatus, the electric steam-generator. To produce steam by electricity appears at first sight a reversal of common-sense, but this process has its economic *raison d'être* in the fact that it can utilise hydro-electric power that would otherwise be wasted. In times of business depression the engineer is forced to consider all kinds of improvements, such as increasing efficiency of production, elimination of waste in material, labour and power; and the electric steam-generator is a handy and simple means of contributing toward this end. There are more than 300 installations in Italy, Switzerland, Sweden and France, and a small number of generators has been in use for a short time in Canada and the United States.

The low cost of the electric steam-generator compared with that of other electrical plant for converting electricity into heat, and the comparative cheapness of the wiring and control apparatus necessary, are very favourable considerations. It can be shown that even when the load factor is comparatively high, *e.g.*, in pulp and paper factories, which purchase big blocks of power and consume it, mainly for pulp-grinding, during only six days of the week, it is economically feasible during the seventh day to turn the power into steam, which is always required either for heating or manufacturing.

In the electric steam-generator the electric current passes through a resistance either of metal or formed by the water to be evaporated, and all electric energy is converted into heat energy. One kilowatt-hour is equivalent to 3412 British Thermal Units; the total heat content of 1 lb. of steam at an absolute pressure of 150 lb. per sq. in. is 1193 B.Th.U.; assuming the temperature of the feed water to be 150° F., the total heat to be supplied will be 1193—(150−32) = 1075 B.Th.U. One kilowatt-hour will therefore produce 3412/1075 = 3·17 lb. of steam. The heat losses are very small.

During the past ten years generators have been made with capacities up to 1000 kw., and only within the last two years have sizes of 2000 kw. or more been constructed.

There are two main classes of electric steam-generators: (*a*) those in which the current passes through a combination of metallic resistors, and (*b*) those in which the water itself forms the resistance. In (*a*) the resistors in the form of wire and ribbon made of some high-resistance alloy may be mounted in tubes similar to those of fire-tube boilers. The arrangement allows the use of alternating or direct current, as the heating elements do not come into direct contact with water; in all other cases in which the resistors are in contact with water and the current passes partly through metallic resistors and partly through water, only alternating current can be used because direct current would decompose the water.

Generators in class (*b*) are built on an entirely different principle. The electric current passes through steam-tight insulating bushings to a system of stationary electrodes partly submerged in water, the water to be evaporated serving as the electric resistance. The outstanding advantages of this type are its simplicity of construction, compactness, easy control, and very low cost per kilowatt capacity. Practically any water that is satisfactory for ordinary boilers is also suitable for the electric steam-generator. The resistance of water has a negative temperature co-efficient, *i.e.*, the resistance decreases as the temperature and pressure increase. The writer has made many tests to determine the relationship between resistance and temperature for various kinds of water, and has used apparatus specially constructed for currents up to 10 ampères and 6000 volts. at atmospheric pressure. Fig. 1 shows a set of curves giving the relation of temperature and resistance for raw water from the St. Maurice River and for condensate water mixed with about 25 per cent. of raw water from the same source

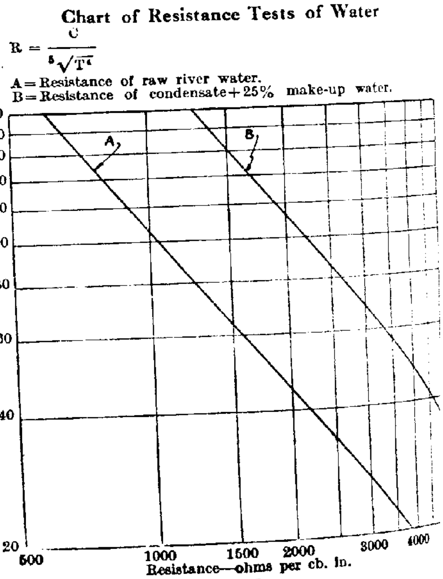


FIG. 1

Using a logarithmic scale, the curves appear as straight lines, and in many other tests, of which the results are not shown in the diagram, it was found that these lines were all very nearly parallel. This would indicate that the same general law applies to all kinds of water. The curves have been verified above 100° C. by tests on steam-generators under pressure.

---

* Abstract of a paper read before a joint meeting of the Montreal Section of the Society of Chemical Industry, the Engineering Institute of Canada, and the Institute of Mining and Metallurgy, at Montreal, on Jan. 19, 1922 (*cf.* J., 1922, 94 R.).

† Chief Engineer, Shawinigan Water and Power Co.

Figure 2 shows a section of a 5000 kw. generator, consisting of a vertical cylindrical tank with an extension at the bottom. The upper part is flanged, and to it is bolted a dished cover which contains three openings for the porcelain bushings that insulate the three copper conductors leading to the electrodes.

Electric Steam Generator
Three-phase single unit system

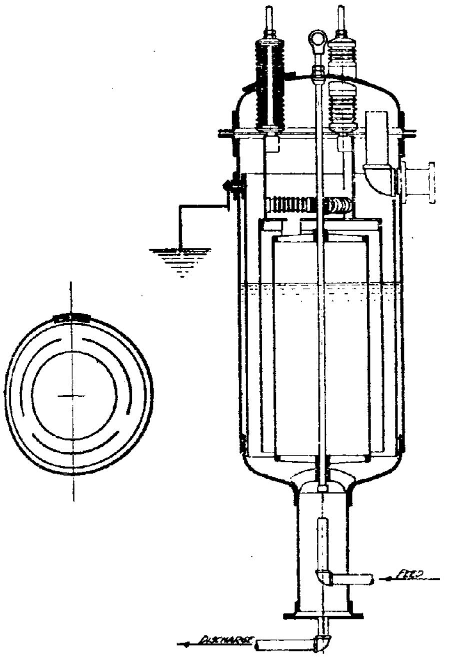


Fig. 2

The insulator bushing consists of three parts: two corrugated sleeves, one of which is outside and the other inside the tank, and a tube inside these sleeves, the whole being held together by the shoulder and nut of the conductor passing through. The arrangement shown in Fig. 2 is for 1300 amps., 2200 volts, 3-phase, 60 cycles, and for a working pressure of 165 lb. per sq. in.; the electric current passes through from both sides of the electrode to the inside and outside cylinders, and to a much smaller extent directly from electrode to electrode.

This type of generator requires but little floor space; the 5000 kw. generator with electric control apparatus can easily be placed in an area 10 × 12 ft., and the 18,000 kw. generator, equal to 1800 boiler horse-power, with all its accessories, needs a floor space of about 15 × 22 ft., and a head-room of 25 ft. for ease in dismantling.

As the heat in the steam-generator is produced in the water, there are no parts subjected to a higher temperature than that of the steam; hence no dangerous stresses are produced by temperature differences. Another element of safety is that interruptions to feed-water supply can be easily met by shutting down the generator. The operation of the electric steam-generator is at least as safe as that of the coal-fired boiler.

PHOTOSYNTHESIS

The following is a short report of the discussion on Photosynthesis which took place at a joint meeting of Sections B (Chemistry) and K (Botany) at the recent meeting of the British Association in Hull. Prof. H. H. Dixon, President of Section K, presided over a large attendance.

In opening the discussion, Dr. F. F. Blackman said that he proposed to deal with the active system of photosynthesis and its organisation in the living cell, and bring together evidence which supported the thesis that here we had to do, not with a simple photochemical reaction, but with a complex system in which other components, that might be described provisionally as protoplasmic components, played an essential part.

The first point developed was that there were numerous lower plants which obtained all their carbon by the reduction of carbon dioxide in the dark without the intervention of radiation, and synthesised all their organic compounds from that source; instead of radiant energy, there was utilised the chemical energy of the oxidation of nitrogen, sulphur, and hydrogen, or their compounds. In those chemosynthetic organisms there was not a gain of energy, but only an exchange of oxidation potential: the gain to the organism was substance for growth. It might be asked whether this power was entirely absent in the higher plants, and what connexion the chemical machinery of it had with the chemistry of photo-reduction of carbon dioxide.

The second point was the fact, now thoroughly investigated, that the seedlings of many plants at a stage when they have developed chlorophyll to a full green colour might be quite incapable of reducing carbon dioxide in light, and gave out as much of that gas from respiration in light as in dark. Some other component or property lagged behind the chlorophyll in its development and the slow, steady rate of its development was the same in darkness or light.

A third point of interest was the efficiency of photosynthesis in the golden-leaved varieties of certain shrubs. Here the amount of chlorophyll might be as low as 4 per cent. of the normal green form, and yet under medium conditions the reduction of carbon dioxide might be as great as in green leaves. The fact had been established that the golden leaf needed more light than the green to carry out the same rate of reduction of carbon dioxide. It looked as if with these extreme variations of chlorophyll what counted was the cube root of the amount of chlorophyll present—a single dimension of the colloid *micellae* and not the total mass—which might be taken as an indication of the organisation of the system.

A fourth point considered was the relation of photosynthesis to temperature. It was established that for a high rate of photosynthesis it was not sufficient to have intense radiation and concentrated carbon dioxide, but a high temperature was also essential. For each temperature there was a specific maximum of activity which could not be exceeded unless the temperature was raised. The specific maximal values increased rapidly for rising temperature and had a temperature-coefficient of about 2 for a rise of 10° C. This temperature relation was quite different from that of a pure photochemical reaction, and it provided a further indication that we had to deal with a complex system in which dark reactions played a controlling part.

The fifth point to be raised had to do with the organisation of the active system. Prof. Warburg had been investigating the action of the narcotic phenylurethane upon the rate of photosynthesis and had found that the process underwent great depression of rate with perfect recovery on removal of the narcotic. The relation of the depression to the external concentration of the drug gave a typical adsorption isotherm indicating that the narcotic acted by adsorption on a surface from which it displaced temporarily some reacting substance of the active photosynthetic system.

Taking all these pieces of evidence together, we were forced to conclude that the chloroplast contained an active system of several components related together in a complex organisation.

Prof. E. C. C. Baly said that the conversion of a substance A into substance B might be represented as the sum of the three equations:—

$$\begin{aligned} A + E &= A' \\ A' &= B' + F \\ B' &= B + G \end{aligned}$$

where E, F and G were quantities of energy and A′ and B′ represented the reactive forms of A and B. The reaction was exo- or endo-thermic according as $F+G-E$ was positive or negative. In any case a quantity of energy, E, must be supplied in order to start the reaction, and this might be done by means of (i) heat, (ii) light, or (iii) a material catalyst. The energy could only be supplied in "quanta," and if E were large only the use of a radiation of short wave-length made the number of quanta to be introduced sufficiently small to be practicable. For the conversion of a molecule of carbonic acid into formaldehyde and oxygen, 150,000 calories was necessary, and this could be supplied in a single quantum by radiation at wave-length 200 $\mu\mu$. Carbonic acid had an absorption band at this frequency, and formaldehyde ought therefore to be produced when a solution of carbon dioxide in water was exposed to ultraviolet light. This had now been shown to take place.

In order to bring about the reaction by means of *visible* light, it was necessary to have present a coloured substance with basic properties, and Malachite Green had been found to fulfil the conditions. There seemed little doubt that the formation of formaldehyde in the leaf proceeded as follows:—

(i) [Chll.A+H_2CO_3]+light → [Chll.B+CH_2O].
(ii) [Chll.B+Carotin → Chll.A+Xanthophyll.
(iii) Xanthophyll+light → Carotin+Oxygen.

The photosynthesised formaldehyde was extraordinarily reactive and was best represented by the formula CHOH. It polymerised rapidly to a mixture of carbohydrates, in which were found hexoses, and evidence was not wanting in favour of the formation of more complex substances. In the presence of nitrite it was converted into formhydroxamic acid, and hence into amino-acids and a mixture of cyclic bases in which piperidine, pyridine, coniine and glyoxaline had been detected. The active (energised) forms of the amino-acids condensed with the cyclic bases to give substituted amino-acids, and these were the immediate source of proteins.

Mr. G. E. Briggs described some experiments to determine the relation between the radiant energy absorbed and the carbon dioxide assimilated by the green leaf (*Phaseolus vulgaris*) in different parts of the visible spectrum. For three different parts of the spectrum the carbon dioxide assimilated was measured, and the energy absorbed by chlorophyll *a* and chlorophyll *b* was estimated from data obtained, due allowance being made for the energy diffusely reflected by the leaf. The results were of the following order:—For the yellow-red (570—640 $\mu\mu$) 15 calories per c.c. of carbon dioxide; for the green (510—560 $\mu\mu$) 7; and for the blue (430—510 $\mu\mu$) 22+, these being maximal values. Since the heat of formation of the most probable products of assimilation ranged from 5 to 6 and more calories per c.c. of carbon dioxide it was probable that both chlorophyll *a* and chlorophyll *b* took part in the photochemical reaction.

Referring to Prof. Baly's suggestions as to the part played by the different pigments in the photosynthetic process, Mr. Briggs said that as the quantity of each pigment underwent relatively little change during prolonged assimilation, no energy was supplied from that source; and, further, that since as much oxygen was evolved as carbon dioxide was absorbed in the red and the green parts of the spectrum (regions where no energy was absorbed by the xanthophyll) as well as in the blue, it was not necessary to postulate a photochemical reaction involving xanthophyll in order that oxygen might be liberated.

Prof. I. M. Heilbron and Mr. C. Hollins put forward some speculations on phytosynthesis. The large number of plant products in which the predominant carbon nucleus was C_5 or a multiple of it suggested that this unit had a special significance. The photosynthesised reactive hexose might be supposed, in addition to its further condensation to sugars, cellulose, glucosides, etc., to furnish by dehydration ω-hydroxymethylfurfural. This by oxidation and decarboxylation could give a stabilised C_5-compound, which, either as the furan derivative or (by opening of the ring) as dihydroxyglutaconic dialdehyde, might be a source of pentoses and of their condensation products. Simple schemes were suggested to show how two, or three, molecules of a "pentose" could give rise, by ordinary condensation reactions, to anthocyans (C_{15}), terpenes (C_5, C_{10}, C_{15}, etc.), coniferyl alcohol (C_9) and the numerous related compounds (including lignin), coniine (C_8) and the phonopyrrole-carboxylic acids (C_8, etc.). The degradation of hexose into "pentose" represented the respiration of the plant. Against the suggestion of Robinson (British Association, 1921) that anthocyans resulted from the condensation of two hexose and one triose molecules were to be set the absence of nonoses in nature and the failure of all attempts to obtain benzene derivatives from hexoses.

Prof. R. Robinson thought that the accumulation of active formaldehyde and formhydroxamic acid scarcely accounted for the almost inexhaustible variety of plant products. The alkaloids were probably produced from hexoses rather than built up atom by atom from formaldehyde. He was unable to accept the suggestions of Prof. Heilbron and Mr. Hollins as to the significance of the C_5-unit. Practically all the compounds in C_{5n} belonged to the terpene family and were derivable from isoprene. Apiose, the sugar corresponding to isoprene, was a simple condensation-product of dihydroxyacetone and glycollaldehyde. The anthocyans he preferred to consider as $C_6+C_3+C_6$ rather than $C_5+C_5+C_5$. Although nonoses had not been found in nature, Emil Fischer had obtained a nonose which was fermentable.

Dr. E. F. Armstrong emphasised the fact that cane-sugar was the first sugar formed in the plant. If hexoses were produced intermediately their existence was but transient.

Prof. Baly, in reply to the discussion, said that Mr. Briggs' experiments, though valuable, could not be interpreted quite so simply as was assumed. The relation between radiation absorbed and quantity of reaction resulting was very complex, and, indeed, in only one case so far (viz., the conversion of oxygen into ozone) was the Einstein theory satisfied. The measurement of photochemical efficiency was thus an abstruse problem and the experimental results were far from justifying Mr. Briggs' conclusions concerning the individual rôles of the leaf pigments.

NEWS FROM THE SECTIONS

MANCHESTER

The new session of the Manchester Section was inaugurated on October 6 by an address given by the President of the Society, Dr. E. F. Armstrong, on "Practice and Theory in an Industrial Problem." Dr. E. F. Ardern, chairman of the Section, presided over a large attendance. An abstract of Dr. Armstrong's remarks is given below.

The main object of my remarks is to illustrate to you the extreme breadth of chemical problems, and the necessity for breadth both in the training and in the mind of the chemist if he is to succeed in his profession. The illustration I have chosen is that of the hydrogenation of fats. The difficulties encountered by Sabatier, Normann and other early workers in this field demonstrate the hundreds of ways in which the chemist has to exercise his ingenuity; how he has to be master of all trades, and how considerations of all kinds, in addition to those of the text-book equations, enter into his daily life. Twenty or twenty-five years ago nobody knew how to make pure hydrogen in quantity and cheaply. Therefore the would-be hardener of fats had to find out how to make hydrogen. Electrolytic hydrogen naturally appeared attractive, but the costs of the plant, the prime costs, and the lack of any outlet for the oxygen ruled it out of court. Alternative fancy methods, *e.g.*, the action of acids on iron, also broke down on the grounds of cost; and the only method which to the manufacturer seemed to promise success was that of removing carbon monoxide from water gas. Now, even the manufacture of water gas in those days was in a very crude state. You could buy producers, but the life, the cost of repairs, and so on, left much to be desired. Therefore the would-be carrier-out of the chemical process found, in the first place, that his energies were dragged right back to what was almost a gas-engineering, at any rate a chemical-engineering, problem of his producer plant. The many and great difficulties connected with this problem were originally solved, more or less empirically, by hard work, the chemist on the spot making practical, careful trials, and keeping data added by the engineer. In later days the physical chemist has come to our assistance, and by a proper use of thermodynamics, etc. has done much to enable the ideal conditions of the laboratory to be foretold before they were applied to the plant. But in the main such work, valuable as it is, merely served to confirm the results which were arrived at empirically by the hard-working men on the spot. The next problem was the very important one of the cost of the hydrogen. It is worth while stopping to analyse the items which enter into that cost. There is, first of all, the actual running costs of the plant, the cost of the iron ore, the cost of labour, the cost of the heat to generate the producer gas, and so on. Then there are the repair costs, and the capital costs, interest, depreciation, rating, and so on. It is no use neglecting, in practice, any one of these costs, and every new method has to be criticised from these points of view. You may have a perfectly ideal process which will break down entirely because the plant has to be renewed once a month. We had the misfortune during the war to work a process in which the plant, otherwise ideal, had to be renewed once a fortnight; this difficulty was fatal. The electrolytic process of making hydrogen suffers from a high capital cost, unless it is carried out in a country with unlimited cheap water-power. Running costs are of considerable importance sometimes, but they alone are never determinative.

To turn now to the problems presented by the oil and the catalyst. Before fat-hardening was introduced the unsaturated oils were worth very much less than the saturated oils, and one could afford to spend quite a lot of money in hardening them and still make a lot of money from the hardening process. To-day, through some vagary of the world's markets, the unsaturated oils are worth so much in comparison with the saturated ones that in hardly a single case can one afford to spend even half the money necessary for hardening. The process is out of action through the vagaries of the market. The wise man at the head of a company will have to take a long view of past and future markets before he decides to indulge in the capital expenditure necessary to put up a plant of this sort, so that directly we are up against the cost of the oil the chemist has to turn himself into an economist, or associate himself with the economist, and think of his problem from that point of view. Of course, the actual production of the oil is outside our range, although it should be within it; because it is very much better for us to receive a carefully made, relatively clean oil, and to deal with that, than it is for us to receive a carelessly made, dirty oil, and try to put right a harm which has been done. So really the chemist's care ought to go right back to the original production of the oil and not to come in when the oil is delivered to him. In the works the oil has to be cleaned to the maximum extent possible.

Then there remains the catalyst. Here the training of the chemist comes into play, and it is to get the catalyst in a suitable state that his skill is required. The early writers on this subject, much of the patent literature, and such technical papers as there are, of course, bring in higher mathematics and every form of modern high-class chemistry, but I think it is very much better for the practical man to approach it from the other end, that of simplicity. The active nickel surface is obtained by saturating kieselguhr with the nickel salt, precipitating with alkali, washing, and reducing the oxide to the metal. It is very simply said, but it is difficult to choose conditions which do not harm that very delicate surface. No theories are required in preserving that surface. First of all, one must use salts that can be easily washed away, nitrates rather than sulphates, for if they are not washed away they can be burnt away. The catalyst must not be overheated, because the globules of metal soften and begin to coalesce far below the melting-point. The actual problem of heating the active catalyst is purely a common-sense one which requires a great deal of thought and care. Although it sounds very easy to describe in a few words, the solution took a great many years of research to find. Then we have catalyst poisons. There is a wonderful literature based on catalyst poisons and a very wonderful jargon. It all amounts to this, that if you have anything which spoils the surface, you obviously reduce the activity of the catalyst. There is no mystery about it, it is obvious simple fact, but it has been wrapped up in a great deal of mystery. The next stage is to bring together the cleaned oil, the purified hydrogen, and the clean catalyst under suitable conditions. We must have chemical control in order to be able to stop at any particular point. The reaction takes place quite fast, and a good many tons of material are worked up at a time. You cannot see when the oil has attained a certain hardness, so you have to take it out and test. The determination of hardening-value takes some time; the determination of the melting-point takes a long time; the determination of the refractive index is the only quick method, and the melting-point may be deduced from the refractive index by means of a correlative curve.

Fats, I might say, are sold, as they always have been, on a titre. The titre has nothing whatever to do with the hardening number or the refractive index of any fat, so the unfortunate fat-hardener is never quite certain he is going to stop at the right titre. If he tries to get over this difficulty by mixing A tons of one titre a little above the mark with B tons of another titre below the mark he does not get the titre he hopes to arrive at. So the chemist has to set up a lot of very elaborate controls in order to comply with an utterly irrational selling-method based upon an archaic custom of the tallow trade. You would think these salesmen and buyers would listen to the chemist; but no, that difficulty is the only one which he is not able to solve. I quote you this, in all earnestness, as typical of British practice, and I think everyone will endorse our feeling that this is an example of some of the real difficulties with which the British nation has to contend.

Having briefly sketched the practice, I will now say a little about the theory of this reaction, because it also brings in every branch of chemical affairs. There are at least two theories to explain why a reduction takes place. One theory is that adsorption of hydrogen occurs at the surface of the nickel. I do not know what adsorption means, but in some mysterious way it is supposed to provide the active hydrogen which brings about saturation. The other theory is that combination between nickel and oleic acid is brought about through partial valencies and that then the unstable complex breaks down. We have a beautiful experimental proof of the formation of such a complex, and the investigations of Rayleigh, Hardy, Adam, and Langmuir, all tend to support the additive-compound theory.

It is hardly necessary to say that such work as I have been describing is the result of team work. Team work is only possible where there is loyalty, self-sacrifice, and good feeling, and I am quite certain that British industry needs work of this kind. My experience, limited as it is, has left me with a feeling that the very training we chemists get, the analytical training, *i.e.*, the training of suspicion, has made us much less ready to mix together, much more critical of our fellow chemists, than is desirable in the best interests of the profession. I think the greatest good this Society has been doing, is doing, and can do, is to keep on bringing us together to discuss problems in the most friendly way possible, so that members may learn what is both in and at the back of one another's minds.

MEETINGS OF OTHER SOCIETIES

THE IRON AND STEEL INSTITUTE

The autumn meeting was held last month in York under the presidency of Mr. Francis Samuelson. In a paper on the bases of modern blast-furnace practice, Mr. A. K. Reese defined the object to be sought as the attainment of the greatest possible quantity consistent with quality, a statement demurred to by Prof. H. Louis, who maintained that the aim should be the greatest possible economy consistent with quality; economy and quantity were not always associated. The paper was very comprehensive, treating the subject from four aspects: (1) preparation of materials, (2) furnace design, (3) auxiliary equipment, and (4) method of operation. Under (1) the author emphasised the need of perfect uniformity in the size and density of the materials charged; under (2) that the output capacity of a blast furnace is proportional to its effective bosh area; and under (3) the importance of rough-cleaned gas and regularity in the volume of its admission.

Mr. C. W. H. Holmes described an investigation of the factors influencing the grain and bond in moulding sands, the factors being the various processes to which such sands are subjected, and the properties investigated being the strength of the bond and the ratio of the mechanical grades of sand. Mr. L. E. Benson related how he had nitrogenised specimens of "armco" iron and steels by annealing them at 500° C. in a salt bath containing 17 parts of sodium nitrate to 3 of potassium chloride, the rate of absorption of nitrogen being about 0·02 mm.

per hour in the case of "armco" iron. In answer to criticism, he stated that there was no positive evidence that a nitride was formed.

The results of researches carried out in the laboratories of Vickers, Ltd. were described by Mr. J. H. S. Dickenson in his paper on the flow of steel at red heat and the scaling of heated steels, a subject of especial interest to makers of steel apparatus, such as that used in synthetic-ammonia production, which has to withstand high temperatures and pressures for long periods. The author has determined that temperature at which the rate of flow of a steel does not exceed a practically negligible amount when subjected to a uniform stress of 8·5 tons per sq. in. A graph was shown comparing the results of tests applied for periods varying from a few seconds to many weeks, and another which emphasised the very great influence of time in determining the maximum temperature at which a steel can support a given load, and therefore also the load which the steel can bear at any temperature.

In some practical notes on the manufacture of high-speed steel in the basic-lined electric furnace, Mr. H. K. Ogilvie stated that at Coventry the use of ferro-tungsten was preferred to that of tungsten powder, and that the use of high-speed turnings as raw material for the furnace was found to be uneconomical. Other papers presented were:—"On the Diminution of Lag at Ar1 through Deformation": J. H. Whiteley; "Changes in the Volume of Steels during Heat Treatment: (1) Air Hardening Nickel-Chromium Steels": L. H. Aitchison and G. R. Woodvine; "Magnetic Properties of Heat-treated Carbon Steels": E. D. Campbell and E. R. Johnson; and "A Brinell Machine Attachment": E. D. Campbell.

At the annual meeting to be held in London, in May, 1923, a resolution will be submitted to alter the period of office of presidents from two years to one year.

THE INSTITUTE OF METALS

Swansea, the metallurgical centre of the South-West, offered its hospitality to the members of the Institute on the occasion of its autumn meeting (Sept. 20–22), and those who took advantage of it must have been impressed by the evident desire of the local people to foster the *entente cordiale* which is springing up between the scientific and the practical pursuers of the art of metallurgy. This desire is clearly shown by the efforts which have been, and are being, made to develop the new University College on sound and broad foundations. The excellent laboratories that are being erected and equipped in Singleton Park—the gift of the Municipality—under the direction of Prof. C. A. Edwards (metallurgy), Prof. J. E. Coates (chemistry) and others: the many scholarships that are being offered to students: and the close *liaison* that is developing between the academic staff and the manufacturers—all point to the thoroughness with which the ground is being prepared and to the plentiful harvest that will surely follow. The Institute of Metals has its eye upon Swansea, and intends to form a local section there as soon as possible. The following papers were presented to the meeting:—

The Sixth Report to the Corrosion Research Committee of the Institute of Metals on "The Nature of Corrosive Action and the Function of Colloids in Corrosion": G. D. Bengough and J. N. Stuart. The report attempts to present a general review of corrosion phenomena based on the study of several different metals, and to examine how far the electrochemical theory of corrosion can interpret those phenomena. The difficulties encountered by this theory are indicated, and it is shown that it gives a satisfactory account of the facts only under certain conditions: many facts can only be explained by recognising the important part played by colloids in corrosion. A theory of the mechanism of colloid action is put forward and some experimental results are reviewed in the light of this theory. On the electrochemical theory the action of oxygen is that of a depolariser; it can be shown that atmospheric oxygen has very little depolarising power at ordinary temperatures. Two chief types of corrosion are distinguished: (1) the general type, usually characteristic of acid corrosion, and (2) the local type, usually characteristic of corrosion in water and salt solutions. The second type is generally characterised by the formation of an adherent scale on the metal, and this scale may contain colloid.

A short Note on the Effect of Superheated Steam on Non-Ferrous Metals used in Locomotives: Sir Henry Fowler. This paper discusses the compositions of the various alloys used for the bushes in which piston tail rods slide, for piston-rod packing, and valve-spindle packings. After various experiments it was found that a phosphor-bronze (Cu 88, Sn 11, and P 1 per cent.) was most satisfactory. The composition of the McNamee rings was 70 per cent. lead, 30 per cent. antimony; this alloy gave complete satisfaction so long as the working temperature was kept below 340° C. A critical point was apparent about that temperature and the rings were liable to fuse. For by-pass valves a complex nickel-brass alloy gave successful results, but owing to the cost was replaced by castings of malleable iron or steel.

White Metals: A. H. Mundey, C. C. Bissett, J. Cartland. The principal classes of white metals are reviewed, together with their composition and physical properties, chiefly in relation to their manufacture and uses.

The Effects of Overheating and Remelting on Aluminium: W. Rosenhain and J. D. Grogan. The work described was undertaken to ascertain whether certain forms of treatment in the melting and remelting of aluminium would cause deterioration approximating to the condition generally described as "burnt" aluminium. High melting and casting temperatures, and even prolonged heating at a high temperature, gave no evidence of any serious deterioration in the quality of the metal. Repeated rolling and remelting were also without appreciable effect.

The Constitution and Age-Hardening of Alloys of Aluminium with Copper, Magnesium and Silicon in the Solid State: Marie L. V. Gayler. The quaternary system of alloys containing aluminium, copper, magnesium and silicon has been regarded as the ternary system aluminium-copper-magnesium silicide, since magnesium and silicon were added in the proportions of the compound magnesium silicide. The solubilities of copper and magnesium silicide in solid aluminium were determined at 500° C. and 250° C. Alloys of various compositions were quenched from 500° C. and allowed to age-harden at room temperature. The results showed that the age-hardening of these alloys is due to the difference in solubility at high and low temperatures of both copper and magnesium silicide. Derived differential curves of alloys which had been quenched but not aged showed three critical points. The highest critical point is suggested to be due to the precipitation of the copper compound, and the next to that of magnesium silicide.

First Report to the Aluminium Corrosion Research Sub-Committee of the Corrosion Research Committee of the Institute of Metals on Experiments on the Oxide Method of Determining Aluminium: J. E. Clenell. The drawbacks of the method for determining aluminium as oxide are discussed and improvements are suggested. Of the various methods examined, that in which thiosulphates are used for precipitation gives, on the whole, the best results. By working according to the standard method described, a practically complete precipitation of aluminium is obtained.

The Copper-rich Aluminium-Copper Alloys: D. Stockdale. An attempt has been made to settle some of the doubtful points concerning copper-rich alloys. Two general methods of fixing the various points were used, viz., the taking of cooling curves and the micro-examination of quenched specimens. The results showed that, contrary to Curry's statement, small quantities of aluminium do not raise the freezing-point of copper. The liquidus presents a minimum at 8·3 per cent. aluminium and shows a maximum at about 12·5 per cent., though the alloys in this neighbourhood all freeze at about the same temperature, 1047° C. The solidus shows the existence of eutectic over a range of alloys containing 7·5, 8, and 8·5 per cent. aluminium; alloys with 10 to 14 per cent. aluminium exhibit cooling curves typical of pure metals. At 16·5 per cent. a second eutectic makes its appearance, whilst the 18 per cent. alloy freezes like a pure metal. The positions of the lines bounding the phase fields formed by the constituents α, β, γ have been carefully determined, and the existence of the γ phase and transformation of the γ to δ phase have been confirmed. The temperature of the eutectoid transformation, determined by quenching experiments, is near 537° C.

The Cleaning of Aluminium Utensils: R. Seligman. In the absence of the author this paper was taken as read. It dealt in general with the cause of corrosion of aluminium utensils and showed that the presence of sodium silicate prevented the corrosive action of the soda. Certain cleansers sold under trade names were recommended.

New Forms of Apparatus for Determining the Linear Shrinkage and for Bottom-pouring of Cast Metals and Alloys, accompanied by data on the Shrinkage and Hardness of Cast Copper-Zinc Alloys: F. Johnson and W. G. Jones; The Hardness of the Brasses and some Experiments on its Measurement by means of a Strainless Indentation: F. W. Harris. These two papers were taken together. The apparatus was designed to be sufficiently simple and robust in operation for use in industrial work. The motion of a shrinking test-bar is conveyed through two steel arms, gripped rigidly by the cast bar, to a micrometer, the head of which is attached to one arm and the anvil to the other. Results of hardness tests on chill cast and annealed bars in both papers are in common agreement, and show an elusive maximum. The hardness curve of sand-cast bars, as shown in Harris's paper, does not give a definite maximum hardness. The author shows that the "absolute" hardness number of a metal is given by strainless indentations. These are obtained by repeated annealings of the metal to remove the strain round the impression and the replacing of the ball in the original indentation and again applying the load. This is repeated until the point is reached when the indentation is of sufficient superficial area to enable the metal to support the load by virtue of its own intrinsic resistance to distortion.

The Structure of Eutectics: F. L. Brady. It is shown that each eutectic grain consists of an inner portion, fine in grade and of uniform fineness, and a boundary of varying thickness, the grade of which is much coarser and of different arrangement. Two possible causes of this structure are discussed. The forms of eutectics may be divided into classes according to certain physical properties of the components; the division proposed shows the considerable connexion that exists between the physical properties, especially surface tension and the structure.

The Antimony-Bismuth System: Maurice Cook. The equilibrium diagram of the antimony-bismuth alloys is shown to consist of an unbroken liquidus curve, whilst the solidus is horizontal up to 60 per cent. antimony. The microstructures of slowly-cooled and quickly-cooled alloys reveal an apparent duplex structure which can be rendered homogeneous with sufficiently long annealing. The results lead to the conclusion that an isomorphous series of alloys is formed.

Note on the Cause of Red Stains on Silver-plated Work: A. Jefferson. The author discusses the possible origin of the red stains sometimes observed on articles electroplated with silver. Hypotheses regarding the origin of these stains were put to the test; ultimately, it was found that the application of rouge was responsible for the red stain; insufficient material at hand, however, prevented the matter being further examined.

Intermetallic Actions. The system Thallium-Arsenic: Q. A. Mansuri. In this paper the author claims to establish the facts that thallium and arsenic alloy in all proportions but do not form any solid solutions. An eutectic is formed at 215° C. between thallium and arsenic, and forms the solidus. The liquidus consists of the primary separations of thallium and arsenic, broken by a gap showing the presence of two layers of liquid.

INSTITUTION OF CHEMICAL ENGINEERS

At the thirteenth meeting of the Provisional Committee, held on September 20, the solicitors announced the receipt from the Board of Trade of a letter stating that the application for a licence to register the Institution under the provisions of Section 20 of the Companies' (Consolidation) Act, 1908, had now been entertained.

The secretary reported that over 180 applications for membership had been received, and that the names of those applicants which had passed the Selection Committee would be brought before the first Council as soon as formed.

The report of the sub-committee on the relations between the Chemical Engineering Group and the Institution of Chemical Engineers was considered and action was postponed until a later date. A vote of thanks was carried unanimously to the Registrar and Council of the Institute of Chemistry for their kind assistance in explaining fully their office organisation.

NEWS AND NOTES

UNITED STATES

The New Customs Tariff

The McCumber-Fordney Tariff Bill was signed by President Harding on September 21 and came into operation on the following day. As passed, the Bill contained no embargo on dyestuffs, coal-tar and synthetic organic chemicals, and foreign potash is to be admitted free of duty. Provision is made for increasing the duties imposed if foreign competition is shown to be injurious to a home industry. In general the rates of duty are increased by 15—20 per cent., but those on certain chemicals, metals, etc. are much higher. The following are some of the rates fixed:—Coal-tar intermediates, 7 cents per lb. *plus* 55 per cent. *ad valorem*; coal-tar dyes, 7 cts. *plus* 60% *ad val.* based on the American valuation; citric acid, 17 cts. per lb.; essential oils, animal oils and greases, ethers and esters, 20 cts. per lb. *plus* 25% *ad val.* The free list includes ores of tin, cobalt and copper, various crude drugs, fertilisers, potassium chloride and crude potash salts, thorium ores, sodium nitrate, sulphur, turpentine, rosin and wax, etc.

Peace-time Uses of War Chemicals

The United States Chemical Warfare Service has recently discovered that the use of hydrogen cyanide as a fumigant can be replaced by that of cyanogen chloride, which is a powerful lachrymatory when used at only one-tenth of the lethal concentration. Encouraging results are also being obtained in experiments on the admixture of a "sneezing" gas with illuminating gas as a means of detecting an escape of the latter, the sternutatory being destroyed when the gas is burned. Progress continues to be made in the use of poisonous gases against insect and rodent pests, notable work having been done recently in combating locusts in the Philippines; and attempts are being pursued to find a gas for destroying the cotton boll-weevil. Very successful experiments have been made by the Louisiana Department of Agriculture in spraying powdered calcium arsenate on cottonfields by means of the air blast from the propeller of an aeroplane; in this way it was found possible to treat 20 acres of cotton per hour much more thoroughly than by means of apparatus worked on the ground, and to reduce by one-half the amount of material needed.—(*Chem. and Met. Eng., Sept.* 13, 1922.)

Anthrax in the Tanning Industry

An analysis of 123 cases of anthrax occurring in the tanning industry of Pennsylvania during the twelve years from 1910 to 1921 showed that the number of cases represented roughly 12 per cent. of the employees directly exposed to infection, *i.e.*, those handling, soaking and liming raw stock. The mortality among these 123 cases was over 21 per cent. Accurate statistics for a five-year period revealed a yearly morbidity rate of nearly 2 per cent. From a study of the sources of infection it is concluded that certification (that imported hides are from districts free from anthrax) offers little if any protection to the tanner. It is therefore suggested that all undisinfected imported stock should be treated at central governmental disinfecting stations before dispatch to the tanners. Experience has shown that the best treatment consists in the continuous, intensive use of anti-anthrax serum, applied subcutaneously or intravenously, combined with excision of the local lesion and injection of a concentrated solution of phenol (25 to 50 per cent.) around the wound. Early diagnosis, prompt treatment and rest are essential for successful treatment. —(*J. Ind. Hygiene, June,* 1922.)

Census of the Dye and Coal-tar Products Industry

The U.S. Tariff Commission has issued a preliminary summary of the census of dye and coal-tar chemicals for 1921, based on the output of 200 firms that manufacture coal-tar products. Adequate supplies of coal-tar during the year were ensured by the increased production of by-product coke, which corresponded with a smaller output from beehive ovens. The statistical information given includes that set out below in tabular form.

Coal-tar products	No. of makers	Output lb.	Inc.(+) or Dec.(—) per cent.	Sales. lb.	Value of Sales. $
Intermediates (232)	107	70,899,912	— 73	33,637,326	8,483,463
Coal-tar dyes ..	74	39,008,690	— 56	47,513,762	39,283,956
Colour lakes ..	43	6,152,187	— 44	6,424,612	2,863,189
Medicinals ..	34	1,545,917	— 68	1,876,246	2,930,324
Flavours ..	17	901,245	+440	933,662	1,002,018
Perfumes ..	15	119,335	+ 20	119,691	175,815
Synthetic phenolic resins	3	1,643,796	— 65	1,674,456	1,352,166
Synthetic tanning materials	4	1,902,597	— 39	1,721,359	141,005
Research chemicals	—	2,012	+ 9	901	18,334
Photographic ,,	5	183,798	— 58	170,221	248,041

The production of dyes in 1921, grouped according to methods of application was as follows:—Acid dyes 7,751,698 lb. (19·87% of the total output); basic dyes 1,852,243 lb. (4·75%); direct cotton dyes 6,787,634 lb. (17·4%); sulphur dyes 10,239,255 lb. (26·25%); vat dyes (including 6,673,968 lb. of indigo) 7,019,120 lb. (17·99%); mordant and chrome colours 3,773,438 lb. (9·67%); lake and spirit-soluble dyes 697,444 lb. (1·79%); unclassified dyes 887,858 lb. (2·28%).

Cadmium in 1921

The production of cadmium in the United States began in 1906 with a small output by the Grasselli Chemical Co., and afterwards increased steadily, reaching a maximum in 1917. In 1921 production of cadmium metal declined to 65,101 lb., valued at $63,799, but that of cadmium sulphide attained the record of 65,446 lb., valued at $71,336. Electroplating with cadmium by the udylite process (*cf.* J., 1921, 628 A) was in use by 18 firms late in 1921 and contracts were made for installations in 9 other plants.—(*U.S. Geol. Surv., Apr.* 10, 1922.)

CANADA

Industrial Notes

The establishment of American branch factories in Canada continues this year to a greater extent than ever. The Anaconda-American Brass, Ltd. has been incorporated in the Dominion with a capital of $1,000,000, with head office at New Toronto, Ontario. The Lion-Meade Tyre Co., capitalised at $2,500,000, is building a factory at Wrightville, Hull, Quebec. A large factory for the production of asbestos goods, at Asbestos, Que., is being erected by the Johns-Manville Co., of New York; over $1,000,000 is being spent on the building and equipment, and the very extensive deposit of high-grade asbestos at Thetford Mines has been acquired. Among other American industries that have recently set foot on Canadian soil are cutlery manufacture, at Hamilton and Welland, electric bulbs at Oshawa, automobile plants at Sarnia and Windsor, silk mills at Cowansville, silk-dyeing and finishing at Drummondville, and textile-dyeing at St. Johns. The number of new industries initiated at Hamilton, Ont., during this year is 13, as compared with 24 for the whole of last year.

It is announced that Bryant and May, Ltd. has acquired the majority of the stock and controlling interest in the Canadian plant of Maguire, Paterson and Palmer (Can.), Ltd. at Pembroke, Ont., and the establishment will be under the same general management as the Canadian Match Co.

Projected Nitrogen-Fixation Plant

The Electro-Chemical Company of Canada intends to erect a plant for the fixation of atmospheric nitrogen at Queenstown, Ont., within a few yards of the power-house of Chippeawa Canal, on the Niagara River. The process employed will be that covered by the patents of J. S. Island. The company proposes to start with a plant of 3000 kw. which, it is said, when running at capacity, will have a potential output of 3174 tons of nitric acid (commercial 64 per cent.) annually. Experimental plants have been in operation at Brantford and Niagara Falls, Ont. Calcium nitrate will be the chief product.

Mining and Metallurgy

British Columbia.—Large deposits of kaolin have been found in the Cariboo District, south of Williams Lake and about half a mile from the Pacific Great Eastern Railway.

The Granby Consolidated Mining, Smelting and Power Co. is producing copper at 9·7 cents per pound. This is the lowest cost in the history of the company and compares with 11·63 cts. in 1921 and 15·94 cts. in 1920. It is hoped to reduce the cost still further after the new hydro-electric installation has been completed.

The spelter trade of British Columbia is very active, and large shipments are being made to the Orient and Europe. All the stock of lead and spelter which had accumulated after the war, owing to price conditions and irregular exchanges, has been cleaned up. A year ago Japan commenced extensive purchasing of spelter, which was followed by European buying, with the result that the demand for lead and zinc in foreign markets is almost exceeding the supply.

It is announced that legislation will be submitted during the next session of the British Columbian Legislature with a view to the establishment of iron and steel works. A company has been organised with a capital of $12,000,000, and, according to the announcement, the provincial government will unite with the Imperial and Canadian governments and guarantee, as its share, bonds not exceeding $4,000,000. The Coast Range Steel Co. has been incorporated with a capital of $15,000,000, and it is understood that representatives of the company have discussed the matter with the facilities committee of the Imperial Board of Trade and the British Columbian government. The proposed plant will have a production of about 120,000 tons finished steel per annum.

Northern Ontario.—Rich silver ore has been found on the property of the Wigwam Silver Mines, at Wigwam Lake, in the Gowganda district. The company is controlled by Montreal interests.

The magnitude of the development of the gold mines of Northern Ontario is attracting world-wide interest, resulting in efforts being made by well-known mining capitalists to obtain control of developed properties. It is reported that the Teck-Hughes mine will pass into the control of the Consolidated Goldfields of South Africa. Interests associated with the International Nickel Co. are also reported to be endeavouring to secure some properties. The Kirkland Lake Mining Co. has struck rich gold ore on its property. The mine adjoins the Teck-Hughes, and the main shaft is down 1000 feet. Important strikes are reported from the Holtyrex district, north-east of McIntyre and Hollinger. The value of the ore was $9·60 per ton.

Alberta.—A large consignment of McMurray tar-sand has been shipped to Swansea, Wales, for extraction of bitumen at an experimental plant. Several small-scale plants have been built and operated in Alberta for the treatment of these bituminous sands, but, so far, no authentic figures have been given of yields and approximate costs.

FRANCE

Industrial Notes

Chemical Industry.—The destruction by fire of Merck's factory at Darmstadt will affect the supply of fine chemicals in France. After the conclusion of hostilities the reappearance in the French market of Merck's products was received almost with a sigh of relief, so bad had the substitutes been found to be. This does not necessarily mean that French fine-chemical manufacturers cannot make products as good as those of Merck, but rather that they are too heavily handicapped by excessive manufacturing costs, for which the high prices of raw materials are responsible. To take one instance: the price of alcohol, a basic raw material, is always maintained at an exorbitant level.

The rumour that, in accordance with the Wiesbaden " agreement," a group of French dye-works is negotiating with German chemical firms for the supply of chemicals, is viewed with great concern by French chemical manufacturers, as such a policy would eventually lead to the closing down of their works.

The demand for ammonium sulphate and calcium cyanamide is very keen, but there are practically no inquiries for nitrate.

Metallurgy.- The demand for metallurgical products has slackened, although stocks, particularly of pig iron and semi-finished products, have been almost exhausted by orders from Great Britain and America. Prices, however, seem fairly stable. There is great activity among makers of iron and steel goods, especially agricultural machinery, but owing to foreign competition the production of machine tools is suffering severely. The announcement that a metallurgical trust, under the control of Herr Stinnes, was being formed between firms in Lorraine and Germany, came as a great surprise. As the French metallurgical firms find difficulty in obtaining adequate supplies of coke and the German firms are confronted with short supplies of iron ore, it seems natural that efforts should be made to arrive at some kind of industrial " understanding "—not to use the word " trust," for so far the problem has been considered without any idea of an *entente*. At present the French are investigating means of producing a good metallurgical coke to replace Ruhr coke, and the Germans have started to make plant for producing pig iron, now imported from France. Under the projected agreement, (1) the Germans would not need to build such plant; (2) the Ruhr would furnish the Lorraine works with a steady supply of coke, after "reparation" coke had been delivered; (3) the Hagondage, Knutange and Rombas works in Lorraine would supply the German metallurgical industry with semi-finished products; and (4) German capital would be represented to the extent of 25 per cent. of the capital of the Lorraine companies. The Lorraine firms mentioned deny that they have come to any agreement with the German firms, but the general impression is that strong influences on both sides are working to discover some common ground on which to base an understanding. The idea of German financial intervention is, of course, out of the question.

GERMANY

German Dyestuffs for the United States

After consultation with the Allied Powers, Germany has agreed to deliver to the United States dyestuffs to the value of $256,000,000 on account of the cost of the American Army of Occupation in Germany.—(*Ind.- u. Handels-Z., Sept.* 30, 1922.)

Discovery of Iron Ore

At the general meeting of the German Geological Society, held recently in Breslau, Herr Krusch, of Berlin, reported that a new iron ore worth exploiting, called "white iron ore" and consisting of nearly pure iron carbonate, had been found in bands of 2 metres in thickness in the low-lying moorlands of North Germany.

The Fire at Merck's Factory

The fire which broke out on September 15 in the establishment of E. Merck in Darmstadt was confined to the store-rooms and was soon brought under control. The factory itself did not suffer. No explanation is forthcoming as to the origin of the outbreak, but the loss incurred is covered by insurance. —(*Chem. Ind., Sept.* 15, 1922.)

Agreement Among German Glassmakers

According to the *Berliner Tageblatt*, the Union of German Factories for Glass Instruments in Ilmenau, and the Union of Thermometer and Glass Instrument Factories in Roda, have formed a community of interests ("IG"), and it has been agreed that glass tubes made by the firms of Schott (Jena), Fischer (Ilmenau), and Greiner and Fredrich (Stutzerbach) shall be sold only to members of the two Unions.—(*Bd. of Trade J., Sept.* 28, 1922.)

Dutch Clinker

In many Dutch and German streets, particularly the former, a beautiful bluish clinker is used for street-paving. Little is known of the nature and origin of this material, but usually it is the so-called Dutch clinker which, by the use of suitable raw material and fuel, is obtained after long baking in the form of very durable bricks. According to P. Thor (Tonindustrie-Zeitung) these are still made mainly in simple clamp-kilns, though ring-kilns with a temporary reducing atmosphere have been successfully introduced in northern Holland. The best fuel is a cut peat of medium calorific value and the firing period lasts from 15 to 20 days, according to the size of the kiln.

The New Börner Airship

In the issue of *Kraft und Stoff* for August 19, S. Hartmann describes the Börner airship, in which an external envelope of nitrogen is used to protect the mixture of coal gas and hydrogen contained in the balloon. Duraluminium is used in the construction of the vessel which, filled with 300,000 cb.m. of gas, could carry a useful load of 90 to 100 metric tons on a continuous voyage of 5000 to 6000 km., and could travel to New York in 48 (?) hours. —(*Chem.-Z., Sept.* 9, 1922.)

Rapid Evaluation of Motor Fuels

The Chemische Fabrik A.-G. has placed on the market a simple apparatus for rapidly estimating the value of a motor fuel. The method is based upon the work of the late Karl Dietrich, and utilises the comparative insolubility of purified "dragon's-blood" resin in benzine and paraffin hydrocarbons, and its solubility in benzol, alcohol, and halogen derivatives of the paraffins. The procedure consists of shaking a piece of "dragon's-blood" test-paper with a sample of the liquid fuel in a glass vessel; benzine remains colourless, but benzol and alcohol become dark red. The test is carried out more accurately by placing the end of a piece of filter paper in the liquid, which is coloured preferably with "dragon's-blood." The height of capillary ascent of the liquid and the characteristic zones of colour formed on the paper afford information concerning the composition of the fuel, and this may be confirmed by determining the refractive index of the fuel.

Mineral Production, 1913-20

The following statistics give a general view of the course of mineral production in Germany in the period 1913—1920. The ores for which output figures are given, in thousands of metric tons, are not only important as sources of metals but as raw materials of the chemical industry.

	1913	1917	1919	1920
Copper and arsenical ores :—				
Output of crude copper ore	947·8	960·1	616·8	576·2
Output of crude arsenic ore	25·8	39·1	26·1	38·4
Number of employees ..	13,292	15,122	12,196	10,849
Lead, silver and zinc ores :—				
Output	2,884·8	2,812·7	1,703·4	1,772·7[*]
Number of employees ..	21,282	18,223	17,047	18,018
Pyrites :—				
Output	268·6	803·7	381·4	436·3
Number of employees ..	821	1,920	1,604	1,821
Tungsten ore :—				
Output	15·8	106·8	20·6	1·4
Number of employees ..	148	613	370	69
Bauxite :—				
Output .. .. .. [†]	—	10·8	9·4	13·4
Number of employees ..	—	190	173	310
Tin, cobalt, nickel, bismuth and sulphate ores :—				
Output	34·3	138·0	123·3	65·5
Number of employees ..	585	1,020	1,326	1,071

[*] In Upper Silesia the output of ore was 10,32,700 t.

[†] The output for 1913 is included in the production of tin, cobalt, etc. ores.

The very small output of tungsten ore in 1920 was due to the resumption of importation, imports being six times as great as in 1913; and the reduced output of ores of tin, cobalt, etc. was the result of foreign competition. Of all the ores mentioned, zinc-ore production shows the largest decrease compared with that of 1913, viz., 54 per cent. Formerly the production of zinc metal was only 11 per cent. behind that of the United States, much imported ore being smelted; but in 1920 there was an excess of 2247 t. of exported over imported ores, and the production of metal fell to 77 per cent. below that of the United States. The partition of Upper

Silesia has entailed the loss of 66·1 per cent. of the output of zinc ore and 60·2 per cent. of the production of metal.

BRITISH INDIA

First Forecast of the Sesamum Crop

This official forecast includes, for the first time, the crop under sesamum in Burma. The total area planted to this crop in British India, exclusive of the United Provinces, is estimated to be 2,329,000 acres, which compares with 1,543,000 acres (excluding Burma) at the same time last year. Except in Bengal, the weather at sowing time was favourable and the present condition of the crop is good, although rain is wanted in certain areas.—(*Ind. Tr. J., Sept.*, 7, 1922.)

SOUTH AFRICA

Motor Fuel from Maize

The Diamond Motor Spirit Co., Ltd., has been formed in England, and will be registered shortly in South Africa, for the purpose of manufacturing industrial alcohol from maize. A site for the factory has been selected in East London, and the erection of buildings and plant will be begun at the end of the year. The total cost is estimated at £100,000, and the production is estimated at 8000 to 10,000 gallons of spirit per day. It is hoped to retail the spirit profitably at 1s. 6d. per gallon.—(*S. Afr. J. Ind., Aug.*, 1922.)

Nicotine Content of S. African Tobacco

In view of the proposal to establish a tobacco-extract factory in the Piet Retief district, Transvaal, the nicotine content of tobaccos from different localities in South Africa has been investigated under the direction of Dr. C. F. Juritz. It was concluded from the investigation that the air-dried leaves of the heavier tobaccos, such as those grown at Barberton, Piet Retief, and Potchefstroom, contain from 3 to 5 per cent. of nicotine, and the leaves of the lighter tobaccos not much above 2 per cent. and often less than 1 per cent. Leaves of the common wild tobacco (*N. glauca*) appear to contain much less than 1 per cent., but those of *N. rustica* have yielded 6 to 8 per cent. and even more of nicotine. The alkaloid occurs in all part of *N. rustica*, but mainly in the leaves, and mature plants show the highest content.—(*S. Afr. J. Ind., Aug.*, 1922.)

JAPAN

Rejection of the Dye Embargo

The Japanese Government has declined either to grant an embargo on imports of dyes or to increase the duty to protect the home dyestuffs industry. Japanese dye manufacturers asked for the duty to be increased from 35 to 70 per cent. *ad valorem* and for the imposition of import licences to cover the following colours made satisfactorily in Japan:—Rhodamine B, Methyl Violet, Bismarck Brown, Fast Red A, Malachite Green, Direct Black, Naphthol Brown, Cotton Violet, Sulphur Black, Sulphur Brown, Magenta, Orange A, and Congo Red. At present Japanese dyestuffs find a market only in adjacent countries and then only at very low prices. The home market is overstocked with German dyes, against which American, French, and Italian products are competing, and sales are limited by the depression in the textile industry. About one-half of the Japanese consumption of dyestuffs is imported, the total value of the requirements being roughly $15,000,000 per annum. Recently the value of imports from Germany and Italy has amounted to about $7,000,000 per annum, and from the United States to about $500,000.—(*Chem. and Met. Eng., Aug.* 9, 1922.)

GENERAL

Oil Technology at Birmingham University

It is officially announced that the chair of mining in Birmingham University has been subdivided into two professorial chairs. One professor will devote his time to coal and metal mining, and the other will be wholly engaged in the department of petroleum and oil engineering, for which large sums have recently been received from leaders in the industry. It is intended to build up an important school of oil engineering which, with the exception of the Imperial College of Science, London, will be the only one of its kind in the British Empire. Prof. R. R. Thompson, formerly Director of Lands and Mines in Trinidad, has been appointed to the chair of oil mining, and Mr. K. N. Moss to that of coal and metal mining.

Home-Grown Sugar

Working arrangements have been made for the future amalgamation of Home Grown Sugar, Ltd. and of the English Beet Sugar Corporation, Ltd., which owns the Kelham and Cantley beet-sugar factories, respectively. In accordance with these arrangements, the British Sugar Beet Growers' Society, Ltd. announces that, this year, the sugar-beet crops grown for Kelham will be worked at the Cantley factory. By working the crop, now grown on more than 8000 acres, in one factory, which will thus be able to work at full capacity, it is hoped to ascertain the lowest economic cost of production for future guidance. Proposals for improving and extending the Kelham factory for the same purpose are under consideration.

Dry Cooling of Coke

A correspondent to the *Times Trade Supplement* of September 9 outlines a new method of quenching coke which has been operated at the gasworks at Zürich. The glowing coke is placed in a closed tank through which a stream of non-inflammable gas is circulated by means of an electric fan; the gas may be flue gases or air from which the oxygen has been removed by previous contact with hot coke. The heat taken up by the gas is utilised in raising steam, and the gas is re-circulated through the tank until the temperature of the coke falls to about 500° F., at which the coke does not break into flame on exposure to air. The first year's working at Zürich showed that one ton of coke yielded an average of 886 lb. of steam at 57 lb. pressure, with feed water at 40° F., so that 1 lb. of coke yielded 450 B.Th.U. in the form of steam. Large quantities of heat and therefore of fuel may thus be saved; the coke produced is of better quality; and less labour is required because the plant is automatic. As the coke is discharged intermittently, a supply of steam has to be provided while the tanks are being refilled.

Peppermint Oil in China and Japan

China and Japan are the only countries in the Far East which produce peppermint oil in important quantities. In China the chief centre of production is Kwantung province, the oil is extracted at Canton, and about 2500 lb. per annum is exported, mainly to Hongkong. The plant is also grown in Kiangsi province, but very little oil is exported. In Japan, the largest centre of peppermint cultivation is Hokkaido, where over 20,000 acres are planted. The districts of Bizen, Bingo, Bitchie, Shitsuka and Okujoto are also large producers. The export from Japan in 1920 was 185·3 tons of peppermint oil, valued at 1,812,366 yen, and 221·5 t. of menthol, valued at 5,489,815 yen (yen = 2s. 0½d. at par). The United States is the chief consumer of Japanese menthol and peppermint. Japanese peppermint oil has an unusually large content of menthol; the dementholised oil has a disagreeable taste and odour and compares unfavourably with the product of other countries (*cf.* J., 1919, 404 R; 1921, 106 R).—(*Ch. of Comm. J.*, June 9, 1922.)

New Manganese Deposit in Hungary

The deposit of manganese ore recently discovered near Urkut lies on the southern spurs of the Bakony Forest, north of Balaton Lake. It will be developed partly by open and partly by underground workings. The initial plant is already being erected, so that the works will probably be in operation by the middle of 1923.

PERSONALIA

Dr. P. Uhlenhuth has been appointed director of the Institute for Experimental Therapy Emil von Behring in Marburg a/Lahn.

Dr. G. P. Teodorescu, of the University of Berlin, has been appointed professor of analytical chemistry in the Polytechnic, Bukarest.

Prof. A. Lottermoser has taken up his duties as director of the laboratory for colloid chemistry, recently established in the Technical *Hochschule*, Dresden.

The Hanbury Gold Medal of the Pharmaceutical Society has been awarded to Prof. E. Perrot, of the Faculty of Pharmacy in the University of Paris, for his researches in the natural history of drugs.

The Council of the Chemical Society has elected Prof. J. F. Thorpe to succeed Dr. M. O. Forster as hon. treasurer, and Dr. J. T. Hewitt to fill the vacancy so created in the list of vice-presidents.

Dr. F. B. Power, director of the biochemical department of the Bureau of Chemistry of the United States Department of Agriculture, has been awarded the Flückiger Medal of the Swiss Pharmaceutical Society.

* * *

Prof. F. T. Trouton, F.R.S., emeritus professor of physics in the University of London, died on September 21, aged 58 years.

Major-General J. Waterhouse, formerly Assistant Surveyor-General of India, died on September 28, aged 81. The deceased received the Progress Medal of the Royal Photographic Society in 1890 for his spectrographic investigations on the action of dyes on dry plates, and served as president of that Society from 1905 to 1907. In 1895 he was awarded the Voigtländer Medal of the Vienna Photographic Society.

REPORTS

REPORT OF THE GOVERNMENT CHEMIST UPON THE WORK OF THE GOVERNMENT LABORATORY FOR THE YEAR ENDING MARCH 31, 1922. *Pp.* 33. *London: H.M. Stationery Office*, 1922. *Price* 1*s.* 6*d.*

The total number of samples examined at the Central Laboratories in London and at the chemical stations in the provinces was 302,562, or 6113 less than during the previous year. Additional work has been imposed on the Department in connexion with the Safeguarding of Industries Act, the Dangerous Drugs Act, and the Dyestuffs (Import Regulation) Act. The report contains detailed statistics relative to the work done for various Government Departments, together with summarised results of some of the analyses made and observations upon matters of outstanding interest.

During the examination of dairy produce it was noted that the proportion of fat in different samples of cheese varied between 9·9 and 38·8 per cent., but no exception could be taken to this, as there are no regulations relating to the marking of unskimmed cheese. There were also large variations in the fat content of condensed milks owing to the adoption of different degrees of evaporation during manufacture.

Work connected with the analysis of waters is increasing because of the investigations being conducted upon the effect of drainage from tarred roads and of other types of pollution upon fish and fish food. Sea-waters are being examined in connexion with the oceanic research scheme of the Fisheries Departments, and efforts are being made to devise a more rapid method of determining the salinity that can be applied readily at sea.

The analyses of several fertilisers and feeding-stuffs were found to differ from the guarantees given upon invoices. One compound manure, sold without a guarantee, was found to contain only 2·6 per cent. of nitrogen and only such a proportion of phosphates and potash as would be found in ordinary soil. Cement, plaster, burnt wood, paper, string, glass and gypsum were found in materials purporting to be feeding-stuffs.

In connexion with the assessment of beer duty 29,642 samples were tested. There were only 702 samples of imported beer, as compared with nearly 10,000 in the year before the war. Arsenic in excess of the legal limits was found in 24 samples of brewing materials, 2 samples of malt and sugar, and 3 samples of beer and wort.

The question of the presence in chocolate of fat other than cocoa butter has continued to receive attention, and the method of determination previously described has given satisfactory results (*cf.* J., 1921, 372 R).

Fourteen samples of drugs were found to contravene the provisions of the Dangerous Drugs Act. Over 3000 samples were examined under the Safeguarding of Industries Act; in many cases the analysis was complicated, the nature of the examination required being frequently entirely different from that employed commercially.

The characteristics of denaturants and colouring substances for alcohol intended for industrial use have been specially investigated during the year. For the purpose of controlling the use of duty-free spirits many samples of denaturants, spirits, residues from stills, and manufactured articles were examined. Samples of imported and home-produced fusel oil were examined to ascertain whether they contained less than 15 per cent. of proof spirit or whether they were dutiable.

The variety of preparations containing sugar is so great that fixed rates of duty have been adopted for those regularly imported or exported, but there are many articles which have to be examined on each importation. Owing to the heavy duty on saccharin, search has to be made for it in all preparations in which there is any probability of its occurrence.

All consignments of tea imported are examined for purity; owing to the high prices ruling and to the dislocation of foreign markets numerous small shipments of doubtful quality have been made and have necessitated very extensive sampling. The packages condemned numbered 5035.

Many samples of tobacco were examined to determine the rate of duty and the contents of water and olive oil. Denaturants for tobacco, such as sulphur, asafoetida, sago flour, tar oil, carbolic and cresylic acids, moss litter, soda ash, borax, hellebore, cayenne, lampblack, and saltpetre, essential oils for flavouring purposes, and preservatives, were also examined.

The recovery of radium from one batch of luminous dials, gunsights, etc. was completed for the Disposal Board, over 300 mg. of radium bromide of 90 per cent. purity being obtained. In addition, 100 mg. of concentrated material suitable for immediate use was recovered.

The quantity of lead contained in the fumes evolved during the cutting of ships' plates by oxy-acetylene burners has been investigated (*cf.* Report on Factories and Workshops, J., 1922, 334 R). Specimens of dust from a plant used in bleaching flour were found to contain basic tin nitrate, the violent decomposition of which had been responsible for an explosion.

REPORT OF THE COMMITTEE OF THE PRIVY COUNCIL FOR SCIENTIFIC AND INDUSTRIAL RESEARCH, 1921—22. *Pp.* 123. *H.M. Stationery Office*, 1922. [*Cmd.* 1735.] *Price* 3*s.*

The economies effected recently in the Department of Scientific and Industrial Research have not interrupted good work already in hand, but have merely slowed down the programme of research. The total expenditure of the Department in 1921—22 was £525,584, and the net expenditure from public funds, exclusive of grants to research associations, was £333,552 (against £427,432 in 1920—21). Among the separate items were £190,024 (less receipts) for the National Physical Laboratory; £43,266 for the Fuel Research Station (less £1,883 from sales of by-products); £57,423 on the Geological Survey and Museum; £10,323 for the work of the Building Research Board; and £17,750 on the station for low-temperature research at Cambridge. Expenditure on grants in aid of scientific investigations conducted by other bodies amounted to £8287, and £47,005 was given in allowances to University research students (205), independent research workers (55), and to scientific workers (20) for the employ of laboratory assistants or the purchase of equipment.

Twenty-two of the 24 associations that have received licences are in active work and 3 new associations are likely to be formed shortly. Research associations, it is stated, cannot look for further grants from Parliament after the original fund of £1,000,000 has been exhausted. Reports are quoted from firms in the Portland cement industry as to the value of the work done by its association, and among other useful work accomplished is recorded the preparation by the British Scientific Instrument Association of a new polishing powder and a new abrasive for optical elements, the use of which saves much time and material. The association for the cotton industry has produced an instrument for recording the regularity of yarns, and that for the linen industry means of readily distinguishing flax and hemp fibres. In several instances research associations are engaging in co-operative work, and individual associations are undertaking fundamental scientific investigations.

Through the co-ordinating research boards Government departments are conducting their research work in closer co-operation, and there is a growing tendency to publish results. Under the Chemistry Co-ordinating Research Board researches on the partial oxidation of hydrocarbons have been carried out at the Royal Naval Cordite Factory where a semi-technical plant is being erected to obtain data on the possibility of manufacturing formaldehyde by this method; and under Dr. D. L. Chapman, of Oxford, results of much scientific interest have been obtained on the indirect production of methyl alcohol from methane *via* methyl chloride. The British Scientific Instrument Association has elaborated a method of producing zinc sulphide with a luminosity, in presence of radium, much greater than that obtained hitherto. Applications to the Board to conduct in Germany an inquiry into the causes of the explosion at Oppau were refused, but certain theories relating thereto are being investigated in the Government Laboratory and at Woolwich. Other work undertaken, or considered, bore on the improvement of accumulators and dry cells, the manufacture in this country of celluloid film for photography, and the corrosion of aluminium and its alloys. In the Oxygen Laboratory of the Air Ministry the question has been considered of replacing charcoal by non-inflammable substitutes as an adsorbent in the vacuous space of liquid-air containers, with the result that silica appears to be a good material for this purpose.

Physical properties of gases that are commonly stored and transported as liquids are being determined at the National Physical Laboratory for the Gas Cylinders Research Committee, which is also considering the use of alloy steels for making gas cylinders. Although fewer tests have been made at the National Physical Laboratory, more special researches have been conducted for research associations and private firms. The metrolog department has been busy; the engineering department is making investigations for the Lubricatio Research and other committees; the metallurgica department has published the results of researche on aluminium light alloys, and, in conjunction wit the Iron and Steel Institute, has prepare chemically standardised samples of steel.

The Fuel Research Board has studied the steaming of coal in vertical gas retorts, the national co resources, pulverised coal, peat, and domestic heating, power alcohol is still being considered, an experiments are to be undertaken on the production of tetrahydronaphthalene ("Tetralin") for admixture with petrol as a motor fuel. Research has been initiated by the Building Research Board on cement, brick-burning, titanium dioxide as a substitute for white lead, and the use of "Dekalin," a naphthalene derivative, as a thinner for paint. The new low-temperature research station of the Food Investigation Board has been completed, and work is being continued on the production of lactic acid in muscle at low temperatures, on putrefaction, etc. Information on the present practice in kiln-drying timber has been collected by the Forest Products Research Board, of which Prof. J. B. Farmer has been appointed chairman and Sir David Prain director of research. Work for the Lubrication Research Committee is proceeding at Cambridge (theory of friction), and at the National Physical Laboratory (pressure distribution in plain cylindrical bearings—failure in lubrication in large high-speed journals). The research work at the British Museum continues to yield valuable results, and the provision of a more convenient laboratory will enable the work to be extended.

The Board is considering the possibility of issuing accounts of investigations performed under its auspices to the daily Press.

Report on the Industrial and Economic Situation in Greece, to April, 1922. *By* E. C. D. Rawlins, *H.M. Commercial Secretary, Athens. Department of Overseas Trade. Pp.* 73. *H.M. Stationery Office,* 1922. *Price* 2*s.*

During 1921 Greek trade and industry suffered severely from political and economic difficulties, and the cereal crops were poor. Production of olive oil declined to 45,180 metric tons, but efforts are being made to improve the industry by introducing modern appliances for extraction and by combating the olive fly which greatly reduces the crop. The valonea crop of 500 tons was nearly double that of 1920. Exports of emery rose by 2317 to 12,709 tons. The Anglo-Greek Magnesite Co., Ltd. (a British company), produced 33,100 t. of crude magnesite, but exported, mainly to Holland and Germany, only 9130 t. of crude, 7055 t. of caustic calcined, and 750 t. of dead-burnt magnesite; other companies shipped 10,000 t. of crude ore, chiefly to Holland. The demand for magnesite was poor. Most of the chrome ore mined was shipped to France. The smelting of lead and zinc ores at Laurium and the mining of manganese ore are still restricted; the average value of the annual output of lead and arsenious oxide is Dr. 4,000,000 (average value of drachma in 1921=3·15d.).

Greek industry is small compared with that of Western Europe, but Greek products, such as soap, fertilisers and cement, are exported to other countries of the Levant. Development of the rich beds of lignite and of the potentially available water-power (estimated at 365,000 h.p. in Central Macedonia and the Greek mainland) would do much to promote industrial life. The chemical and related industries are progressing. There are four up-to-date factories for the manufacture of glass and pottery, sulphuric acid (from local pyrites) and fertilisers are made in one large works, and there is one modern factory making coal-tar dyes. Soap, sulphur oil, turpentine oil and colophony are manufactured from local raw materials; the leather industry has been long established; and there are six paper factories and five breweries.

The value of imports during 1921 was Dr. 1,674,375,055 compared with Dr. 2,131,038,321 in 1920. British trade lost ground to countries with depreciated currencies. Pharmaceutical products are now mainly supplied by Germans, who are also doing much trade in heavy chemicals; soda products, formerly almost a British monopoly, are being imported from Antwerp at a much lower price than the British; and glassware is once again being derived from Czechoslovakia. Exports in 1921 increased in value by Dr. 167,057,623 to 831,170,270. Detailed statistics for the complete year are not available.

OFFICIAL TRADE INTELLIGENCE

(*From the Board of Trade Journal for September* 28 *and October* 5)

THE GAS-MANTLE INDUSTRY

The text of the report of the committee appointed under the Safeguarding of Industries Act, Part II., to inquire into the importation of German incandescent gas mantles into this country, is given in the *Board of Trade Journal* for October 5. The committee's conclusions are summarised as follows:—

We are in the main satisfied that the bulk of the German mantles which are imported into this country are sold to dealers at the prices fixed by the Convention of German Mantle Manufacturers.

This price is very much above German manufacturing costs, very considerably lower than the costs of manufacture of the principal British manufacturers, and distinctly lower even than the lowest prices of British mantles quoted by the opponents as an indication of the real minimum cost of manufacture in this country. We find that the difference between the costs put before us by the principal British manufacturers and the price of the German goods is so large as not to be substantially affected by any qualification we may make with regard to the former.

We are of opinion that this capacity to undersell is principally due to the advantage which the Germans derive from their low costs in respect of labour, salaries, and other overhead charges, when reckoned in sterling, for the reason that these charges have not increased in proportion to the decrease in the exchange value of the currency. This advantage is not offset to any appreciable extent by any necessity to purchase raw materials abroad.

We are of opinion that, in view of the progressive rise in German imports, coincident with a decline from other sources, and in view particularly of the wide margin between German domestic wholesale prices and the Convention selling price in Great Britain, these imports have, and are likely to have, a serious effect upon employment in the home gas-mantle trade.

We are not convinced that the imposition of a duty on gas mantles would have any appreciable effect on employment in the gas industry, which is the only industry which, we think, could possibly be considered as using mantles as *material.*

We are of opinion that the gas-mantle industry is over-capitalised, and that this fact must tell against full economy in cost control, but that, as regards processes of manufacture and use of materials, it is up to date and efficiently conducted.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
Australia ..	Industrial chemicals, spring steel	356
Brazil.. ..	Iron and steel	352
British West Indies ..	Cement	9529/E.D./M.C.
Canada ..	Chinaware	323
,, ..	Pig iron	9594/E.D./E.C.
Czechoslovakia	Pharmaceutical goods, drugs, patent medicines	333
Egypt.. ..	Glass, glassware, pottery ..	225/36/F.G./M.C.
,, ...	China, earthenware, soap, perfumery, leather	371
France ..	Boot and metal polishes.. ..	711/F.G./M.C.
,, ..	Yeast	363
Germany ..	Ores, metallic residues	334
Hungary ..	Leather	335
Italy	Tin, tinplate, blackplate, copper..	336
,, ...	Iron, steel, tinplate, copper and brass pipes, lubricating oils ..	365
Mexico ..	Coal-tar dyes	6829/F.L./C.C.
,, ...	Kola oil, extract of coca, caffein and hyssop	6747/F.L./C.C.
Netherlands ..	Chemicals, soap, perfumery ..	337
,, ..	Alum, formaldehyde, caustic soda, Epsom salts, sodium sulphate, ferrous sulphate, soda crystals, sodium bicarbonate, tartaric acid, sodium bisulphate, sodium sulphite, copper sulphate, ammonium chloride, glacial acetic acid (98–100%), etc., paper, earthenware	341
Norway ..	Leather, imitation leather ..	368
Switzerland ..	Boot and metal polishes.. ..	711/F.G./M.C.

TARIFF CUSTOMS EXCISE

Angola.—The duty on rubber exported from ports outside the Congo Basin has been reduced to 0·1 per cent. and 0·2 per cent. *ad valorem*, respectively, according as the destination is to a Portuguese or a foreign port.

Australia.—The duties on certain categories of iron and steel products have been amended. The complete text of the reciprocity agreement between Australia and New Zealand is published in the issue for October 5; British preferential rates of duty are accorded to all goods not specified in the schedule.

Belgian Congo.—An export duty of 10 per cent. *ad valorem* has been levied on hides and skins.

Canada. — Provisions for the valuation for customs purposes of goods imported from countries with depreciated currencies have been applied to goods made or produced in Austria, Czechoslovakia, Germany, Hungary, Yugoslavia, and Russia. The period during which oleomargarine may be manufactured in, or imported into, Canada has been extended until August 31, 1923.

East African Protectorate.—By the customs agreement entered into with Uganda all export duties have been abolished.

Egypt.—The import duties on alcoholic liquors have been revised.

France.—A "co-efficient of increase" of 3 has been applied to the import duties on cellulose pulp not destined for the manufacture of paper for newspapers, periodicals and other publications.

Germany.—Articles with a sugar basis and fruits preserved or prepared in spirits may not be imported. New rates of monopoly tax have been applied to imported spirits, and the tax on imported acetic acid and vinegar has been increased to 56,190 marks per hectolitre of anhydrous acid.

Greece.—Recent modifications of the import duties affect coconut and palm oils, groundnuts, petroleum, coal-tar dyes, Sulphur Black, ethers, certain wares of porcelain and glass. "Co-efficients of increase" have been applied to the duties on cocoa, metal polishes, petrol, alcohol, white metal, and the importation of "luxury articles" is prohibited.

Jamaica.—A list of new duties on exports of spirits, wines, or spirituous liquors has been issued.

Japan (Korea).—The duty on tinplate for use in canning cottonseed oil is reduced by 70 sen per 100 kin; for tinplate of United Kingdom origin this remission equals the amount of import duty leviable.

Mauritius.—Increased customs duties have been applied to denatured alcohol, methylated or plain spirits, etc.

Mexico.—New rates of export duty on petroleum and its products have come into force.

Morocco (French Zone).—The following consumption duties have come into force:—Saccharin and artificial sweetening substances, 500 fr. per kg.; glucose and unspecified sweet materials (excluding glucose used in brewing), 20 fr. per 100 kg.; sugared products, condensed milk containing sugar, from 20 to 60 fr. per 100 kg.

Netherlands.—Animal fats that bear proof of having passed an official inspection are exempted from the Dutch regulations for the inspection of imported meat.

Poland.—A surtax of 79,900 per cent. has been applied to the duties on imported spirits, cork stoppers, wares of porcelain and glass, scent and cosmetics, soap, washing blue, artists' colours, and manufactures of copper, tin and certain other metals and metallic alloys.

Portugal.—By a recent Decree, the surtax on colophony is fixed at 50 escudos per metric ton, on essence of turpentine at 500 esc. per m.t., and a special surtax of 10 per cent. is applied to goods not specially mentioned.

Portuguese East Africa.—*Ad valorem* rates of duty have been applied to exports of certain grades of sugar.

Rumania.—It is proposed to increase the duties on dextrin, starch, glue, sesamum oil, tartaric acid, and lampblack.

San Salvador.—Preparations for purifying water are dutiable at the rate of 2 centavos (gold) per kg. The import duty on perfumed and toilet soap has been reduced to 40 centavos (gold) per kg.

Solomon Islands.—The export duty on copra has been fixed at 12s. 6d. per ton, and on ivory nuts at 15s. per ton.

Yugoslavia.—The import duties on goose grease, lard, and raw pigs' fat have been withdrawn.

COMPANY NEWS

NITRATE COMPANIES IN 1920-21

Of the eight nitrate companies whose financial year ended in June, 1921, all except one made increased profits, but only one paid a larger dividend and in three cases the dividend was reduced. Reserves increased by £35,145 to £639,333, and the sums carried forward rose from £116,868 to £335,088. The total share capital increased by £8268 to £2,045,068, due to the absorption of the San Lorenzo and Buena Ventura companies by the Liverpool Nitrate Co. Three companies disclosed an average estimated trading profit of 65·3d. per quintal (of 101·44 lb.), as against 30·5d. in 1919–20, and the combined trading profits of the eight companies represented 38·1 per cent. on the capital employed, compared with 30·5 in 1919–20. Dividends distributed amounted to £207,132, or an average of 10·1 per cent. on the total share capital, compared with £318,765, or 12·5 per cent., in the previous year.

The thirteen companies whose financial year closed on December 31 did badly during 1921: profits declined and dividends were reduced substantially. Their total issued capital was £3,664,950, the decrease of £200,000 being due to a reduction in the capital of the Lautaro Co. Debentures were diminished by £55,200 to £203,600. Reserves, excluding sums allocated to depreciation etc., fell by £249,351 to £959,665, and although most of the companies increased their carry-forward, a heavy reduction by the Alianza Co. brought the total down by £128,772 to £1,016,764. The position, however, is still good, as the reserves and carry-forward combined represent over 50 per cent. of the total share and debenture capital. The total estimated output was 2,965,417 quintals, which compares with 9,354,432 quintals in 1920. Reliable figures for calculating the average profit per quintal are not available. A total of £512,122 was distributed in dividends, representing an average of 13·9 per cent. on the total share capital, as against 21·7 per cent. paid on £3,864,950 in 1920.

Combining the figures of the 21 companies, the total share capital amounts to £5,710,018, upon which £719,254, or 12·5 per cent., was distributed in dividends, compared with £1,158,606, or 19·7 per cent., paid on £5,901,750 in 1920. Statistics of production, profits, etc. are appended.

NOBEL INDUSTRIES, LTD.

The address of Sir Harry McGowan to the third annual general meeting, held in London on September 22, was devoted to a detailed explanation of the company's financial position and of its investments in associated companies. Nobel Industries, he said, had weathered the storm of industrial depression and the outlook was hopeful. One of the essentials at the present time was to reduce the cost of manufacture, and hence selling prices. Owing partly to a slight fall in the cost of raw materials, but mainly to the policy of concentration which had been pursued, the company had been able four times during the past twelve months to reduce the prices of explosives, etc. Although much trade had been lost owing to the coal stoppage and general depression, the gross profit for 1921 was over £1,200,000, and the net profit, after deduction of income-tax, was £809,241. Out of this sum it was proposed to allocate £350,000 to a reserve fund, to pay 5 per cent. on the ordinary shares, and to carry forward £463,349. [The issued capital is £15,818,654, of which £7,958,872 is in ordinary shares and £3,000,000 in 8 per cent. 7-year notes. Investments in associated and other companies stand at £21,043,040.] A consolidated balance-sheet had been made out for the year 1920, which showed that there was a surplus of £3,000,000 of assets over all liabilities, and that actual values existed in full, pound for pound, for the entire share capital, with a substantial margin. The position at December, 1921, would be found to be no less satisfactory, and at the present time neither the parent company nor any of its constituent companies were indebted to banks in any part of the world.

The company had a large interest (809,425 shares) in the General Motors Corporation, an American company whose business was now improving; the investment in the Dunlop Rubber Co., which had effected many economies, remained the same, as did also that in the British Cellulose Co., but, owing to financial reconstruction, Nobel Industries had been forced to accept 6 per cent. income bonds in lieu of first debentures. The directors of the Cellulose Co. were so satisfied with recent progress that they had decided to extend the plant. The chairman of the British Dyestuffs Corporation had assured him that its works were now much more

			Production Quintals	Inc. or dec. %	Trading profits £	Inc. or dec. %	Net profits £	Dividends %	Inc. or dec. %
Lagunas Synd.	1920–21	..	—	—	75,878	+ 99·4	27,287	Nil	—
Liverpool	,,	..	—	—	317,755	+ 28·1	113,843	100	—40
London	,,	..	—	—	100,893	+ 55·3	31,543	7½	—
Pan de Azucar	,,	..	231,000	—38·2	48,361	+ 108·7	22,502	15	+ 5
Santa Catalina	,,	..	143,243	—55·1	46,761	+ 61·8	30,879	20	—
Santiago	,,	..	—	—	29,307	+ 42·8	15,197	7½	—
New Tamarugal	,,	..	594,000	—40	167,160	+ 20·7	159,560	15	— 5
Rosario	,,	..	476,691	—53·9	170,782	— 19	99,441	10	—10
Aguas Blancas	1921	..	14,000*	—98·2	48,109	— 29·5	35,373	70	—30
Alianza	,,	..	341,000	—88·3	78,142	— 91·1	2,929	40	—35
Angela	,,	..	77,000	—50·8	27,232	— 34·6	17,293	15	— 5
Anglo-Chilean	,,	..	1,133,800	—35	294,086	— 48·2	183,384	15	—10
Barrenechea	,,	..	54,000*	—78·6	24,027	— 34·3	12,409	35	—15
Lagunas Nitrate	,,	..	116,000*	—75·7	40,470	— 39·7	21,132	2	— 2
Lautaro	,,	..	597,000*	—62	473,667†	—9661·3	Nil.	—	—
New Paccha	,,	..	164,000*	—34·5	12,206	+ 57·3	9,546	6	— 2
Salar del Carmen	,,	..	231,000	—11·1	86,897	+ 2·9	55,761	20	—
San Patricio	,,	..	—	—	5,597	— 46·4	2,568	2½	— 2½
Santa Rita	,,	..	19,000*	—95·4	28,973	— 31·5	17,620	15	—10
San Sebastian	,,	..	66,617	—60·7	14,776	— 67·8	5,881	Nil.	—
Tarapaca	,,	..	152,000*	—76·4	57,343	— 35·7	38,463	10	—

* Estimated. † Loss.

—(*So. Amer. J., Mar.* 18, *Aug.* 19, 1922.)

efficient than formerly, and that when the textile industry improved the company should be working on a profitable basis. All the shares of the British Pluviusin Co., which manufactured artificial leather, were owned by Nobel Industries, and good results were expected for 1922. Considerable economies in the manufacture of gas mantles had resulted from the formation of Lighting Trades, Ltd., but German competition was being felt severely. The Chilean Explosives Co., in which Nobel Industries held 50 per cent. of the capital and American interests the rest, was about to erect a factory for the manufacture of explosives, thus making Chile self-contained in that respect.

BRITISH GLUES AND CHEMICALS, LTD.

At the second annual general meeting, held in London on October 5, the address of the chairman, Mr. T. Walton, dealt mainly with the company's financial position. In 1921–22 there was a net trading loss of £64,177, against a profit in 1920–21 of £241,722, subject to taxation; the ordinary shares again receive no dividend (the preference dividend was paid up to October, 1921), and £64,177 is carried forward, against £149,873 brought in. The loss was due mainly to bad trade and to constantly falling values, which necessitated the writing down of stocks nearly to their pre-war values. Many improvements have been made in the factories and production costs have been sensibly reduced. There are no mortgages or charges on any of the company's assets and the balance-sheet shows a surplus of liquid assets over all liabilities, except taxation, of £298,440 (issued capital £1,399,984). The directors, who have waived their fees, are contesting the claims of the revenue authorities for a large sum in respect of excess profits duty.

AMERICAN CYANAMID COMPANY

The annual report of the board of directors states that in the financial year ended June 30, 1922, the company made a gross profit of $624,765, after deducting $699,081 for depreciation of plant, and that the net income was $197,992, after setting aside $288,975 for income-tax and depreciation of patents (issued capital $12,190,200). The surplus account decreased by $148,213 to $3,143,276 and $4,200,246 is held in reserve. Ordinary repairs and maintenance of plants during the year cost $232,100, and extraordinary repairs and maintenance $113,945. Results are considered gratifying in view of the prevailing abnormal conditions and the reduced activity in most of the company's departments. The company's interest in the Amalgamated Phosphate Co. is now valued at $4,982,186, and in the Air Nitrates Corporation at $1000 at par.

KAYE'S RUBBER LATEX PROCESS, LTD.

This company has recently issued a prospectus, for public information, which states that its object is to acquire and exploit Mr. F. Kaye's patents for the use of rubber latex in paper-making, and in new classes of goods such as substitutes for leather and linoleum, asbestos goods, etc. The authorised capital of the company is £12,000, of which £1000 is in £1 ordinary shares and £2000 in 1s. deferred shares. The purchase consideration is £2000 in cash and 18,000 deferred shares.

TRADE NOTES

BRITISH

The British Industries Fair, 1923

The Board of Trade announces that the British Industries Fair, 1923, will be held concurrently at the White City, Shepherd's Bush, London, and at Castle Bromwich Aerodrome, Birmingham, from Monday, February 19 to Friday, March 2. The trades to be represented in the London Section, the ninth of the series organised by the Department of Overseas Trade, include light and heavy chemicals, dyes, drugs and perfumery, glass and ceramic ware, scientific and optical instruments, paper, etc. In the Birmingham Section, organised by the local Municipality and Chamber of Commerce under the auspices of the Board of Trade, will be exhibited plant for brewing, distilling, mining, lighting and many other industrial purposes, metals and metal products (excluding precious metals), indiarubber goods, paint, colours and varnish, and weighing and measuring appliances. Approximately 90,000 illustrated booklets about the Fair are being distributed in all parts of the world as propaganda by the Department of Overseas Trade, which will also issue invitations to 50,000 overseas buyers. Prospects for securing overseas business are enhanced by the comparative failure of the Leipzig Autumn Fair, and as admittance is confined to *bona-fide* buyers, every visitor will be a potential customer. Further information can be obtained from the Department of Overseas Trade.

FOREIGN

German Trade in Chemicals in 1921-22

Although the depreciation of the German mark has led to increased exportation of many chemicals, the quantities exported are still far below those in 1913. The following figures of exportation make this clear:—

	1913	1920	July, 1921, to June, 1922
		Metric tons	
Potash salts	1,676,187	843,065	662,502
Ammonium sulphate	75,868	26,094	17,182
Sodium sulphate	83,239	15,487	46,734
Potassium sulphate	133,368	158,368	236,292
Potassium magnesium sulphate Potassium chloride	59,207		
Coal-tar and sulphur dyes ..	64,288	17,847	27,310
Alizarin and alizarin dyes ..	11,040	3,325	2,474
Indigo	33,353	6,671	12,710
Basic slag, ground	713,879	4,874	2,103
Superphosphate, etc.	282,653	1,040	13,494
Quinine and alkaloids ..	319	74·7	103·8
Drugs, prepared..	2,508	1,049	1,437
Chemicals, medicinal	1,291	285	578

Exports of potash began to improve in 1921, but fell off in 1922, although exports of other chemicals and pharmaceutical products increased. The next table shows the destinations of the exports of coal-tar and sulphur dyes in 1913 and during the first half of 1922.

		1913	Jan.–June 1922
Total export,	Metric tons	64,288	.. 15,541
United States,	Per cent. ..	21·5	.. 0·7
Great Britain	„ „	17·1	.. 1·2
China	„ „	13·2	.. 23·1
Austria-Hungary	„ „	9·0	.. —
Austria	„ „	—	.. 4·0
Italy	„ „	6·4	.. 3·5
British India	„ „	5·9	.. 6·6
Japan	„ „	5·5	.. 10·7
Belgium	„ „	3·9	.. 0·6
France	„ „	2·2	.. —
Netherlands	„ „	2·1	.. 3·5
Russia	„ „	1·3	.. —
Czechoslovakia	„ „	—	.. 12·0
Baltic States	„ „	—	.. 7·7

The chief market for German dyes is now China, followed by Czechoslovakia, Japan, the Baltic States, and British India. The United States has fallen in importance as a consumer from first to seventeenth place. The values of the chief groups of imports and exports during the years (ending March 31) 1914, 1921, and 1922 were as follows:—

	Imports			Exports		
	Millions of dollars					
	1913–14	1920–21	1921–22	1913–14	1920–21	1921–22
Plant products	98	261	173	201	483	318
Animal products	41	62	47	77	188	136
Fibres, textiles	109	244	140	22	19	5
Wood, wood products, paper	37	57	36	63	285	180
Iron and wares of ..	144	246	110	15	77	28
Non-ferrous metals and wares of	36	56	30	53	46	28
Minerals, non-metallic ..	85	206	138	9	40	23
Chemical and related products	17	36	24	5	20	9
Other products	52	73	24	6	32	14
Totals	619	1,240	748	432	1,189	740

Much ground has been lost in the export trade to Canada; Germany now holds only the fourteenth place, as compared with the fourth place in 1914.

Union of Bulgarian Producers of Otto of Roses

The producers of otto of roses in Bulgaria have amalgamated to form a combine bearing the above title. The Union has offices in Kazanlik and Sofia, with a branch office and store in Berlin, from which exportation is conducted by the Balkan Trading Company.—(*Chem. Ind., July* 3, 1922.)

GOVERNMENT ORDERS AND NOTICES

IMPORT DUTY ON GERMAN GAS MANTLES.—The Board of Trade has issued the Safeguarding of Industries (No. 2) Order, 1922, dated October 7, imposing an import duty of 33⅓ per cent. *ad valorem* on mantles for incandescent lighting and component parts thereof, whether finished or not, manufactured in Germany. Certificates of origin are required for goods covered by the Order and consigned from European countries. The Order came into force forthwith (*cf.* p. 425 R).

DISTRIBUTION OF "REPARATION" DYESTUFFS.—The Board of Trade has announced that the British Dyestuffs Corporation, Ltd. has been appointed its agent for the distribution of "Reparation" dyestuffs from Germany in place of the Central Importing Agency. In future, prices quoted will include delivery to purchasers' works or stores, and will not be subject to any commission. Prices will be quoted for packages of 60, 120, or 240 lb., and a reduction of 1d. per lb. will be made on purchases of 4 cwt. or more, and of 2d. per lb. on purchases of 1 ton or more; for less than 60 lb. the price will be increased by 1d. to 3d. per lb., to cover cost of extra packing. The Corporation may allow 30 days' credit on all accounts. The dyestuffs will be distributed under their original German denominations and, as far as possible, in their original packages. Notification of the arrival of additional quantities of dyestuffs (which will be reserved for actual consumers for 14 days) will be given through the Colour Users' Association, but the Corporation will issue a periodical list of stocks and of the current prices fixed by the Board of Trade. Inquiries should be addressed to the British Dyestuffs Corporation, Ltd., Reparation Department, 70, Spring Gardens, Manchester.

REVIEWS

MANUFACTURE OF NITRIC ACID FROM NITRE AND SULPHURIC ACID. TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915—1918. No. 7. *Ministry of Munitions and Department of Scientific and Industrial Research. H.M. Stationery Office,* 1922. *Pp. vi*+86. *Price* 11*s., post free.*

The production of nitric acid from sodium nitrate and sulphuric acid was carried out on a very large scale during the war. Two national factories alone, Queen's Ferry and Gretna, were able to turn out 1300 tons of nitric acid per week. Although the method used was well known before the war, it had not been worked on such a large scale, and the appearance of the atmosphere around Queen's Ferry in the initial stages of its operation was sufficient to show that the problem of condensing the oxides of nitrogen produced in the works was not solved in the design of the plant. The final arrangements are described with admirable clearness by Mr. W. Macnab in the present report, which maintains the high standard of its predecessors and is a valuable contribution to the literature of chemical engineering.

The materials for the process, Chile nitre, and the pyrites for sulphuric acid, were imported, and the great demands made on shipping for this purpose at one time became extremely serious. Great Britain is still the only great power in the world which depends almost wholly on Chile for the supply of fixed nitrogen, and the description of the antiquated method of producing nitric acid from Chile nitre may therefore still possess an intrinsic interest. The question of this dependence, however, is one which must sooner or later be faced in the interest of national defence, and it is hardly conceivable that such immense retort plants for the production of nitric acid as were in operation during the late war will ever again be employed.

J. R. PARTINGTON.

DOCUMENTS AND THEIR SCIENTIFIC EXAMINATION. *By* C. AINSWORTH MITCHELL. *Pp. xii* + 215. *London: Charles Griffin and Co., Ltd.,* 1922. *Price* 10*s.* 6*d. net.*

This is a welcome and valuable addition to the present scanty but growing literature of forensic chemistry and is written by an expert. The subject matter includes the examination of paper, pen markings, ink, pencils and their pigments in writing, handwriting, secret writing, typewriting, stamps, seals, envelopes and finger prints on documents. The apparatus and methods used are fully described and the book contains a large number of illustrations and an excellent bibliography.

The author explains that the book, which has especial reference to the chemistry involved in cases of suspected forgery, investigation of disputed documents and the comparison of handwriting, is based upon personal experience extending over many years, and that when called upon to present expert evidence in legal cases he frequently found that the available information was so inadequate or altogether lacking that he was compelled to make prolonged laboratory investigations in order to obtain trustworthy results. The present book contains the records of those experiments, some of which have already been published in scientific journals, but many of which are now given for the first time.

The chapters on pencils and their pigments in writing (one chapter being devoted to blacklead pencils and another to copying-ink pencils) are particularly valuable, and contain a wealth of new information. Until Mr. Mitchell investigated the subject it was thought to be impossible to distinguish between writing made with different pencils, but it is now shown that under certain conditions the writing done with different pencils may be differentiated both by microscopical examination and by chemical tests.

The book summarises the proved results of the latest knowledge on the subjects treated, and is confidently recommended to all who are interested, whether from the point of view of the expert, who will find much that is new and to whom it will be especially useful; the lawyer, who will learn from it the possibilities and limitations of a subject with which he is frequently called upon to deal; the business man, especially the banker, who daily handles documents that may be forged; or even the general reader, who is interested in the practical application of chemistry to everyday life and who finds a fascination in mysteries and their solution.

The problem of whether a suspected document, which may be a banknote, a will, a promissory note, a deed of sale, a register, a passport, or even a postage stamp, is genuine or not is a constantly recurring one, and the book under review shows in a very practical manner how the truth should be sought and how it may be discovered. There is only one way, and that is by the use of scientific methods scientifically applied. The value of the expert is nowhere more patent than in questions having reference to suspected documents, since many of the facts can be found only by an expert, and he alone can present them in a convincing manner to a judge and jury.

The book is well arranged, well and clearly printed on good paper, and is strongly recommended.

A. LUCAS.

DIE LÖSUNGSMITTEL DER FETTE, OELE, WACHSE UND HARZE. *By* DR. H. WOLFF. *Monographs on the Chemistry of Fats, edited by Prof. K. H. Bauer. Pp. vi+118. Stuttgart: Wissenschaftliche Verlagsgesellschaft*, 1922. *Price 9s.*

During the past year or more a noteworthy feature of the oil and fat industry of Germany has been an active propaganda among its chemists in the direction of organisation and co-operation, ostensibly for the purpose of the furtherance of research. A perusal of the German technical journals leaves one with the impression that the spirit of pre-war days is far from dead, and that apparently, in spite of the present economic condition of their country, the chemists still hope and yearn for ascendency in provinces not altogether restricted to the laboratory. As one result of this activity may be mentioned the projected publication of a series of monographs under the editorship of Dr. K. H. Bauer, dealing in a specialised manner more particularly from the technical standpoint with the various branches of the oil, fat and allied industries.

The first volume of these monographs, now before us, covering as it does a description of the properties and uses of most of the solvents employed in connexion with oils, fats, waxes and resins, undeniably fills a gap in this particular branch of technical literature. The information found in this work is for the most part either absent or only lightly touched upon in text-books on the chemical technology of oils, fats, waxes, resins, and the like.

This book, or, as it would be better designated, brochure, is divided into five main sections; the first deals in a somewhat general style with the determination of the physical constants common to most organic liquids. Density, refractive index, flash-point, boiling-point, methods of distillation for solvents of a wide boiling-range, and so forth, are each described, wisely without excessive detail. The methods given for fractional distillation, particularly those for paraffin oils, though perhaps not of great interest to the English reader—conforming as they do with German practice where the standardised apparatus used complies with the regulations issued by the German Government and other administrative institutions—are certainly instructive for comparison.

The second and main portion of the work discusses with reasonable detail individual solvents, their sources, methods of refinement and purification, and their relative merits and degrees of utility as media for effecting solution and extraction; the latter points being treated both from the laboratory and the industrial viewpoint. Amongst the hydrocarbons are described the newer synthetic products, the hydrogenated derivatives of naphthalene, "tetralin" and "dekalin"; substances not so well known in this country, but which have become notorious in Germany as a source of "copy" to the technical Press for controversial articles on their merits and demerits as articles of commerce. Following the hydrocarbons, including, of course, a full treatment of paraffin and coal-tar products as well as turpentine, are given the chlorinated compounds with their main redeeming feature, the minimised risk of fire. Alcohols, ester of formic and acetic acid, ether, and finally carbon disulphide, are all included. Where applicable, methods of quantitative estimation, chemical test for impurities, and physical data are to be found in these individual descriptions. References, however, to English and American publications are sadly meagre, and to cite only one instance, the extensive work of Dr. H. G. Colman on the estimation of benzene and toluene in coal-tar distillate would, one might think, deserve mention in a wor of this kind. A good deal of the data included i this chapter has been tabulated and incorporated in a copious appendix with other information o the nature usually found in chemical year-books.

An interesting discussion on the physiologica properties of the solvents forms the third part o the book, whilst the fourth goes into the questio of identification of the solvents either singly or i mixtures. In the final chapter is given a descrip tion of the methods of quantitatively determinin the saponification and acetyl values of those sol vents amenable to these tests.

On the whole, the book can be recommended one of great utility; the style is lucid, the printin good. The author expresses a hope that the boo will be of great practical use in the laboratory, bu is certain that this poorly bound brochure edition uld not stand for long the rigorous handling ually meted out to such books of reference. One her point which serves to emphasise the justification of the remarks made in a recent article in this *urnal* (1922, p. 111 R), is the fact that this book published in Germany at 75 marks and its price reaching this country is 9s., equal to about 700 marks. Whilst no doubt one could hardly pect to benefit to the extent of the uttermost mit of the difference in the exchange, the great isparity between the two prices gives much food r thought.

E. R. BOLTON.

1) LES COLLOÏDES. *By* J. DUCLAUX. *Second edition, revised and enlarged. Pp. x+305. Paris: Gauthiers-Villars et Cie.*, 1922. *Price* 10 *francs.* (2) KOLLOIDE LÖSUNGEN. *By* JOACHIM LEIMDÖRFER. *Pp.* 108. *Augsburg: H. Ziolkowsky G.m.b.H.*, 1921. *Price* 4*s.* 10*d. post free.*

(1) The general trend of Duclaux's work is ufficiently indicated by two—slightly contradictory —passages in the preface to the first edition, of hich the following is a careful translation: "One s entitled to assert to-day (*although the contrary pinion is widely held*) that the theory of the colloids is complete, and that it is possible to bring into it the same clearness as everywhere else. . . . The present theory of colloids, which will be found set forth below, and *which is now almost universally accepted*, is not the work of one day. . . ." (Reviewer's italics.)

The theory thus referred to is the author's well-known "Complex" theory of sols, or more particularly of the ferric hydroxide sol. This is held to consist of "micellæ" having the constitution: $nFe(OH)_3.FeCl_3$, which dissociate into the complex ion or "granule" $nFe(OH)_3.Fe^{\cdots}$ and the corresponding number of chlorine ions. The osmotic pressure of the sol varies with the number of ions formed, and therefore, assuming the concentration of $Fe(OH)_3$ to remain constant, with the number n in the formula. Appropriate treatment, *e.g.*, prolonged dialysis, may cause this number to vary from 5 to 800. Electrolyte coagulation is an ordinary precipitation reaction, governed by stoichiometric relations and the solubility product. Although, admittedly, the sol of ferric hydroxide is the only one completely investigated in this sense, the theory is put forward as perfectly general, and all difficulties are to to yield to its rigid application. The biologists in particular, whose ordinary methods the author criticises with some severity, are exhorted to lay it to heart.

It is rather surprising that the author makes no mention even of investigations tending in the same direction, such as the work of McBain and his school on soaps, or of Pauli's extension of the chemical theory to such systems as gold sols. No evidence on the other side is presented, nor is the re-examination of the ferric hydroxide sol by improved methods (Pauli and Matula, 1917) mentioned; indeed, the small number of names quoted throughout the book is remarkable, and practically no references are given.

In view of the dogmatic manner in which the "chemical" theory of coagulation is put forward, the reader will be naturally curious to learn how the crucial phenomenon of protection is explained. He will be disappointed to find that the old suggestion of a coating formed by the protective colloid is all the author has to offer, although it has been repeatedly pointed out that the quantitative relations make this quite untenable, and although it is impossible to see how such a coating, even if it existed, could prevent the exchange of, say, SO_4-ions with Cl-ions, which is said to bring about precipitation.

The descriptive parts of the book, as far as they do not suffer from the author's strong bias in favour of purely chemical theories, are written with great lucidity, and emphasis is rightly laid on the development of a specialised and perfected technique. Perhaps the least satisfactory chapter is that on adsorption, in which no reference is made to any of the theories of the phenomenon, nor to the large bulk of recent work which is gradually clearing up the anomalies found in experimental investigations, by examining the adsorption of the *solvent* as well as that of the solute.

Whilst the book cannot be said to give an adequate or comprehensive view of the present state of the subject, it should be of great interest to readers familiar with other text-books and prepared to exercise the chief privilege of thinking beings, that of making a choice.

(2) The merest tyro in epistemology would, on reading Leimdörfer's book, come to the conclusion that it could have been written only in German, with its extraordinary facilities for forming compound words, with which—presumably—an equal number of subtly differentiated concepts may be coordinated. This remark applies principally to the first part of the book, of which a little more will be said below; the second consists of a brief account of the properties of colloidal solutions and the methods used in their study, which does not differ materially, or favourably, from those to be found in the standard text-books.

The first part sets forth a theory of the constitution of matter which the reviewer cannot claim to have grasped. This failure will be viewed leniently, or even sympathetically, by anyone attempting to study the book and confronted with entirely unfamiliar concepts, such as a unit of matter called a "Schwebeteilchen" (the bald translation "suspended" or "floating" particle at once emphasises the unfitness of English as a medium for speculation); with chess boards of 49, 121 and more squares, in which these particles are arranged in ones, twos, threes and fours, symbolising the three states of aggregation, and a fourth, postulated by the author and called the "hyper-solid"; with a further element of matter called a "Kristallom," etc. All this somehow leads to a conclusion bearing more immediately on the subject of the book: that true solutions differ from sols in the source from which the energy required for dispersion is derived —this being the solvent in the former, and the disperse phase in the latter. Even if this distinction could be established by recognised methods, which seems improbable, it is not at all clear what diagnostic of systematic value it could possess.

It is difficult to conceive any class of readers who could derive from the perusal of this book any benefit at all commensurate with the time and effort required.

EMIL HATSCHEK.

OBITUARY

ALEXANDER SMITH

Prof. Alexander Smith, who died in Edinburgh, his native city, on September 8, three days before his 57th birthday, is known almost wherever chemistry is taught as the author of several text-books on chemistry of superlative worth. His "Introduction to General Inorganic Chemistry" and his "General Chemistry for Schools and Colleges" are particularly well known, but nearly all his works have been translated into German, Russian, Italian, and Portuguese. As these books attest, Alexander Smith was a great teacher: he had the gifts of personality, originality, and of lucid and stimulating exposition. Unfortunately he overburnt the candle of life—he was a most strenuous worker—and his early death leaves a gap that will be hard to fill; but his text-books are a legacy that will perpetuate his memory for many years to come.

Prof. Smith received his chemical education in the Universities of Edinburgh and Munich, where he graduated B.Sc. and Ph.D., respectively. His first important appointment was to the chair of chemistry and mineralogy in Wabash College, Indiana, which he resigned in 1894 to become professor in the University of Chicago, where, perhaps, his best work was done. In 1911 he became professor and director of the department of chemistry in Columbia University, City of New York, resigning this post about two years ago owing to ill-health. His scientific papers included original investigations on diketones, the benzoin reaction and on potassium cyanide as a condensing agent; and in inorganic and physical chemistry he did notable work on the liquid and amorphous forms of sulphur and the determination of vapour pressures. Among the honours bestowed upon him were election to the presidency of the American Chemical Society and conferment of the honorary degree of LL.D. of Edinburgh University.

WILLIAM KELLNER

Dr. William Kellner died in London on September 12, in his eighty-third year. Born at Frankfurt in 1839, he received his scientific training under Prof. Wöhler at Göttingen, where he eventually took his Ph.D. degree. In 1862 he came to England as assistant to Sir H. Roscoe at Owens College, Manchester, whence in 1864 he went to Woolwich and joined the staff of the War Department Chemist, then Sir Frederick Abel. In his early years at Woolwich Dr. Kellner was engaged in the varied general work of the Chemical Department. Later his main work became investigatory and experimental in connexion with explosives, and to meet the requirements of the various Commissions and Committees on which the War Department Chemist was a prominent member; of these the Royal Commission on Accidents in Mines and the Explosives Committee (appointed in 1889 to produce a smokeless powder for the Service) may be mentioned.

Dr. Kellner also devoted much work to the production of an apparatus for determining the flash-point of oils, and was largely responsible for the Abel flash-point apparatus, subsequently perfected; in collaboration with Sir Boverton Redwood he carried out an exhaustive series of tests with this apparatus.

As a scientific worker Dr. Kellner was painstaking and methodical, and he displayed much skill in devising experiments. His most important practical work was that undertaken at Woolwich in connexion with the evolution of cordite; in spite of the numerous smokeless powders which have been brought into use since, the fact that after a period of 30 years cordite still remains the British Service propellant for Army and Navy use, is perhaps the best testimonial to the thoroughness of his work in this direction.

In 1892 Dr. Kellner succeeded Sir Frederick Abel as Chemist to the War Department and, in addition to the duties of this office, served as an Associate Member of the Ordnance Board and as Consulting Chemist to the Royal Gunpowder Factory at Waltham Abbey. He retired from the Service in 1904. Kellner was one of the first Fellows of the Institute of Chemistry and served on its Council from 1895 to 1898.

Of an extremely modest and retiring disposition, the value of Dr. Kellner's work was little known outside his Department; he had a kindly and sympathetic nature, and his courtesy and cheerful optimism charmed those with whom he came into contact and won him a large circle of friends.

O. Trigger.

PUBLICATIONS RECEIVED

Colour Index. Part I. *Edited by* Dr. F. M. Rowe. *Pp.* 24. *Published by the Society of Dyers and Colourists,* 30, *Pearl Assurance Buildings, Bradford, England. Subscription price for the whole work* 84*s.*

An Introduction to the Chemistry of Plant Products. Vol. II. Metabolic Processes. *By* P. Haas *and* T. G. Hill. *Pp.* 140. *London: Longmans, Green and Co.,* 1922. *Price* 7*s.* 6*d.*

The Origin of Spectra. *By* P. D. Foote *and* F. L. Mohler. *American Chemical Society: Monograph Series. Pp.* 250. *New York: The Chemical Catalog Co., Inc.,* 1922. *Price* $4·50.

Cours de Chimie Organique. *By* Prof. F. Swarts. *Third edition, revised and enlarged. Pp.* 674. *Brussels: M. Lamertin,* 1921. *Price* 45 *francs.*

Cours de Chimie Inorganique. *By* Prof. F. Swarts. *Third edition, revised and enlarged. Pp.* 734. *Brussels: M. Lamertin,* 1922. *Price* 50 *francs.*

Theories of Organic Chemistry. *By* Dr. F. Henrich. *Translated from the revised fourth German edition of* 1921 *by Prof. T. B. Johnson and Prof. D. A. Hahn. Pp.* 603. *New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.,* 1922. *Price* 30*s.*

Chemical Engineering Library. The General Principles of Chemical Engineering Design, *by* H. Griffiths (*pp.* 63); Materials of Chemical Plant Construction: Non-Metals, *by* H. Griffiths (*pp.* 64); The Weighing and Measuring of Chemical Substances, *by* H. L. Malan and A. I. Robinson (*pp.* 63); The Flow of Liquids in Pipes, *by* N. Swindin (*pp.* 64); Pumping in the Chemical Works, *by* N. Swindin (*pp.* 80). *London: Benn Brothers, Ltd.,* 1922. *Price per volume* 3*s.*

REVIEW

Vol. XLI] OCTOBER 31, 1922 [No. 20

INTERNATIONAL CONGRESS ON LIQUID FUELS PARIS, 1922

THE growing importance of liquid fuel renders necessary the standardisation of nomenclature and of methods of analysis. This was recognised some years prior to the war, and several International Congresses were held to deal with these important matters. It has remained for the Société de Chimie Industrielle to realise that the time was ripe for re-starting these annual meetings.

An International Congress on Liquid Fuels, and an Exhibition, were held in Paris, from October 9 to 15, in a building specially erected on the Esplanade des Invalides, under the direction of the Société de Chimie Industrielle and the presidency of M. Paul Sabatier. The success of this first Exhibition and Congress organised by the Society, is a proof of its activity and foresight. The chairman, M. Paul Kestner, and the secretary, M. Jean Gérard, are certainly entitled to the many congratulations they received upon the success of their arduous work.

The Exhibition was comparatively small but exceedingly interesting, and was remarkable for the comparatively large amount of space occupied by firms connected with the academic and scientific side of the petroleum industry. Many small Diesel and semi-Diesel engines were shown in action, and considerable business seems to have arisen from the Exhibition. Many types of burners and furnaces were shown, some in action, and great interest was taken in a small central-heating installation, in which very heavy oil was being burnt without the use of either compressed air or a positive pump for spraying the oil. On the scientific side there were exhibitions of refractory glasses of the Jena type, for one of which—the "Boromica" glass—it was claimed that the co-efficient of expansion was about 33 per cent. less than that of a Jena glass. Some new types of laboratory fractionating columns were shown, in which the column itself is protected by an outer jacket, which can be evacuated if liquids of high-boiling point are fractionated. Engines were shown that were running on fuels containing different proportions of ethyl alcohol.

The attendance, in spite of the counter attractions of the Motor Show, was on the whole very good, and towards evening the rooms were congested. The Exhibition was visited by several Ministers, and by the President himself. The keen interest taken by the heads of the political world in scientific and technical matters in France is in marked contrast to the apathy shown under similar circumstances in our own country.

The Congress was divided into six sections, and the principal matters dealt with in each section were as follows:—

1. *Petroleums.*—Distillation and distillation products of crude petroleum: motor spirit, kerosene, heavy oils, lubricating oils, paraffins, vaseline, etc., and their uses.
2. *Shales.*—Distillation and products of distillation: heavy and light oils.
3. *Lignites and Peat.*—Distillation and distillation products: benzols and tars.
4. *Coal-tars and Benzols.*
5. *Alcohol.*—Alcohol production, uses of industrial alcohol, and admixtures of alcohol with other combustible liquids for use as fuels.
6. *Vegetable Oils.*—Use of vegetable oils as fuels and as lubricants.

The Congress was formally opened on the morning of October 10 by M. Paul Sabatier, who briefly outlined its aims and gave a historical sketch of the problems requiring solution, showing both the necessity for fixed nomenclature and unified methods of analysis, and for the compilation of a systematic inventory of the world's resources in fuels. He pointed out that the reserves were not inexhaustible, and asked whether before they disappeared, and so upset the conditions of modern life, it would not be possible to produce combustibles synthetically, and on an industrial scale, utilising, as plants do, solar radiation for producing carbohydrates from water and carbonic acid. The results realised in chemistry, since the discovery of catalytic processes, gave great hope of the possibility of accomplishing this.

Prof. Daniel Berthelot dealt with the question of a national liquid fuel, which, as he pointed out, the war had proved to be a vital one for all nations. France being an essentially agricultural country, the national fuel was alcohol, and the only question was, whether it could compete in price with petrol. He described the work of the scientific committee appointed to consider this subject, and gave reasons for the final decision that for the present mixtures of petroleum fuels with a certain amount of ethyl alcohol should be used. He referred to the various proposals which had been made to render ordinary commercial alcohol (95 vol. per cent.) miscible with commercial motor spirit in comparatively small proportions, such as the addition of butyl alcohol, isopropyl alcohol, cyclo-hexanol, "tetralin," ether, and the like.

The following two problems of an international character were put down for special consideration, namely :—

1. Terminology and characteristics of liquid fuels. 2. Analytical methods for determining these characteristics.

An international commission, appointed at the inaugural meeting to consider these problems, recommended that each nation represented should draw up a classified list of all commercial liquid fuels, together with exact particulars of their physical and chemical constants, as well as of the methods and apparatus employed for determining these constants, in accordance with a scheme approved by the commission ; the lists to be presented for consideration to the Fourth International Conference of Applied Chemistry, to be held at Cambridge in 1923. A sub-committee was appointed to draw up a form to be used in furnishing the information for each individual fuel ; this form was approved at the final meeting of the Congress. References were made to the work of the American Government Departments on testing methods and to that of the Standardisation Committee of the British Institution of Petroleum Technologists.

It can hardly be said that the organisation for the reading of papers was entirely successful. In the first place, frequently three meetings were going on simultaneously, and in the second place, the meetings were held in rooms within the Fuel Exhibition, and the noise of moving machinery and the roaring of oil-burners did not make for clarity in the proceedings. Then, again, the number of papers presented was far too great for the time available ; at future meetings it would be advisable to have a selection or editorial committee to select the papers of outstanding interest for reading and discussion, the remainder merely to be printed. As it was, in Section 1, between 9 and 11.55 a.m., ten papers were announced for reading and discussion. Many were not read in entirety, and many were not read at all ; in consequence, one never knew at what time to be present to hear any given paper. All the papers will be published in a special number of *Chimie et Industrie*, which should appear in November. Many of the papers in all Sections were compilations dealing with generalities, rather than original work dealing with specific subjects, a few were of the advertisement type, and some were of outstanding interest. As the official *précis* of the papers presented to the six sections occupies 30 pages of close print, in this place it is only possible to indicate their nature very briefly.

In the Petroleum Section Dr. J. P. Wibaut, of Amsterdam University, read a most interesting paper on the relationship between single and double linkages of the carbon atoms in hydrocarbons, as measured by the heats of combustion. From a technical point of view, M. A. Mailhe's paper on industrial and laboratory processes for transforming solid into liquid hydrocarbons, either by cracking or catalysis, was important. A paper by MM. H. Gault and A. Merle on petroleum in Madagascar was of considerable economic interest ; experiments have shown the possibility of obtaining oils by distilling mixtures of local bitumens in special plant. Other papers dealt with petroleum from various sources, methods and apparatus for obtaining, testing, and using it. Two papers dealt specially with the production of petrol by the hydrogenation of heavy oils, according to the Bergius process.

In the Shales Section a paper by Admiral P. Dumas and Mr. Cunningham Craig urged the necessity for developing shales and bituminous peat, described the modes of their formation and the methods of mining them, and outlined distillation and refining processes. There were papers on the French shale measures, on those of the Lower Alps and of Esthonia, as well as on the various bituminous rocks of Syria, and also on the French shale industry and on new methods of distillation, etc.

The Lignite and Peat Section dealt with the lignites of Hérault, Aude, and of Serbia. Papers were also read on the low-temperature distillation of lignites and on the recovery of by-products. It was brought out in the papers, and in the discussion, that the French lignites can be as successfully worked as those of Germany ; those of Hérault, for example, give 15 per cent. of crude oil, from which 25 per cent. of light oils, similar to benzol and petrol, can be obtained. A description was given of the French peat fields, and of methods of winning, treating and using the peat.

In the Tars and Benzols Section, papers were read on the production of benzol in the principal countries, on the treatment of tars and benzols as sources of liquid fuels, and on the subject of liquid fuels in relation to the low-temperature distillation of coal. The question of de-benzolising in small establishments was discussed by M. Baril, who explained that the technique was not well understood, because the law fixing a limit to the calorific value of gas was still before the Chamber, and, therefore, no one in France was troubling to work out de-benzolisation on economic lines. Two other papers were read on the same subject. Modern methods of extracting benzol from coal gas were described as well as the manufacture of cyclo-hexanol, the hydrogenation of phenol by the platinum-black method, and the hydrogenation of naphthalene. The use of benzol and of naphthalene in connexion with the production of a national liquid fuel was considered.

The principal papers read before the Alcohol Section discussed the production of alcohol from vegetable materials and from ethylene ; its use, either alone or in admixture with hydrocarbons in internal-combustion engines, and as a national liquid fuel. Other papers which proved of great interest related to the hygroscopicity of absolute alcohol, the preparation and use of alcohol in combustible liquid mixtures, the findings of the scientific committee on a national liquid fuel, and the trials in connexion with the use of alcohol in admixture with benzol, petrol and ether in the London General Omnibus Company's 'buses. A paper in this section which attracted great attention, was that by M. W. Vernet describing a new process (*Procédé* Prodor) for the production of alcohol by the acid hydrolysis of sawdust and cellulosic materials. Strong hydrochloric acid, both liquid and gaseous, is used, and the operation takes place at ordinary temperatures in a vessel which is constructed of an acid-resisting concrete, made of fine quartz and pitch. A yield of 250 litres of 100 per cent. alcohol per metric ton (56 gallons to the long ton) is stated to have been obtained in a semi-technical plant.

A series of papers was read before the Vegetable Oil Section on the production of these oils, and another series on their utilisation in internal-combustion engines, particularly in the colonies, where petrol is not available. Palm oil, groundnut oil and even castor oil can be used, but objections were raised in regard to their acidity and consequent action on the cylinders and valves.

The proceedings terminated with a most interesting lecture by Professor Mailhe on the production of petroleum bodies by the hydrogenation of vegetable oils. The possible bearing of this on the theory of the origin of petroleum was briefly referred to.

The social side was by no means neglected. The delegates were received by the Committee of Organisation at the Palais d'Orsay on the evening of Monday, October 9, and on Tuesday evening at the Hôtel de Ville there was a reception by the President of the Municipal Council. On Saturday evening the delegates were invited to a banquet at the Palais d'Orsay, where the chair was taken by the Minister for Public Works, who referred to the interest taken by the French Government in the subject which had been discussed by the Congress, and whose importance was not only national but world-wide.

THE COLLOID MILL

A. FORSTER and J. REILLY

According to Svedberg, the preparation of colloidal solutions can be grouped under two general headings : (a) the condensation method, depending on the building up of disperse particles from molecules ; (b) the dispersion method, in which the solid material is scattered throughout the liquid by various means. There is a large literature on the technical preparation of these solutions by (i) chemical reactions, which can be classified under either (a) or (b), and (ii) electrical methods which come under grouping (b). It is curious, however, that mechanical means to disperse materials have not been employed technically, except on a limited class of substances until a comparatively recent date. In the present review attention will be confined to a recent development of this method of producing colloids.

For many chemical and technical purposes it is often necessary to reduce materials to a certain degree of division, and recently much attention has been given to the evolution of disintegrators and so-called " colloid " mills—machines for greater efficiency and new effects in fine grinding. The method employed is the application to the material of a high-power blow, either direct as in ball- and hammer-mills, or by throwing the material at a high speed against a resistant wall, as in throw-mills. The limitations of dry grinding, however, even with these machines, have long been realised, owing to the resistance of the air, the development of frictional heat, and the necessity for ventilation. Consequently, in mills aiming at maximum division the material is suspended in a liquid—usually water. In the disc-mill—perhaps the best known of these—the material in an aqueous suspension is fed into the centre of two discs in rapid revolution, either in the same or in opposite direction, and becomes disintegrated by its friction against the discs while being forced centrifugally to their edges. Another general form is the " dismembrator," in which the material in aqueous suspension is fed on to the axis of a high-speed revolving arm-wheel, surrounded by a number of close-fitting baffles.

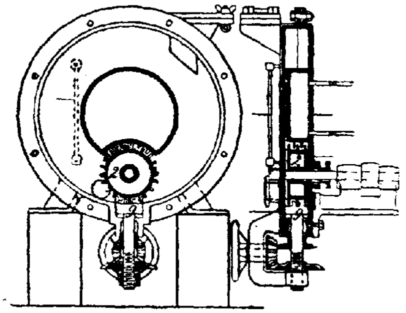
Recently Dr. Plauson and his co-workers have published papers and patents* claiming the attainment of new effects in mechanical milling, whereby ultra-microscopic suspensions of particles less than 0·001 mm. diameter, which show the characteristic Brownian movement, are readily obtained with a wide range of substances. Two types of mill have been employed. One is a disc-mill in which is applied (a) an adjustable pressure to the suspension passing through the discs, (b) a continuous circulation of the milled suspension, and (c) a rapid counter-revolution of the discs at 2000 r.p.m. The other mill consists in principle of a "dismembrator," in which Plauson's innovations are (1) the rotating arm-wheel is placed eccentrically towards the base of the containing case so that the material continually falls into the field of action instead of circulating centrifugally outside the arm-wheel range, (2) the reduction of the baffles to the minimum number—two for balance—in order to obtain a maximum force at each; in the ordinary dismembrator the force is divided over a number of baffles; (3) the application of extremely high speeds of revolution.

---

* Z. angew. Chem., 1921, p. 25 ; p. 469 *c.f.* Die Kolloidmühle u. ihre Anwendungsmöglichkeiten, H. Plauson, Z. angew. Chem., **34**, 1921, p. 469-473. Die Kolloidmühle u. ihre Verwendung f. d. Chemische Grosstechnik, B. Block, Z. angew. Chem., **34**, 1921, p. 25. Eng. Patents 155,836, 156,140, 156,142-3-4, 156,149, 156,124, 156,137, 156,150, 156,189-9, 156,138, 171,084, 183,908, 184,532. D.R.P. 314,560, 327,575, 329,593, 331,348, 337,429, 337,487.

Plauson has embodied his modifications of the dismembrator mill in a standard design, generally known as Plauson's Colloid Mill, as shown in the diagrams. The standard size of this mill is 15 litres capacity, but larger sizes have been built. The containing case is a circular body of cast iron (or other suitable metal), the front being detachable on horizontal arms for inspection and repairs. The body is double-cased in the casting, the cavity being arranged for heating or cooling. The beater-wheel is mounted on a horizontal shaft (ball bearings) eccentrically placed. It consists of several armed discs of special quality steel bolted together. The arms pass closely with 1 to 3 mm. clearance through gaps in the stationary baffles (or anvils) above and below the axis of the revolving shaft carrying the beaters. The number, width, arrangement and clearance of the teeth may be varied. The beater-wheel and the two baffles almost fill the lower part of the mill case; in the upper part are feed-holes, level-gauge, sight-glass, cooling coils and steam-inlet. As an additional effect perforated baffle-plates are arranged co-axially with the beater-shaft in order better to retain the material within the area of the beater-wheel. The arm-wheel is rotated by a belt-drive up to 3000 r.p.m. The material in suspension is added through an inlet into the case, and, becoming engaged by the revolving wheel, is subjected to the forces between the wheel-arms and the baffles.

The arm-wheel at its high speed of revolution (3000 r.p.m.) may be considered to be running in a highly cavitated fluid offering small resistance, thus avoiding much of the loss of power experienced in some other mills by undue friction. The surrounding liquid suspension is said to be continually thrown towards the arms of the rapidly rotating wheel. The particles in suspension in this liquid receive a powerful blow either directly, or through the liquid between the travelling arm and the water behind it, at such a velocity as to shatter them before any of the force can be dissipated, thus utilising the short-duration high-energy impulse transmitted through the water. The disintegrating action of this mill is probabl in the main, mechanical. The use of t enclosing baffles is to impart an increase pressure to the liquid being forced through it b the travelling arm. Stress also is laid upon t function of the force of each individual blow the disintegration of particles, and distinctio is made between the positive results in th direction effected by a powerful force of sho duration, and the negative results of a small force over long periods. Thus, for each substance there is a minimum impulse, that is, i the colloid mill, a minimum rate of revolution the arm-wheel, below which disintegration cannot be achieved. This critical or specific ra of revolution depends upon the hardness, ela ticity, and strength of the material, and range roughly from 3000 r.p.m. upwards. In preparing some emulsions, it is stated that excessiv speeds have a coagulating effect. In certai cases temperature, too, it is stated, must b kept within certain limits for the best results.

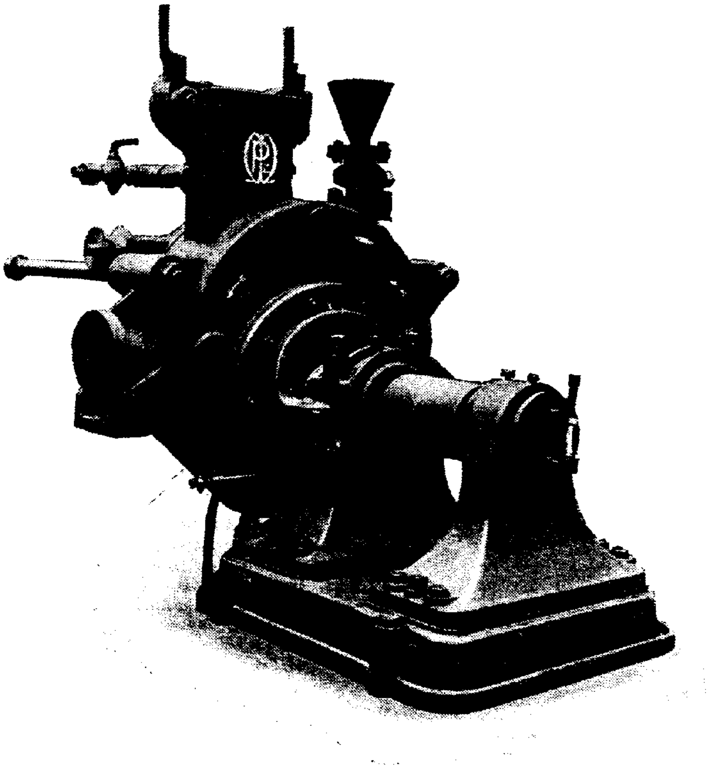


Sectional View of Mill: Front and Side Elevation.

In almost every colloidal preparation, however, the mechanical action of this mill i assisted by the addition of "dispersators" o "accelerators," which are claimed to be necessary for the preparation and permanency o many colloids. Their purpose is, by physical o chemical means, to allow or accelerate the disintegration of the particles and reduce th power consumed by the mill. Theoretically their function is to absorb or to precipitat soluble electrolytes always present, althoug sometimes only in traces, in the material bein reduced to the colloidal state. Actually, they appear to act as protective colloids. These accelerators cover a wide range of substances, as may be seen in the patent literature quoted. Another use claimed for the mill is the fractional disintegration of mixtures of substances of different hardness, enabling a ready separation of the less disintegrated ingredient by settling.

During a recent visit to Plauson's Research Institute, at Hamburg, a 15-litre mill, running at 3000 r.p.m., was inspected, and some experiments were carried out with this mill. A great variety of products made in the mill was seen. The specimens approximate to the list attached.

For the manufacture of colloidal solutions, it is proposed to run the mill as a continuous operation. Many substances are said to be sufficiently quickly dispersed in the mill as to be capable of being run continuously through at a comparatively rapid rate. With more resistant material a continuous process is aimed at by the use of a number of mills in series.



Complete Mill, showing Setting of Shaft.

The material to be milled must first be ground in ordinary mills, ball-mills, etc., since the colloid mill cannot deal with particles too large to be caught in the small clearance between the wheel-arms and the baffle-sides. After preliminary grinding, it is then made into a suspension with water (or other liquid), in suitable proportions not exceeding the specific saturation. The accelerator, the nature and amount of which depend on the colloid to be prepared, may be added at this stage, or simultaneously run into the mill. The suspension is then run continuously into the top of the mill, the beater-wheel of which must exceed the critical number of r.p.m. for the material being milled. During the milling the sight-box provides a view, and samples may be run off from the gauge-glass. The product, after passing through the mill, runs off continuously from the base outlet.

In some cases it is not considered economic to aim at a complete disintegration of the material in one set of millings, but to allow the non-colloidal material to settle out for milling in a succeeding batch.

If the milling continues over several minutes, a rise in temperature takes place. In the majority of cases this heat is stated to assist disintegration, but sometimes it is a disadvantage which must be obviated by a flow of water through cooling coils in the upper part of the machine. In some cases the injection of steam into the machine facilitates the disintegration.

Thus, a Plauson-mill installation would usually include preliminary crushers or breakers, pre-grinding mills, sieves, storage and mixing tanks for water, accelerator and suspension, and settling tanks for the milled product together with elevators, conveyors and dust catchers. When the colloid has to be separated special filters and driers might also be required (E.P. 155,834).

The output and power consumption of the mill depend on the ease of disintegration of the material, the extent of disintegration, and the rate of revolution of the mill. It is stated that three 15-litre machines in series, running at 9000 r.p.m., can grind 1000 kg. ground "raw phosphate," or 200 kg. cellulose in an hour to such a state of division that 85 per cent. of the particles is estimated to be of the order of 0·001 mm. diameter. Exact figures of power consumption have not been obtained. It is understood that with the older type of 15-litre apparatus for tar oil the power consumption was of the order of 1 h.-p. per 33 kg. of material disintegrated, and with calcium phosphate of the order of 1 h.-p. per 5 kg. of material treated. These figures are only very approximate and with the new machines, fitted with baffles, etc., and possibly run at higher speeds, a much greater output per h.-p. is claimed.

For convenience the industrial uses claimed for the colloid mill have been divided into four groups. The following is a brief outline, under these headings, of the industrial uses claimed :—

I. The Preparation of Plastic Masses

Raw material	*Use*
Sawdust-waste, wood-meal, mica waste (with resin, etc.)	.. Insulators, buttons, etc.
China clay	.. Filling, etc.
Slag	.. Road bricks, porous bricks
Shale residues	.. Bricks
Rubber waste	.. Regeneration and moulding
Gelatin, casein, starch	.. Masses (buttons, etc.)

II. The Preparation of Colloidal Solutions for Direct Use

Raw material	*Use*	*Remarks*
Sulphur	.. Disinfectant, spraying on plants	.. Rapidly absorbed
Creosote	.. Do., general	.. Avoids precipitation by dilution
Metals Cu Mn Ag	—	.. Form of disinfectant
Phosphate Felspar	Fertilisers	Rapidly absorbed without sulphuric-acid treatment
Milk (condensed)	.. Formation of milk (substitute)	.. —
Tar	.. Road spraying, etc.	.. Saves heating
Asphalt	.. —	.. —
Scents Essential oils	Scents	Saves solvent for exporting abroad. Increased efficiency
Mineral and organic pigments	.. Inks	.. New pigments can be used
Graphite Oil (grease) Water emulsion	Lubricants	Enhanced lubrication, avoids overheating of lubricant and charring
Resin (in water)	.. Polishes	.. Saves solvent
Vaselines	.. —	.. —
Shellac	.. Lacs	.. Saves solvent
Resin, size, cellulose esters, copal, Bakelite, rubber	Enamels, etc.	.. —
Ultramarine	.. Paints, etc.	.. —
Metals and alloys (bronze)	.. Paints, etc.	.. —

III. The Division of Materials for Chemical Action

Raw materials	*Use*	*Remarks*
Fats	.. Soap	.. Cold saponification
Nitro-compounds	.. Dyes, etc.	.. Cold reduction to amino-compounds
Nickel	.. For hardening oils	.. —
Peat	.. Fermentation	.. Rapidly assimilated
Cellulose	„ Viscose	.. „ „ Reduces amount of reagents
Cellulose	Glucose Fermentation	.. Dilute acids, higher yield,, avoids decomposition by acids

IV. The Separation of Mixtures by Fractional Disintegration

By suitably adjusting the speed of the mill and the type and amount of accelerator, intimate mixtures are fractionally disintegrated; and if the milling be suitably timed, a separation of one ingredient in colloidal solution from another in coarse suspension by simple screening through fine mesh sieves can be made, as for example :—

Application	*Remarks*
Dyes	.. Brown pigment removed from Royal Blue, etc.
Metallic ores	.. Metal from rock
Clay	.. Kaolin from silica
Shales	.. Oil from mineral
Bituminous coal	.. Montan wax

For the formation of emulsions, and the rapid, continuous, fine disintegration of soft colloidal solids, such as china clay, graphite, dyes etc., the mill offers possibilities.

In conclusion it may be said this colloid mill is sufficiently suggestive to justify a recommendation to manufacturers to put it to the test in every possible direction.

ATMOSPHERIC DUST*

The results referred to in this paper have been obtained by the aid of a new instrument for measuring atmospheric dust. This instrument has already been fully described elsewhere,† and therefore a very short description of the method will be sufficient for the present purpose.

The instrument is based upon the facts that atmospheric moisture can be condensed by a reduction of pressure and that such condensation occurs around the dust particles as nuclei. The principle is utilised by J. Aitken,‡ but in Aitken's dust-counter the actual particles counted are the drops of water, and as it is now known that condensation can occur round nuclei other than dust, the counting of such drops does not give the information required.

In the instrument referred to here the reduction of pressure and temperature is brought about by impressing a very high velocity on the air in a small jet. The jet travelling at its maximum velocity, *i.e.*, that of sound in air, has its pressure reduced by the loss of "velocity head," and condensation takes place; as the jet is caused to strike a microscope cover-glass placed 1 mm. away from the opening, the dust particles striking the glass adhere to it by virtue of the condensed water, which is then evaporated as the air flows away, leaving the dust behind.

In the actual instrument a ribbon-shaped jet is used, 1 cm. long and 0·1 mm. thick, and the efficiency of this, when used under suitable conditions, has been found to be extremely high. The air before entering the jet is caused to pass through a damping chamber to provide sufficient water.

The nature of the record obtained is a linear deposit of dust which can be examined microscopically or micro-chemically, and the number of dust particles counted. If sufficient air is drawn through the instrument a thick deposit of dust will be obtained, and if during the process the damping chamber is slightly warmed, excess water will be condensed and this dust deposit will be washed by the condensed water, with the result that on the record itself dried-up stream beds will be found flowing out laterally. In these streams crystals of the soluble salts contained by the dust are to be found. The dust particles are counted by means of a net-ruled micrometer eye-piece with millimetre squares, and by the use of this a few strips across the linear record may be counted and an average obtained which, multiplied by a factor depending upon the length of the record and the volume of air taken, will give the number of particles per c.c.

---

* Paper read by Dr. J. S. Owens, before Section B (Chemistry) of the British Association, Hull, 1922.

† Proc. Roy. Soc., A. Vol. 101, 1922

‡ Trans. Roy. Soc., Edinburgh. Vols. 30-36.

NATURE OF DUST OBTAINED FROM THE AIR

Size.—Most of the records taken to date have been in London, but a fair number have also been obtained in country districts and at sea. It has been found that the particles composing a smoke fog in London are curiously uniform in size and rarely exceed 1 micron in diameter, the average size being about half a micron.

Shape.—The particles vary in shape, and are usually irregular but with somewhat rounded outlines.

Composition.—It is somewhat difficult to ascertain the true composition of this suspended dust, but certain means are available such as crystallographic and micro-chemical methods. The suspended matter in London air can be definitely stated to consist mainly of soot. It has been possible, for examples, to volatilise from a record quite a recognisable quantity of tar. From the presence of sulphur in coal and coke smoke one would expect to find crystals of sulphates in the air of cities, and this has been found to be the case.

In country districts the dust obtained by means of this instrument is quite unexpectedly large in quantity under certain conditions; notably during the bluish haze which is often found over practically the whole of England with certain types of weather. This impurity is doubtless derived from cities. It is black in colour, contains some soluble salts, and is very finely divided, the size of the particles averaging about half a micron in diameter. The existence of a haze overlying a country is not, however, a proof of the presence of smoke, as I have found a similar haze at sea when nothing could be obtained from the air but crystals, presumably of sulphates. Again, a record taken in Algarve, in the south of Portugal, last March showed that a haze which existed at the time was composed practically entirely of common salt.

The nature of the dust suspended in the air is of considerable importance from many points of view:—In a haze consisting of salt crystals it is obvious that there would be a marked tendency to fog with a smaller increase of humidity of the air than would otherwise be required; due, for example, to fall of temperature. Doubtless in many cases the presence of such crystals suspended in the air is a fruitful cause of fogs. The dust, however, which is found over the country in England is quite different. It is mainly insoluble in water and the amount of crystalline salts contained is very small. This dust interferes with visibility, and one cannot help feeling that it is not conducive to health to breathe air containing several thousand insoluble particles per c.c., as is often the case during a comparatively light haze.

Microchemical Examination.—The attempt to produce crystals from the records, as already indicated, is one of the means available for examination; the crystals can then be examined microscopically for shape, and under polarised light; they can also be examined chemically by using minute quantities of reagents, but the excessively small size of the crystals, even when obtained, makes their recognition somewhat difficult, for the crystals rarely exceed a few microns in length and there is also the tendency to form imperfect and skeletal crystals. Records taken on cover-glasses treated with dilute solutions of an indicator, such as methyl orange, show that the dust is sometimes acid and sometimes alkaline.

Practical Bearings.—The importance of dust in the air from the standpoint of public health is well recognised, and to fix permissible standards of dust pollution it is essential to have a means of measuring it and of obtaining samples for examination. Again, in the study of visibility and factors affecting it, there appears to be little doubt that the presence of suspended impurity, other than water in the air, has a profound effect, and is, indeed, the governing factor. The whole question of visibility and its measurement is one requiring careful investigation since the present methods of measurement are very crude. There is little doubt that parallel measurements of visibility and dust pollution would show a definite relation between them, as, indeed, I have demonstrated.*

Another practical use for this instrument is in the testing of air-purifying plant. There are many forms of so-called air-purifying plants but few of them produce anything like the effect intended or claimed, and the methods adopted for examining their efficiency have been so unreliable as to be of little use. It is now possible, however, by the aid of this instrument, to state what is the percentage efficiency of an air-purifying plant; to say, for example, out of every 100 particles of dust in the air entering the plant how many penetrate through.

There is, again, a bearing upon the question of condensation of water from the air. It has long been held by some authorities that the initial stages of condensation take place round hygroscopic nuclei composed of soluble salts or even of sulphuric anhydride, and that the haze which we often see in the mornings, and which has already been referred to, consists of minute drops of water condensed round such nuclei. This is a question of fact rather than one of theory, and given a sufficient number of hygroscopic nuclei in the air there is no doubt condensation would initially occur upon them. The question is, however, are there a sufficient number present, and does the haze referred to consist of liquid? I think this question can now be answered fairly definitely: in some cases there are quite sufficient hygroscopic nuclei present and few or no solid dust particles, in others the reverse holds good, and the suspended matter consists mainly of insoluble dust. By the use of the instrument referred to, I have demonstrated that the haze over the country in England during a fine summer's day consists of insoluble dust and not liquid.

---

*Proc. Roy. Soc., A. Vol. 101, 1922.

Electrical State.—There is a method of examining the electrical condition of dust suspended in the air which has been adopted by Millikan and others by which the suspended particles are examined microscopically while in the field between two charged electrodes, one positive and the other negative. In such a field the dust particles sort themselves out, the positively charged moving towards the negative, and the negatively charged towards the positive electrode, neutral particles being unaffected. Tobacco smoke examined in this way shows a mixture of positively and negatively charged particles with some which are neutral.

In order to examine this effect a simple apparatus has been devised which consists of a vulcanite cell, 2 or 3 mm. deep and about 1 cm. in diameter, which contains two insulated electrodes connected to terminals on the outside. The cell can be placed upon a microscope slide and closed above by a cover-glass. Such a cell illuminated by the dark-ground method, and examined under a comparatively low power, say a ⅔ in. objective and ×10 eye-piece, shows the particles of tobacco smoke suspended in the air between the electrodes, each particle in rapid Brownian movement. By charging the electrodes the movements of the particles can be examined. The cell is illustrated in Fig. I, and it is hoped that by its use it may be possible to ascertain the electrical condition of London fog particles.

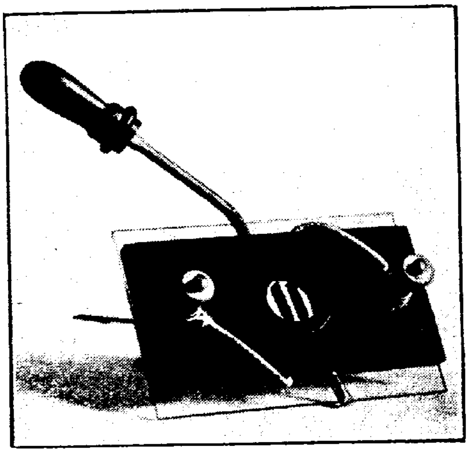


FIG. 1

SOURCES OF DUST

The common sources of dust are the smoke from imperfect combustion and dust blown up from the ground. There are other sources whose importance has not yet been ascertained; the most probable seem to be volcanic, cosmic, and solar. It is well known that the finer particles of dust ejected during volcanic eruptions may remain in suspension in the air for many months; again, the arrival of dust from outside the earth's atmosphere, either of cosmic or solar origin, would tend to bring about a concentration in the lower strata of the air, since the rate of settlement of such particles through the air would be continually reduced owing to the increasing density of the air near the earth. An extract from the *Barbados Advocate* of May 23, 1922, was referred to in the *Meteorological Magazine* of July last. This is of great importance in the present connexion and reads as follows:—"A peculiar phenomenon which has spread over the whole Carribbean from Barbados to St. Kitts, and extending south almost to Demerara, has been the prevalence of a low-hanging mist which has shut off the horizon. For some time the idea prevailed that it was dust due to volcanic eruption, but this was removed by the reports from vessels arriving, and from advices, from the neighbouring islands. Captains trading in these waters for years state that they have never before experienced such continued low visibility at this time of the year. No scientific explanation of the phenomenon has yet been offered."

Dust from space outside our atmosphere would naturally be drawn towards the earth when it came within the sphere of the earth's attraction, and there is little doubt that some, at least, of our dust comes from this source. There is again the projection of dust particles from the sun under the action of light which may also account for some of the dust in our atmosphere. The latter source has been dealt with by Fleming[*] and others.

In this connexion the presence of spherical particles mixed with the ordinary irregular dust particles is suggestive, and although a small proportion of such particles is nearly always found in the dust records, sometimes the proportion rises considerably, so that a very large percentage of the dust particles found consists of apparently perfect spheres, usually transparent and varying in diameter from 1·5 μ downwards. For example, early in March last the proportion of such spheres commenced to increase and towards the end of the month reached something like 50 per cent. of the dust particles in London air. The number of these and their distribution were investigated by Mr. G. M. Watson, the Advisory Committee's research chemist, and the result of this investigation is given below:—

The presence of an unusually large proportion of spherical particles in the dust of the atmosphere was first noticed on March 16, 1922, when, from a record taken with the jet instrument in Westminster, it was found that quite 50 per cent. of the particles was spherical. Many were apparently colourless and transparent, similar in appearance to air bubbles in a liquid, and as much as 1·5 μ in diameter, *i.e.*, three times as large as normal fog particles.

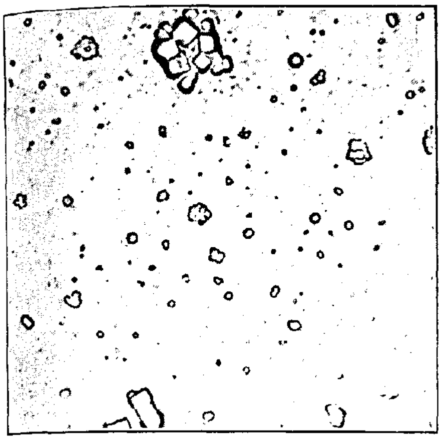
The presence of large spheres is not unusual since they are produced during combustion in certain types of industrial furnaces, but never before had such numbers been found. In an investigation carried out in the neighbourhood of such a furnace, 90 black spheres per c.c., together with 7700 smaller particles, were detected, the diameters of the spheres ranging from 0·75 to 1·8 μ.

On another occasion 64 spheres, of diameters from 0·75 to 1·5, with 3800 particles of an average diameter of 0·5 μ were found per c.c. These results, however, were obtained near a chimney from which spheres were constantly emitted, and all the particles were opaque and black.

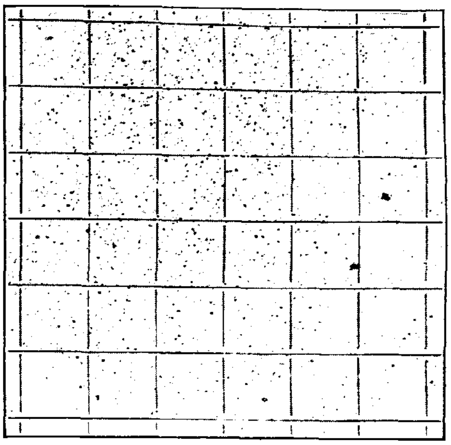
A local source of the spheres was suspected in Westminster, but records taken on March 18 and 19 in Surrey, 12 miles from London, showed a similar abnormality. Records taken on March 26, 20 miles

---

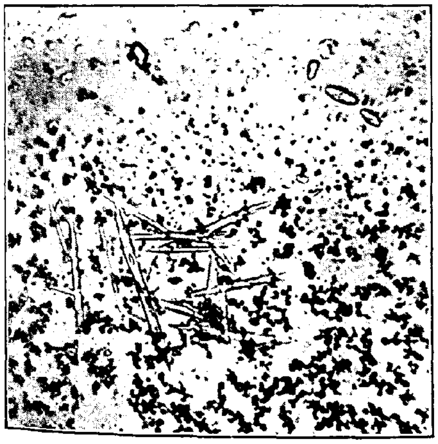
[*] Jour. Roy. Soc. Arts, Vol. LXX, No. 3604.



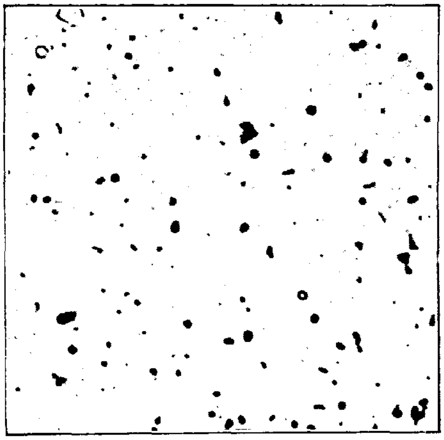
Haze of Salt Crystals,
Algarve, Portugal.
Magnification—1000 diameters.



Record of London fog, taken on Sunday, November 27, 1921, showing the squares in eye-piece used for counting particles. Magnification—approximately 250 diameters.



Suspended matter brought across the North Sea from the Continent, showing crystals and smoke particles. Record taken on East Coast of Norfolk, August 19, 1921. Each millimetre of linear record contains dust from 1000 c.c. of air. Magnification--1000 diameters.



Dust from London air showing spherical particles—Sunday, March 26, 1922. Wind from N. Each millimetre of linear record contains dust from 5 c.c. of air. Magnification—2000 diameters.

north of London showed the same phenomenon, when the wind was from the North. The investigation was therefore continued, records were taken under conditions as varied as possible, and many back records were re-examined with a view to ascertaining:—(1) Nature of the spheres; (2) first occurrence in abnormal quantities; and (3) subsequent distribution.

Appearance of Particles.—Every examination was carried out under a 1/12 in. oil-immersion objective, a magnification of at least 1200 diameters being essential. Whereas the majority of the particles seem solid and opaque, the larger ones appeared as black circles, each with a bright spot in the centre. The width of the bounding rim could be altered and the bright centre moved slightly from side to side by varying the illumination. The smaller the particles, the smaller were the bright centres, and at a diameter of 0·75 μ the spots disappeared and the particles appeared entirely black. Occasionally reddish brown spheres were found.

The term "transparent sphere" will be here reserved for the particles large enough to show a bright spot in the centre, although the small black spheres may be made of the same material.

When an object, such as a pencil, was interposed between the source of illumination and the microscope-condenser, each transparent particle behaved as a lens, producing a sharp, recognisable image of the object. For instance, it was easy to distinguish between the square and pointed end of a pencil by examining the images produced in spheres of 1·5 μ diameter. Images of the thin supports of a stop in the carrier of the condenser were perfectly definite, about half a micron above the spheres, showing that they were composed of a transparent glassy material and their appearance was not a spurious effect due to diffraction. The dust was mounted dry; thus bubbles were impossible.

When mounted in xylol, Canada balsam, cedarwood oil, or water, the transparent spheres altered in appearance but did not dissolve. This was established by focussing upon a particle and allowing the liquid to flow under the cover-slip until the sphere was immersed. The spheres then appeared less conspicuous and the bright centres became smaller. From the movements of the boundary, when focussing on a sphere mounted in balsam, it was concluded that the refractive index of the material was slightly less than that of Canada balsam—1·54. The particles were not hygroscopic. After being kept for some weeks several records became covered with drops of moisture, but there was no tendency for them to form round the spheres more than on other parts of the cover slip. Occasionally spheres were enveloped in the drops, but they remained undissolved. The spheres had no effect whatever on polarised light, and mounted in blue glycerin jelly showed no tendency to take up the stain. The effect of heat was never attempted, as this was impossible under the microscope.

Quantitatively the problem was much more difficult and the results can be taken only as a rough guide, for the following reason:—No distinction is possible between transparent spheres and black spheres, the one passing into the other at a diameter depending somewhat upon the illumination, thus introducing a personal element. Moreover, there is a limit to the resolution of the microscope, and below a diameter of 0·3 μ, every particle appears spherical—a spurious effect due to diffraction. Thus, if true spheres and irregular particles were present together, distinction would depend entirely upon the size of the irregular particles. In general, spheres classed as transparent were of a diameter of 0·9 μ or over. In estimating the number of black spheres, all particles above the limit of resolution which were obviously spherical and not large enough to appear transparent were counted.

The type of result will be best illustrated by a particular case. On April 5 last, at 4.30 p.m.:—

Total number of particles per c.c. ..	2,400
Number of transparent spheres definitely greater than 0·9 μ.	26 per c.c.
Number of spheres greater than 0·75 μ. but not all transparent	50 per c.c.
Very many spheres	1·2 μ. diams.
Few small particles, estimated as 10% below limit of resolution. All above limit appeared spherical. Therefore 90% called spheres.	

Results.—Table I shows some typical results selected after examination of a large number of records.

TABLE I

Date (1922)	Time (summer time)	Total No. of particles per c.c.	No. of transparent particles per c.c.	Percentage of transparent spheres	Estimated % of all spheres	Place of observation
Mar. 18	Afternoon	1200	66	5·5	100	Cheam, Surr'y
„ 20	1 p.m.	17,200	410	2·38	—	Westminster
„ 20	4.30 p.m.	8,450	212	2·60	—	„
„ 26	1.45 a.m.	5,200	106	2·23	50	Bloomsbury
„ 27	12.45 p.m.	5,100	80	1·57	50	S. Kensington
April 1	10.10 p.m.	4,500	53	1·18	50	S. Kensington
„ 3	3.45 p.m.	14,100	159	1·13	—	Westminster
„ 5	4.30 p.m.	2,400	26	1·08	40	S. Kensington
„ 9	12.30 p.m.	9,440	146	1·54	50	Bloomsbury
„ 17	4.30 p.m.	1,960	10	0·51	50	Grimsby, L'cs.
„ 29	6.30 p.m.	6,120	80	0·13	100	S. Kensington
May 3	6.30 p.m.	8,530	0	0	20	Westminster
„ 6	5.30 p.m.	2,580	40	1·55	90	S. Kensington
„ 9	12.15 p.m.	2,610	26	0·99	50	„
„ 25	4 p.m.	3,480	0	0	10	„

The only definite conclusion which can be formed is that about March 4 there appeared in the air some abnormal particles, reaching a maximum about March 18, followed by a slow return to the normal. The spheres were not confined to one district and therefore, presumably, the source was not local, yet there was apparently a distinct variation with the smoke content of the air. If the source were extra-terrestrial the number of spheres might be expected to be independent of other particles, which is clearly not the case.

On consecutive days, at corresponding hours, there are great variations in the smoke content of the air of cities. This does not imply that on one day more smoke is produced than on the other, but that on some days meteorological conditions do not permit of its removal. If the conditions which prevent smoke from rising would also tend to bring down any impurity from the upper air due to a distant source, this might account for the relationship between the spheres and smoke particles above indicated.

Attempts to correlate the number of spheres with other particles were made on May 8, 9, and 11, when series of records were taken at the same place throughout the day. The results were not conclusive, since the spheres were not sufficiently numerous to give a reliable indication, but there was no evidence of any definite relation to the number of other particles. In 10 cases out of 11 the number of transparent particles per cubic centimetre was 13, whereas the total number of particles per c.c. varied from 1850 to 5750.

Fig. 2 shows the daily percentage of transparent spheres, and if the spheres and smoke particles had the same origin we should expect the percentage to remain fairly constant, whereas it varies considerably.

Variation of Transparent Spherical Dust Particles in Air

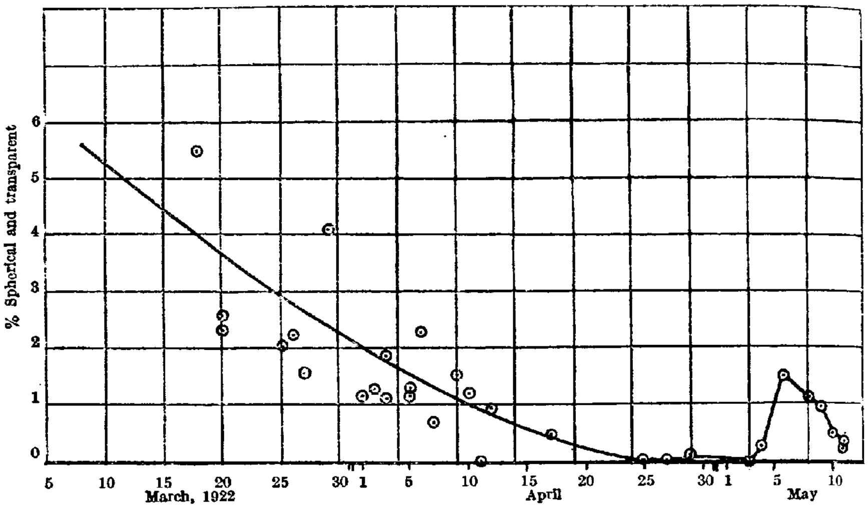


Fig. 2

Origin.—Some of the possible explanations of spherical particles in the air are as follows:—(1) Micrococci; (2) spores of fungi, or pollen grains; (3) drops of oil or of solutions; (4) furnace ash; (5) bits of crystal too small to show definite shape; (6) organic matter synthesised from CO_2 and H_2O by radio-activity; (7) cosmic or solar dust; and (8) volcanic dust.

Considering each of the above separately, we may dismiss most of them as unlikely in the present case.

(1) Micrococci should show more uniformity of size than the spheres noted. They should presumably be independent of, or vary inversely with, the smoke content of the air, and should be capable of staining. The presence of micrococci could not explain the sudden increase of numbers in March and subsequent decrease. Micrococci are also of large diameter.

(2) Spores are rarely less than 12 μ and pollen grains than 25 μ in diameter. The particles noted never exceeded 2 μ. Spores are capable of being stained and would not account for the increase in March.

(3) Drops of oil or solutions would be soluble in xylol or water.

(4) Industrial furnace smoke would not produce large variations in the percentage of spheres on different days and gives no explanation of their comparative absence before March 4.

(5) Crystals below a critical size are spherical in shape and these spheres may be minute crystals of insoluble matter. But they have no effect upon polarised light and show no tendency to grow together. Further, this will not explain the increase in March.

(6) Formation of globules of carbohydrates by radio-activity has been described.* This would not explain the increase in March and the variation with smoke content of the air.

(7) Cosmic dust. This is a likely explanation but does not account for variation with smoke content. If the whole of the upper air were full of spheres they should be detected all over the world. This was not noted. Records taken in Portugal in April contained no spheres.

(8) Volcanic dust is the most probable source. This is known to travel great distances (compare Krakatoa, 1883), and for some time before March there was great volcanic activity in Europe. Particles of material thrown molten into the air would assume a spherical shape and cooling quickly would remain structureless.

In verification of the volcanic dust theory, a sample of the finest dust collected at Krakatoa after the eruption of 1883 was examined.

Only the larger particles which had settled near the volcano were available and so a comparison with the minute spheres obtained in the jet-apparatus records was hardly correct, though information which may throw light upon the nature of the material of the spheres was obtained. Nearly all the particles consisted of thin flakes of colourless, glassy material with a finely pitted surface, broken into irregular angular pieces. The appearance suggested fragments of thin-walled bubbles blown in molten glass. The size of the pieces ranged up to 18 microns, the average being about 12. Very few were smaller than 3 μ, but there were some spheres of diameter 1·2 μ, identical in appearance with the unknown atmospheric dust. There were also a few perfect spheres with smooth surface of about 5 μ diameter, some appearing reddish-brown in colour.

When mounted in Canada balsam the large irregular particles disappeared, the refractive index being the same as that of balsam. Their positions could then be distinguished by the fact that many of the marks on the surfaces were really adhering particles, which in balsam stood out as black spheres up to 1·2 μ diameter. These were not air bubbles in the balsam, as they were quite different in appearance. Occasionally black spheres up to 3·5 μ diameter, made more obvious by the disappearance of the irregular pieces, were also seen, affording support to the theory that the particles described above were of volcanic origin.

---

* Harrison Glew, *Nature*, June 3, 1922, 714.

The photographs given illustrate some of the records obtained by the instrument referred to.

The following are typical counts of recent records which afford comparison of the state of the air in different localities:—

TABLE II

Date, 1922	Place	Time (summer time)	No. of smoke particles per c.c.	Remarks
Sat, Sept. 2	Holme, Norfolk	12 noon	152	Country air, no chimneys near
Tues. „ 5	Brighton	12.10 p.m.	1,380	Wind NE'N.
Thur. „ 7	Hull, near Victoria Pier	7.30 a.m.	4,830	Thick water fog
Fri. „ 8	Do.	7.15 a.m.	8,100	Wind NE'N. Smoke haze
Sun. „ 10	Do.	6.30 p.m.	3,080	Wind NE'N. Air obviously clearer
Mon., „ 11	Do.	7.30 a.m.	13,800	Wind W. Thick smoke haze
„ „ 11	Outside Spurn Point	4.30 p.m.	140	Haze visible over land

SOCIETY OF CHEMICAL INDUSTRY

ANNUAL DINNER IN LONDON

This year's annual autumn dinner of the Society was held in the Connaught Rooms, London, on October 13, Dr. E. F. Armstrong, F.R.S., President, in the chair. Among the guests were Mr. Roscoe Brunner, the Rev. E. C. Pearce, D.D. (Vice-Chancellor, Cambridge University); Mr. Robert Hicks (Master of the Salters' Company); Mr. Chas. T. Heycock (Prime Warden of the Goldsmiths' Company); the Hon. W. Hulme Lever; Sir R. Waley Cohen; Mr. Max Muspratt (Chairman of the Association of British Chemical Manufacturers); Dr. H. S. Hele-Shaw (President of the Institution of Mechanical Engineers); Mr. A. Chaston Chapman (President of the Institute of Chemistry); Mr. P. A. Ellis Richards (President of the Society of Public Analysts); Mr. A. Gordon Craig (Chairman of the Chemical Industry Club); Dr. T. M. Legge (Chief Medical Inspector to the Home Office); and Mr. E. G. Gillick, the designer of the Messel Memorial Medal.

Proposing the toast of "The Society of Chemical Industry," Mr. Roscoe Brunner said that although they could have selected a more distinguished person than himself to propose this toast, they could not have chosen a more appropriate one because his family and business connexions with the Society dated from its very commencement. Mr. Ludwig Mond, his father's partner, was chairman of the first meeting which started the Society, and his patron saint, Henry Roscoe, was the Society's first president. Incidentally, Henry Roscoe had had something to say about the tonnage of salt which had been decomposed during his first year of office by the Leblanc process, and it was noteworthy that the tonnage of soda produced in that year was equalled in ten days during the palmiest days of the ammonia-soda process. That showed how the world had progressed. He ventured to say that the Society of Chemical Industry since its foundation had done more to raise the status of the chemist than any other agency. He could claim to have been connected with the chemical industry since 1874, and in those days the elder members of the Society would remember that a chemist who had not been educated somewhere on the Continent was not considered worth his salt; but we had progressed very far since then. The scientific education in this country was certainly better than the scientific education in any other country in the world. Even Oxford now had a very brilliant scientific school, and speaking in the presence of so distinguished a member of the University of Cambridge as its Vice-Chancellor, he even ventured to say that Oxford had a reputation as a school of chemistry second to none in the whole world. He hoped that the Society would continue to press for the better standing of the chemist. In his opinion it was improper that the scientific man who had studied chemistry should be classed with the pharmacist, and he hoped that the Society would take such steps as were possible to give the chemist that standing in the world to which, in the opinion of those qualified to judge, he was entitled. What steps the Society could take to that end he confessed he did not know. He wished long life and prosperity to the Society of Chemical Industry.

Dr. H. S. Hele-Shaw supported the toast and said that he felt quite at home in a gathering of chemists because of the close relationship between the work of the chemist and the engineer. He was, moreover, happy to be in the company of the sons of two men who had done so much for chemistry and engineering. The late Sir John Brunner was one of the greatest friends of all professors and a generous host. When they wanted advice, assistance, and sometimes pecuniary assistance, they knew where to go and never came away empty. Mr. Max Muspratt, who was present, was also the son of a man who had always assisted the universities. The objects of the Society of Chemical Industry and the Institution of Mechanical Engineers were identical in their respective industries, and everyone knew how the chemists and engineers had come together and were jointly responsible in aiding, backing up and making a success of the noble efforts of the fighting line during the war. It was admitted that the engineers and the chemists did not fail when the crisis came. All these things made him, as an engineer, feel at home in a gathering such as this. The chemist of to-day was not the chemist of the old days. Times had changed. The picture of the old chemist was that of a venerable man with a long beard reaching to the ground, a man who worked in a very dark and mysterious place, with, perhaps, a long tall hat, something like a fool's cap, on his head, with various retorts and furnaces all around him. That old idea of a chemist, like the old idea of an engineer, had passed away. The chemical works of to-day had its furnaces and retorts, but there was a great development of engineering appliances in the chemical works of to-day, and it was this which constituted a great bond of union between the chemist and the engineer. Engineers and chemists must co-operate, for it was co-operation which formed the strongest bond of union between men. In another respect the Society of Chemical Industry and the Institution of Mechanical Engineers had an interest in common, and that was they both issued Journals. The ably-edited *Journal of the Society of Chemical Industry* gave the latest information of what was going on all over the world, just as the *Journal of the Institution of Mechanical Engineers* tried to do. The Institution of Mechanical Engineers had just celebrated its 75th anniversary and had a membership of 10,000. The Society of Chemical Industry was in its 40th year and had a membership of about 6000, a figure which the Institution of Mechanical Engineers reached ten years ago. He hoped that in another ten years the Society would have a membership equal to that of the Institution of Mechanical Engineers and that it would continue to progress and flourish.

The President (Dr. E. F. Armstrong), replying to the toast, said that in the old days chemistry was a very formal science; chemists were very formal people and they used to have very formal dinners and sit at long tables. Everything now had changed. Formality had gone by the board and ladies now appeared at their functions. It was, indeed, the desire of the Society that the proceedings should be as informal as possible and that enjoyment should be general. If we endeavoured to take a broad view of the present as compared with the past, it was instructive to cast our eyes right back to ancient Egypt, to ancient Greece, and to the wonderful Roman Empire, and to reflect in what way we differed from the men and women of those times. Had we progressed in Art? He thought the answer was No. Had we progressed in Literature? The answer was No. Had we progressed in Government, whether State or Imperial? Had we progressed or were our methods not founded on those of the ancient Empires? Why was this age different? Was it not because of mechanics and mechanical inventions? This was a mechanical age and all the changes which had taken place were due to the brains of man evolving mechanical aids for his well-being. The theme which he wished to elaborate for a moment was that whilst we used the term "mechanical" and thought of the mechanical inventions, was it not the chemist who had made these discoveries and the engineer had taken the credit? Ought not it to be asserted at meetings such as this that engineering was but the handmaid of chemistry, and that the engineer was but the kindly gentleman who carried out in the world the ideas which the chemist had conceived in the laboratory? What they wanted to drive home was that the engineer—who he believed originally was a Scotsman—was a very canny man. They had just been told that 35 years before the chemists, the engineers got together and formed a society, and the moral they had to learn was that the engineers got together and as a consequence of that they had got the ear of the public and the credit, and well they deserved it, because surely the prize was to the swift. Chemists did not seem to have been swift enough. Take the social services which were so essential to the public. In the case of the water supply of the great City of London, which was the outstanding name? He believed it was the name of Sir Edward Frankland. But who really got the credit for the water supply of the City of London? It was one or other of their friends the engineers. The same thing applied to sewage; it was the chemist who had made the discoveries which had rendered it possible to live in our great cities, but it was the engineer who had reaped the reward both materially and in the shape of knighthoods and the like. There was something about the chemist which was hard to define. Chemists seemed to suffer from an excess of modesty, and if they were to reach that standard of excellence and to have that weight in the counsels of the nation they deserved, something must be done to put this state of things right, and the only advice he could give them that evening was advice based on the words of the President of the Institution of Mechanical Engineers, viz., to keep on getting together. The chemists in the Society o Chemical Industry numbered only some 5000; le them get together and become 10,000 in a very shor time.

Passing to another theme, the President said tha the Society was unique in that its activities wer world-wide. It had Sections not only throughou the British Empire, but even firmly planted in th very heart of the United States. Two President had been citizens of the United States, and h wished to emphasise the importance both to th welfare of Anglo-Saxon chemistry and also to th welfare of civilisation, that British and American should stand together firmly at the present juncture If any of them had sufficient leisure to reflect upo the future of civilisation they could not help havin a fear for its future at the present time. Th world was upset. The East was in a fermen and in the Bolshevik Great Britain had th greatest enemy she ever had in her history. A the present time we alone stood in the brea between Bolshevism and the wreck of all that we hold dear. It was a great pity that America did not understand that fact and had not yet come to our assistance. If any of them had the advantage of going to America they would realise that what was called America was not America. America was controlled politically by the inhabitants of what was known as the Middle West, and those people lived so far from the sea that they did not understand the problems of Europe. Some of the enlightened men in America, and particularly enlightened chemists, realised the danger, but as chemists we must make our brother chemists in America alive to the fact that the situation menacing civilisation is a grave one. We must co-operate as chemists and develop an Anglo-Saxon chemistry. The first steps in that direction had already been taken, for the Society of Chemical Industry was almost a pioneer and unique in having an American Section; he felt that a message should go forth across the seas on the occasion of a meeting like this to tell our American friends that there were duties bigger than national duties, namely, a duty to civilisation. The time had come when chemists must hang together if they were to go forward, and they must put the interests of their profession before themselves. He wished to thank Mr. Roscoe Brunner and Dr. Hele-Shaw for the kind words they had said about the Society, and to express the hope that the chemists could rely upon the support of the great and successful manufacturers and their friends the engineers.

Mr. Edwin Thompson proposed "The Visitors," and in mentioning their names said the Society looked forward with very great pleasure to being the guests of Cambridge at the next annual meeting.

The Rev. E. C. Pearce (Vice-Chancellor, Cambridge University), who replied, said that although, as Mr. Roscoe Brunner had said, Oxford University might have a school of chemistry second to none, he noticed that the Society was not going to Oxford for its next annual meeting. Speaking of the applied chemist and the pure chemist, he said that in Cambridge they had a very great respect for the applied chemist, because he had done a great deal for the University and was going to do much more for it. Some of them might know that the oil firms a little time ago gave the University 200,000 guineas because they realised what pure chemistry in Cambridge was doing for them. The University very much appreciated the action of the oil firms, and wished that other firms would do the same because they were all very poor in Cambridge. That was really no laughing matter because the salaries for which people who were worth very much more were working in Cambridge would surprise those present if he were to mention them. That, however, was rather a domestic matter; on behalf of the visitors, he wished to say that if the Society enjoyed itself in Cambridge at its next annual meeting as much as he had enjoyed himself—and he was sure the other visitors, too—at that dinner, the University would be more than repaid.

NEWS FROM THE SECTIONS

BRISTOL

On October 13 the first session of the Bristol Section—which does not now include South Wales—was inaugurated by an address from the President, Dr. E. F. Armstrong. Mr. C. J. Waterfall, the chairman of the Section, presided over an audience of 111 members and guests, the latter including a large number of students of the Chemical Department of Bristol University. Dr. J. P. Longstaff was also present. At the close of the address votes of thanks to Dr. Armstrong were moved by Prof. F. Francis, on behalf of the students, and by Dr. T. H. Butler, seconded by Dr. F. W. Rixon, on behalf of the members of the Section.

Dr. Armstrong, who chose as his subject "The Importance of the Chemist to the Nation," first spoke of the great services rendered by chemists during the war, and said that it was the duty of the Society and possibly of the Institute of Chemistry to see that such a shortage of chemical munitions which was then experienced would never occur again. The man-in-the-street did not fully realise the value of those services, and he was sure that the daily Press did not, for from time to time it made announcements of great discoveries which either were erroneous or had been made many years before. The ignorance of the public was due mainly to the ignorance of the Press, and the chemist was responsible for the latter. The chemist was far too modest and had allowed others, *e.g.*, the engineer, to take the credit that was due to him. Prof. Hinchley had said that the success of our chemical industry depended upon our progress in engineering, but he (the speaker) would say the success of our engineering industry depended upon our progress in chemistry. That was well illustrated by the history of the development of high-speed steel; the credit of the achievement had gone to the engineer. Most applied sciences were really applied chemistry; and the chemist's work had laid many of the foundations of human progress. As illustrations might be cited the solution of problems connected with sewage disposal and other public utility services, therapeutics, the discovery and manufacture of antiseptics, food-supply, and so on. How came it that the chemist's work was unknown or imperfectly understood? In the first place, the youth of the country was brought up largely on obsolete educational methods. Almost everyone posed as an expert on education, and hence that subject had been a great battlefield for would-be reformers; and the more would-be reformers the smaller the progress. There had been some advance in the teaching of science, but the urgent need was to stimulate the pupil's interests and activities in such a way that he learnt without conscious effort things really worth knowing, and not merely such things as the names and deeds of professional cricketers and football-players! By teaching science in that way, the public would learn to appreciate it and there would be an end to the murders of elementary scientific facts committed by the Press. At present chemists were almost incomprehensible to one another; how much more so must they be to the man-in-the-street. They must learn to express themselves in clear and simple language. They had many advantages over the average man; in their first year's training in the University, experience in analytical work should inculcate the habit of inquiry and develop to some extent the critical faculty; in the second year they should acquire the synthetic, the constructive, habit of thought; and in the third year, when they passed on to theoretical studies, they had a good opportunity of developing their reasoning faculty. Chemists had something to learn from the medical profession, especially in the matter of standing together. No profession exercised so much authority with so little knowledge. How did they do it? The explanation was that every medical man praised every other medical man. On the other hand, the characteristic of the chemist was to condemn every other chemist. Chemists must learn to speak with one voice. On several occasions when he had taken part in a deputation to a Cabinet Minister on some question of importance to chemical industry, he had learned that a day or so before an equally eminent deputation of chemists had waited upon the Minister to express diametrically opposite views. Unless chemists pulled together they would never speak with one voice and never exercise any real power in national affairs. He regarded the formation of any new society as a potential disaster to the community of chemists. There should be one, and only one Society, with sectional groupings, if necessary, but all under the umbrella of a Federal Council, to which the affiliated sections would send representatives. With the exception of organised labour, the most powerful community in the country was the brewing industry, and this was because it spoke with one voice. The organisation of chemists in this country compared badly with that in America and Germany. Lately the Institute of Chemistry had opened wide its doors and was now really representative of the chemical profession; and he would ask all those who could to support what he might term the latest form of collective chemical activity, viz., the Chemical Industry Club, which had the great advantage of being one of the few places where chemists could meet and converse informally.

Speaking to the younger chemists present, Dr. Armstrong pointed out the need for greater self-assertiveness on their part, particularly in regard to joining in discussions at meetings like the present one. In the past the work of leading and supporting the Sections had been left to a small minority. It would be a healthy sign if at an election for a local committee there were twice as many candidates as there were vacancies to be filled. Then, again, the elder men complained sometimes of narrowness of outlook on the part of the juniors. Personally, he thought that an attempt was made to teach far too much in the University course. This was not the fault of the teacher, but of the syllabuses on which examinations were based. The result was that far too much time was spent in preparing for examinations. The ultimate test of a "first-class" man was his ability to acquire knowledge of any subject in which he was interested. Broadness of outlook should be cultivated to the fullest extent possible in private life; and the future chemist would benefit if he would almost drop his chemistry as chemistry and regard it as a training in scientific method, which was to be applied to the broadening of his interests. When the University graduate entered the works he would find that his knowledge was more up-to-date than that of many with whom he had to work, and this advantage, among others, would give him driving power; the ability to speed up a process or any part of it was worth more than all the first-class honours in the world. The chemical profession was terribly overcrowded at the present time, and the men who entered the Universities during the post-war boom were now leaving them at a time of great industrial depression; to find employment was very difficult. These men should remember that they had lost nothing by their scientific training; if they had profited by it they would be in a position to take any job provided it was an honest one, *i.e.*, one that required hard work and "push." Better progress could be made in commercial posts, for which there was much less competition, than in the position of junior chemist, which too often led to nowhere.

SOUTH WALES

The first meeting of this new Section was held on October 20, in the Technical College, Cardiff, Prof. C. M. Thompson presiding. A paper was read by Prof. W. J. Jones on "The Congealing Temperatures of Essential Oils," describing an investigation carried out in the University College, Cardiff, on essential oils, and in which special attention was given to their purification and to the thermometry. It was shown that European oil of rue consists of a solution of methylheptylcarbinol in methylnonyl ketone; the congealing temperatures of the purest product, after repeated fractional crystallisation followed by distillation *in vacuo*, was found to be 12·6° C. Aniseed oil showed a maximum congealing temperature of 21·3° C., which is also the freezing-point of pure anethole. When the oils are at least of 93 per cent. purity, it is found that the percentage of impurity is directly proportional to the difference between the observed freezing-point and that of the pure oil; so that a simple determination of the congealing temperature affords an accurate method for the analysis of essential oils when the required data on the pure oils have been obtained. Many of the required data are given in the paper.

CHEMICAL ENGINEERING GROUP

On October 20, in the Hotel Cecil, London, members of the Group gave a complimentary dinner and made a presentation to Mr. H. Talbot on the occasion of his forthcoming marriage, as an expression of appreciation and gratitude for the good work he has done as hon. secretary of the Group. Mr. J. Arthur Reavell, chairman of the group, presided and proposed Mr. Talbot's health; other speeches were made by Prof. J. W. Hinchley and Messrs. C. S. Garland, F. A. Greene, W. J. Gee, F. H. Rogers and E. A. Alliott. A programme of music, as well as a "syncopated" orchestra, contributed to the general enjoyment.

MEETINGS OF OTHER SOCIETIES

THE CERAMIC SOCIETY

The eleventh meeting of the Refractory Materials Section of the Ceramic Society, held in Birmingham on October 3 and 4, was characterised by a full and varied programme. Lt.-Col. C. W. Thomas presided, and after a few introductory remarks from him the regular business commenced with a discussion on "Bricks for Coke Ovens." This was opened by Mr. A. H. Middleton's paper, in which he strongly advocated the adoption of silica bricks in preference to the clay silica bricks now mostly used in this country. There seemed to be fairly general agreement that silica bricks would give better results in cases where salty coals were coked, but in other cases, whilst some speakers favoured the use of silica bricks, others considered that, having regard to the different conditions here and in America, a satisfactory quality of the type of brick now used would be more suitable.

Sir Arthur Duckham described "Some New Forms of Kilns" which have been successfully used during the last few years. One of these consists of 16 chambers placed in two rows side by side. Each chamber has four fireholes and bags, and the firing is semi-gaseous with down-draught. The products are firebricks, burned to cone 13, and artificial draught is recommended. A second type of kiln consists of a single chamber with a central bag, heated by an outside producer burning coal. This gives even heating and other satisfactory results. In an open tunnel-kiln, cross walls on each truck, registering with offsets on the kiln walls, force the gases to travel zigzag, and in this way the length of the tunnel-kiln can be reduced from, say, 300 ft. to 130 ft. The heating is even, and cooling is greatly facilitated. An annular tunnel-kiln was designed for burning large glazed goods. Continuity of the tunnel is broken at the unloading and loading point, but the annular firebrick tray carrying the material is continuous all round the kiln. The kiln is heated by producer gas burned in six separate horizontal flues placed one above another in the side walls of the tunnel. Mechanical draught is provided by fan and motor. The chief advantages of this kiln are convenience of working, elimination of trucks, even heating, and economy of fuel.

"The Grading of Silica Bricks" was the subject of a paper by Messrs. P. B. Robinson and W. J. Rees. The results obtained led to the conclusions that for a mechanically strong brick (*a*) a hard rock crushing into fragments of high angularity is ecessary; (*b*) the best size for the largest pieces the brick is 6—7 mm., these large angular pieces mparting strength to the brick both at high and w temperature; (*c*) at least 40 per cent. of fine round material passing 100-mesh should be used, nd for a dense brick addition of fine ground aterial from a ball-mill must be made; and (*d*) the ricks must be well-burned.

In a paper on "The Behaviour of Fireclays, auxites, etc. on Heating," by Mr. H. S. Houldsworth and Prof. J. W. Cobb, the materials nvestigated included several forms of silica and lumina, red and white bauxites, kaolin, fireclays, nd other hydrated compounds of silica and lumina, and the three minerals of the composition $Al_2O_3.SiO_2$. The outstanding points are:—(*a*) Kaolin and all the clays and shales examined show distinct heat absorption at 500°—530° C. and heat evolution at a higher temperature; (*b*) this heat evolution occurs at 1060°—1130° C. with pure alumina made by calcining aluminium nitrate at 700° C., but about 100° C. lower with the bauxites and clays; (*c*) most of the materials show heat absorptions below 500° C., presumably due to the loss of water from colloid substances; (*d*) the phenomena observed with the clays are not primarily dependent on the presence of silica, being noticeable with alumina and with a red bauxite practically free from silica; (*e*) although alumina calcined at 700° C. and the bauxites and clays showed marked heat evolution at about 1000° C., precipitated alumina gave no sign of it.

"Some Changes Taking Place in the (Low-Temperature) Burning of Stourbridge Fireclays" was the title of a paper by Mr. C. E. Moore. Four different clays were examined, two Old Mine and two New Mine, of which analyses are given, as well as very numerous data concerning contraction, porosity, specific gravity, hygroscopicity, solubility in HCl, heating curves, and dehydration. The chief conclusions are:—(1) Three definite critical ranges are to be found in Stourbridge fireclay at temperatures approximating to 700° C., 920° C., and 1030° C.; (2) the changes take place in all the clays of the series and at similar temperatures in each; (3) the magnitude of the changes decreases slightly with the alumina content, particularly of the changes at 700° C. and 900° C. The change at 1030° C. is probably of a purely mechanical nature.

A paper entitled "X-Radiogram of Kaolinite, and the Thermal Decomposition of Clay" was communicated by Prof. W. H. Bragg and Dr. J. W. Mellor. Prof. Bragg has recently been working on the structure of crystalline powders with the aid of X-rays. He has found definite crystalline structure in kaolinite before heating. After heating at 600° C. it becomes practically non-crystalline, showing the merest trace of crystalline material. Radiograms of china clay were found to agree with those of kaolinite.

"An Examination of Refractories by the Oxy-Hydrogen Blowpipe," by Mr. A. L. Curtis, relates to a method for rapidly examining the properties of refractories, especially in small amounts. Coal gas or acetylene may be used instead of hydrogen, but acetylene is difficult to control for a small test-piece. The refractory in powder is mixed with water or with a solution of dextrin in water. For check tests Seger-cone mixtures are similarly prepared, and the number of seconds required to produce the desired effect is noted. A camera is used to record appearances, microscope- and telescope-objectives being employed. The effect is watched on a screen all the time.

The final paper was by Dr. C. H. Lees, "On the Stresses in Cylindrical and Spherical Bodies due to Differences of Temperature Inside and Out."

THE CHEMICAL SOCIETY

The first ordinary scientific meeting of the session 1922—1923 was held on October 5. The President, Sir James Walker, alluded to the appointment of Dr. M. O. Forster to the post of Director of the Indian Institute of Science, Bangalore, and said that his wise guidance of the Society's finances during the critical period of high expenditure had obviated further increase in the subscription. Prof. J. F. Thorpe had been appointed by the Council to fill the office of treasurer, and Prof. J. T. Hewitt to that of vice-president, each to hold office until the next annual meeting.

Sir J. Walker made a further appeal on behalf of Russian men of science, and read a letter from the president of the Russian Physical Chemical Society acknowledging assistance already given. As an example of the difficulties with which scientific men in Russia had to contend, he said that it had been ascertained that whereas the salary of a Russian professor averaged an equivalent of about £3 10s. a month, the cost of commodities which he had to purchase was approximately double their cost in this country.

The following papers were read:—(1) "Cupric tetrammine nitrite and the corrosion of copper by aqueous solutions of ammonia and of ammonium nitrate": H. Bassett and R. G. Durrant. (2) "The additive formation of four-membered rings. Part I. The synthesis and resolution of some derivatives of 1:3-diazidine": C. K. Ingold and H. A. Piggott. (3) "A determination of the relative proportions of the isomerides in nitrotoluene or toluidine": W. H. Patterson. (4) "Rates of reduction of nitro-groups by hydrogen in the presence of colloidal palladium, especially of nitrotoluene isomerides": W. H. Patterson.

(1) Prof. Bassett has examined the action of ammonium nitrate on copper in presence of air, and found a blue product, the tetrammine nitrate $Cu(NH_3)_4(NO_3)_2$, and a green one consisting mainly of the insoluble basic nitrate $Cu(NO_3)_2 3Cu(OH)_2$. The small amount of nitrite which was found in the corrosion products results from the catalytic oxidation of ammonia and not from the reduction of nitrate, for some nitrite is always formed when air and aqueous ammonia act upon copper. Pure cupric tetrammine nitrite $Cu(NH_3)_4(NO_2)_2$ is best prepared by extraction of the basic nitrite $Cu(NO_2)_2$, $3Cu(OH)_2$ with ammonia (0·880). It has not the formula $Cu(NH_3)_2(H_2O)_2(NO_2)_2$ given to it by Pélagot (Comptes. rend., 1861, **53**, 209), nor does it deflagrate. At 100° C. it forms the diammine nitrite, and at a higher temperature it decomposes leaving a residue of copper oxide. Pure cupric tetrammine nitrite and nitrate are a little more sensitive to shock than picric acid; a mixture of the two is much more sensitive.

A meeting was also held on October 19, when Prof. H. E. Armstrong presided, and papers on valency and polarity in organic compounds were presented by Prof. T. M. Lowry, Dr. J. Kenner, and Mr. W. E. Garner.

SOCIETY OF LEATHER TRADES CHEMISTS

A meeting of the British Section of the Society of Leather Trades Chemists was held in the Leathersellers' Technical College, London, on October 6. Mr. J. R. Blockey presided over a good attendance.

Reports were presented from some of the Analysis Committees, and a long discussion arose on the question of the determination of Insolubles in Tannin Analysis. Mr. D. Woodroffe sent a report from the Crome Leather Analysis Committee.

The following papers were read:—(1) "The estimation of sulphides by means of standard zinc sulphate solution": W. R. Atkin. (2) "The estimation of ammonia in lime-liquors without distillation, and incidentally the simultaneous estimation of caustic alkalinity": W. R. Atkin. (3) "Proposed provisional method for the analysis of lactic acid": F. C. Thompson. (4) "Water-soluble matter in leather; its estimation and significance": J. R. Blockey. (5) "The sampling and preparation of leather for analysis": J. R. Blockey.

Discussion followed the reading of the papers, the first three of which came as contributions from the Limeyard Control Committee, and the other two from the Sole-Leather Analysis Committee.

THE PROPOSED INSTITUTE OF PAINT AND VARNISH TECHNOLOGISTS

Members of the Paint and Varnish Society and of the Oil and Colour Chemists' Association met at dinner in London on October 10, and resolved unanimously to take steps to form an Institute of Paint and Varnish Technologists. Sir Ernest Benn presided, and among others present were Prof. H. E. Armstrong, Prof. T. M. Lowry, Dr. F. Mollwo Perkin, Dr. R. S. Morrell, Dr. J. N. Friend, Dr. M. B. Blackler, Messrs. T. H. Barry, G. H. Howse, Noel Heaton, A. S. Jennings, J. Cruikshank Smith, H. D. Bradford, H. A. Carwood, W. F. Reid, W. J. Palmer, C. Harrison, and C. A. Klein.

The opinion was expressed that the formation of an Institute of Paint and Varnish Technologists would bring together two bodies which had worked independently since 1918. It was felt by those members of the Oil and Colour Chemists' Association who were present that the best interests of the industry would be served by co-operation in such an undertaking. The most important function of the Institute must be to issue a live Journal, which would help the members to keep abreast of modern developments in the industry. Since the failure of the National Federation of Paint and Varnish Manufacturers to devise a scheme of organised investigation, it was hoped that the proposed institute would be able to encourage research work throughout the country and, if possible, to form a centre for providing a better knowledge of the properties of the raw materials in the industry, whereby goods could be produced more economically and of a uniform standard of excellence. The Institute would also influence the education of its future members and endeavour to establish some kind of professional status for the paint and varnish industry. It would afford members an opportunity of reading papers and would help to maintain a high standard of qualification among its technical members. One of the speakers at the dinner considered that if each of the 250 paint manufacturers in this country subscribed £10 a year, a good start would be made towards carrying out the proposals which were approved by those present at the dinner; as an insurance against ignorance it would be well worth the money.

A provisional council of nine members of the Oil and Colour Chemists' Association and nine members of the Paint and Varnish Society was elected to examine the proposed articles and memoranda of association as well as to consider the financial requirements. The report of this council will be submitted to the two societies, and if approved by them the Institute will be inaugurated. The members of the provisional council are:—Dr. J. N. Friend, Dr. R. S. Morrell, Dr. H. H. Morgan, Messrs. S. G. Clifford, E. S. Hanes, S. K. Thornley, A. de Waele, W. J. Palmer, H. A. Carwood (all of the Oil and Colour Chemists' Association); Dr. F. M. Perkin, Dr. M. B. Blackler, Messrs. Cruikshank Smith, W. F. Reid, A. S. Jennings, C. Harrison, Noel Heaton, C. A. Klein, and H. D. B. Bradford (of the Paint and Varnish Society).

INSTITUTION OF PETROLEUM TECHNOLOGISTS

The opening meeting of the current session was held on October 10 at Burlington House, W., Prof. J. S. S. Brame presiding. A paper on "Standardisation of Petroleum Tests" was read by Dr. A. E. Dunstan.

The lecturer recalled the speech of Mr. Alexande Duckham in 1917 in which he suggested that th Institution should appoint a Standardisatio Committee whose function should be to investigat methods of testing and to recommend standards fo adoption in this country. That suggestion receive strong support from many quarters, and early thi year a Standardisation Committee, with Mr. Duckham as chairman, was appointed. The range of investigation and deliberation was divided among six sub-committees, and the tentative recommendations of these sub-committees up to the present date were set forth in the paper with the object of stimulating discussion and inviting helpful criticism before the conclusions were revised and summarised by the main committee. The Standardisation Committee had worked in close accord with the British Engineering Standards Association and the American Society for Testing Materials, and in many cases the valuable recommendations of the latter society had been adopted without modification. It was intended to arrange meetings between the Committee and the various firms of instrument-makers in order to assist in the attainment of uniformity in apparatus used for petroleum-testing. Prof. Brame had consented to edit a special brochure containing the recommended tests, which would be tentative tests and subject to periodical revision, if necessary, and it was anticipated that this brochure would be published early next year.

Messrs. Alexander Duckham, Arnold Philip, Le Maistre, and Anfilogoff took part in the resulting discussion, and comments and criticism i writing were invited for consideration by the Committee and for publication in the correspondence columns of the Institution's *Journal.*

AMERICAN ELECTROCHEMICAL SOCIETY

The annual meeting of the Society was held in Montreal on September 21 and 22. Dr. C. G. Schluederberg, of Pittsburgh, Pa., president of the Society, gave an address upon "Electrochemistry and the Electrochemist," in the course of which he said: "An electrochemist is a cosmopolite in the truest sense of the term. He must be an engineer, chemist, metallurgist, manufacturer, and an all-round scientist. In order that he may keep abreast of developments he must be broadminded, progressive and aggressive." Papers were read "On Electric Heat; its generation, propagation and application to industrial processes," by E. F. Collins; "On the Principles of High Temperature Furnace Design," by E. L. Smalley; "Some Electrical Properties of Alloys at High Temperature," by M. A. Hunter and A. Jones; and on "Resistivities of some Granular Resistor Carbons," by C. E. Williams.

Of the technical papers presented on the 22nd, that by P. S. Gregory, of the Shawinigan Water and Power Co., upon "Electric Generators and their Application," was of greatest local interest. It was followed by a very good discussion, fruitful of much general information upon the subject, which is considered one of the most important in electrochemistry. The type of generator seen by the members of the Society of Chemical Industry during their visit to Shawinigan in 1921, has been further developed and improved and made more applicable to conditions in Canada by F. T. Kaelin, (*cf.* J., 1922, 94 R, 412 R). By the adoption of these electric generators, and utilisation of the "off peak" hours, the two large industrial factories of the Laurentide Pulp and Paper Co. and the Belgo-Canadian Pulp and Paper Co. are saving 400 tons of coal daily. In the ensuing discussion, Prof. W. D. Bancroft declared that some day the electric firing of porcelain would bring artistic and decorative porcelain to a very much higher state of perfection than was formerly thought possible.

SAFEGUARDING OF INDUSTRIES ACT

GALLIC ACID

On September 26 Mr. Cyril Atkinson, the Official Referee, heard the complaint made by Mr. J. L. Rose, chemical manufacturer, of Barking, that the Board of Trade had improperly removed gallic acid from the list of chemicals subject to import duty under Part I of the Act. The parties were not represented by counsel, and the hearing was terminated within three hours. Mr. W. J. U. Woolcock, M.P., General Manager of the Association of British Chemical Manufacturers ("A.B.C.M."), appeared for Mr. Rose, who is a member of the Association, but the Referee stated that in future he would enforce the rule that a complainant must either conduct his own case or be represented by a barrister or solicitor.

Mr. Rose, after giving evidence in camera concerning his process of manufacturing gallic acid (3.4.5-trihydroxybenzoic acid), said that he had been making it since the beginning of the war; for 30 to 40 years prior to that time all the gallic acid used in this country had been imported from Germany. The imported acid was sold by merchants; he had supplied the acid to R. W. Greef and Co., and had dealt only with that firm's fine-chemical department; but he was unable to bring into court such trade witnesses because merchants as a class were opposed to the Act. Gallic acid was regarded by the trade as a fine chemical. In his process of manufacture samples had to be taken and tested at every stage; he employed a staff of fifteen of whom two were qualified chemists. The gallic acid he manufactured was of about 98 per cent. purity.

Mr. Woolcock said that gallic acid was made only from gall-nuts in plant similar to that used in making azo-dyes and other fine chemicals; the nature and amount of supervision required justified the classification of the substance as a fine chemical. In previous inquiries the heading to Group VI in the classification of the A.B.C.M. had been wrongly interpreted. The first term—"fine chemicals"—alone was definitive, the remaining terms ("analytical," "pharmaceutical," etc.) were illustrative: a chemical might well be a fine chemical even if it did not come under one of these descriptive sub-headings. Gallic acid was not covered by any one of the sub-headings, but the same was true of many other fine chemicals. On the other hand, he suggested that the group to which the Council of the Association allocated a member was a criterion; a member could not join any group he liked. Mr. Rose was a member of Group VI. Gallic acid was used in the manufacture of pyrogallic acid, an admittedly fine chemical, and of certain dyes, which were but fine chemicals coloured. When the Schedule to the Dyestuffs Act was being drawn up, the Board of Trade had omitted gallic acid from it on the ground that it was not a dye-intermediate; it was undoubtedly the intention of the legislature to include gallic acid within one Act or the other.

Mr. J. Ronca, for the Board of Trade, accepted substantially all that had been said. In compiling the list of dutiable articles, the Board had considered the trade classification of "heavy" and "fine," and it had not applied to each article what might be called the secondary tests of its correct classification. In doubtful cases, however, it was useless to refer to the trade, different sections of which would invariably hold divergent opinions, and certain secondary tests had to be applied. Originally the Board had never thought of applying the secondary tests to gallic acid, having no doubt that it was a fine chemical, but after its inclusion in the Schedule had been challenged, thus proving that in fact there was doubt as to its correct classification, the Board gave consideration to certain criteria or secondary tests as laid down or described by the Referee in the Tartaric Acid case (*cf.* J., 1922, 116—118 R). For example, in his judgment in that case the Referee stated that, the search for a definition of fine chemical having failed, he would adopt trade usage as the test and "the trade regarded heavy chemicals as commercial products mainly used for industrial purposes." By that test gallic acid was not a fine chemical, and it was consequently deleted from the original list.

Mr. Woolcock said that if the Board's interpretation of the judgment were correct, very many admittedly fine chemicals, including all those used in making other fine chemicals, would have to be removed from the list. The Referee said that he had not intended his remarks in the judgment mentioned to constitute a definition; he still believed that, in the main, the trade regarded a big industrial use as a criterion of a heavy chemical. Mr. Ronca said that the Board did not accept the view that industrial chemicals were invariably used in large quantities; some were used in very small quantities. The Referee pointed out that Mr. C. A. Hill's paper on the manufacture of fine chemicals, read before the Society of Chemical Industry in 1916, was definite and important evidence for complainant's view, but he required direct evidence, dating from before the passing of the Act, that the trade regarded gallic acid as a fine chemical. After the adjournment for lunch, Mr. Woolcock produced the new trade catalogue "Where to Buy" in which gallic acid was listed as a fine chemical. Mr. C. A. Hill stated that for 25 years at least he had known gallic acid as a fine chemical and had never heard it referred to as a heavy chemical; and copies of the *Journal of the Society of Chemical Industry*, dating from 1895, were produced to show that up to 1909 gallic acid had been classified in the *Abstracts* among fine chemicals. The Referee stated that he was satisfied with the evidence produced, and no evidence had been given to the contrary. Mr. Ronca's view was that his original classification was right. In future he would regard trade usage as determinative if it can be found, and evidence must always be given on that point.

Judgment was issued on October 18, as follows:—

The complaint in this case is that gallic acid has been improperly excluded by the Board of Trade from the lists of articles dutiable under the Act. Gallic acid was originally included in the list. Complaint was made of this inclusion, and the Board of Trade took it out of the list in the belief that it was covered by something I said in the Tartaric Acid case. There was not any real contest at the hearing before me. None of those persons who might be interested in maintaining the exclusion of the substance from the list attended to take part in it. I am satisfied that the usual notices have been given and that persons interested have had the usual opportunities of giving evidence and of taking part in the argument. I regret that no one of them has availed himself of these.

On the evidence of Mr. Hill and Mr. Rose, and of the chemical journals and catalogues that were put in, I find that gallic acid has been and is regarded by the trade as a fine chemical. I think, therefore, that the original inclusion of the substance in the list was right and that its present exclusion is wrong. The reason for this exclusion is the supposition that in the Tartaric Acid case I defined a heavy chemical as a commercial product mainly used for industrial purposes. It is said that as gallic acid is a commercial product almost entirely used for industrial purposes therefore it is a heavy chemical. So far from laying down any definition in the Tartaric Acid case of the terms "heavy" and "fine," I expressly decided that there was no scientific or trade definition of the terms and that therefore the test was the trade classification in each particular case. The view that I intended to express in the Tartaric Acid case was this; there was no definition of "heavy" or "fine," but that in ascertaining how any particular substance had been regarded by the trade one would probably find that the purpose to which the substance had been put had had a good deal to do with its classification, and that for the most part chemicals mainly used, and used to a substantial extent, in industry had been classified as "heavy." I do not think that this applies to photographic chemicals. As to gallic acid, the total quantity used in a year is comparatively small, and I find on the evidence that the trade has regarded it as a fine chemical. Applying, therefore, the same test as that applied in the Tartaric Acid case I come to the conclusion that gallic acid should be included in the list and I so award. No costs.

CHEMICAL INDUSTRY CLUB

The report of the Executive Committee for the year ended August 31, 1922, shows that the Club has well maintained its position: the membership has increased from 690 to 707 and the financial position is excellent. A feature of the past year has been the strengthening of the *liaison* between the Club and the Federal Council for Pure and Applied Chemistry. For some time past three members of the Federal Council have been co-opted on the Executive Committee of the Club, and the hon. secretary of the latter has served on the Federal Council. Sir William Pope, Dr. C. A. Keane, and Mr. E. V. Evans were the original representatives of the Federal Council, but Dr. Keane, to everyone's regret, has been obliged to retire from this and other similar positions owing to illness. Dr. S. Miall has been appointed in his place. During the past year co-operation has been extended by the institution of informal, periodical meetings of an advisory body consisting of seven members of the Council and seven members of the Club. The ordinary monthly meetings were continued as usual and were much appreciated by those who attended them. The report also refers to the re-decoration of the Club premises, the provision of additional papers and magazines in the reading room, the foreign guests who were offered temporary membership, joint meetings with the Institution of Mechanical Engineers and the London Section of the Society of Chemical Industry, and to the annual dinner. This year's annual dinner will be held in the Connaught Rooms on Friday, November 24, and the speakers will include Lord Riddell and Mr. Roscoe Brunner (tickets, 15s. each, exclusive of wines). The report of the hon. treasurer is equally satisfactory. In spite of increased expenditure, there is a balance in hand of £86, in addition to a reserve fund of £100, a portion of which is being utilised to defray the cost of re-decoration.

The above reports were presented to and adopted by the annual general meeting, which was held in the Club on October 15, Mr. A. G. Craig, chairman of the Executive Committee, presiding over a good attendance. Except for some discussion upon a few points concerning organisation the business was formal. The hon. secretary, Mr. H. Edwin Coley, and the hon. treasurer, Capt. C. J. Goodwin, were re-elected, and the ballot for candidates to fill the five vacancies on the Executive Committee resulted in the election of Dr. E. F. Armstrong, Mr. A. J. Chapman, Mr. W. Cullen, Mr. C. S. Garland and Mr. T. Miller-Jones.

NEWS AND NOTES

FRANCE

Industrial Notes

Chemical Industry.—The continued instability of the international situation has affected the chemical market, which is very sensitive to such political disturbances; buyers have not been inclined to purchase forward, and business has been generally dull. German competition is not serious at present owing to the wide fluctuations in the value of the mark, but Belgium, benefiting from an appreciable decrease in costs, is undercutting French producers and gradually obtaining a hold on French markets. Manufacturers are again complaining of the State monopoly of the sale of alcohol. Whereas the State pays only 70 fr. and 90 fr. per hectolitre for alcohol of 95° and 99·5°, respectively, produced from beet molasses, the sale price to manufacturers of organic chemicals is so high that they find difficulty in reducing their costs so as to meet foreign competition. Fertilisers are not much in demand, and ammonium sulphate is being replaced by sodium nitrate, which is cheaper. The sugar-beet crop is very promising; the fine, rather cold weather has helped to ripen the beet, and extraction will probably be easy, as the quality is reported to be high. The estimated yield is 500,000 metric tons of refined sugar, to which must be added about 90,000 t. of raw sugar from the colonies.

An account of the International Congress on Liquid Fuels appears elsewhere in this issue. At the close of the Congress the delegates visited the petroleum field at Pechelbronn, where one well is producing at the rate of 1100 gallons per 24 hrs., and another, with an intermittent production, is yielding 45 metric tons per day. A new well is being sunk at the rate of 2 metres per day of 16 hrs. The annual output of crude petroleum in this locality is now about 70,000 t., which represents 8 per cent. of the entire consumption in France.

Metallurgy.—The general outlook is good, and the exportation of metallurgical products to Germany is increasing steadily. On September 1 the number of blast-furnaces alight was 98, compared with 94 on August 1, three having been blown-in in Alsace-Lorraine and one in the eastern metallurgical area. During the first eight months of 1922 the total output of pig iron was 3,136,482 t. and of steel 2,809,703 t. Rumours of an agreement between French and German metallurgical interests still persist, and in certain well-informed quarters are considered likely to prove true.

GERMANY

Chemical Industry in September, 1922

According to information transmitted by H.M. Commercial Secretary in Berlin, the inland demand for dyestuffs during September was satisfactory, despite a crisis in the textile industry. In many cases the orders in hand would suffice to ensure employment for some time to come, but the disparity between the amount of working capital available and the high prices of the necessary foreign raw materials compels restriction of work. The practice of investing in foreign currency may offer a security against fluctuations in exchange, but it also results in the raising of inland prices to prohibitive levels. Foreign sales were also satisfactory. A reaction in the unusual business activity is feared owing to the increasing difficulty of purchasing raw materials from abroad. Soda and benzol have, in particular, had to be imported in large quantities. The supply of rocksalt and lime was frequently insufficient owing to the scarcity of railway trucks, and that of fuel was quite inadequate. Large quantities of foreign coal and coke had to be imported for the nitrogen and dyestuffs industries, and the use of different kinds of fuel greatly hindered operations. The paper industry has suffered severely from difficulties in procuring raw material and a crisis is anticipated owing to the scarcity of capital. Dependence upon foreign coal and raw material is also handicapping the fine ceramic industry whose output is now about 75 per cent. of the pre-war total and whose exports are but 30 per cent. of the production, or less than one-half of the pre-war figure. —(*Official.*)

The Potash Industry

Preliminary returns from the German potash mines show that the production during the first six months of 1922 was 5,893,711 metric tons of potassium salts, equivalent to 682,787·5 t. of pure potash (K_2O). Export deliveries were below expectation but inland sales of potash products were fairly brisk and 58 per cent. higher than during the corresponding period of 1921. The number of workers employed increased from 39,594 to 42,139, and full-time was worked until towards the end of June when 76 of the 206 works ceased production. Later advices state that export sales have improved and for the year will probably amount to 23 per cent. of the total sales (5 per cent. in 1921), and these will probably create a record, even over pre-war totals.

The Cause of the Oppau Explosion

Before the Parliamentary Committee appointed to investigate the cause of the explosion at Oppau (*cf.* J., 1921, 381 R, 453 R), Prof. Wöhler reported on the evidence of the experts who were charged with the task of finding answers to the following questions:—

(1) Is there any evidence of a criminal act? (2) Was an exceptionally powerful explosive used, and could it have been the cause of the explosion? (3) Could the use of a large amount of the explosive normally employed have caused the explosion? (4) Can a normal fertiliser-salt be exploded with the explosive used? (5) Can a salt of abnormal composition be exploded? (6) Could such an abnormal salt have been present? (7) Can a positive answer be given as to the origin of the explosion? (8) Does the fact that two successive explosions occurred indicate the possibility of another cause, and can that fact be harmonised with the suggested explanation?

The replies of the experts to these questions were negative in nearly every case, including that to question (7). A charge of negligence against the Badische Anilin- und Soda-Fabrik could not be sustained, and even when every possibility was taken into consideration, such an explosion as occurred could not have been foreseen. The experts recommend that blasting of fertiliser salts containing nitrate be forbidden (as it has been since), but do not see any necessity for discontinuing the manufacture. As the printed evidence of the experts was not in the hands of the members of the Committee, it was decided to postpone the final decision.—(*Chem.-Z., Oct.* 5, 1922.)

Technical Utilisation of German Lignites

Prior to the war difficulties of sale restricted the output of German lignites (brown coals), and the maximum possible output was not attained despite a rapid increase in demand, which extended into the period of the war, and except for a temporary set back in 1919, has continued since. Supplies in 1921 amounted to 141 per cent. of those in 1918. In 1921-22, according to returns of the Deutsche Braunkohlen-Industrie Verein, more than 80 per cent. of the output of lignites was obtained by open-working, a factor influencing the output of this commodity, as all the coal in the country has to be mined. Owing to increased production and reduction of working hours, the number of workers engaged was about 125 per cent. greater in 1921 than in 1918.

The calorific value of lignite is only about one-third of that of coal, but the calorific value of brown-coal briquettes is about double that of the original lignite. Even then, freight charges for transport over any considerable distance, operate against the use of lignite in place of coal. The unsuitability of lignite as a fuel in certain branches of industry is also an adverse factor, and thus it comes about that lignites are exclusively employed in the districts where they are produced. In 1921, 57 per cent. of the output of lignites was briquetted, and the output of briquettes amounted to 28,243,000 tons, an increase of 116·4 per cent. compared with 1920, and of 128·5 per cent. compared with 1913. Although, owing to the lack of coal, lignites have of recent years found extended application in certain directions by the introduction of new devices, coal has not been displaced to any great extent for technical purposes. Thus the attempt to use lignites for the firing of locomotive boilers proved unsuccessful. Aided by the increased charges for transport, the "migration of industry towards coal," which set in before the war, has made considerable progress.

The following table shows the distribution of the consumption of lignite during the period January—April, 1922:—

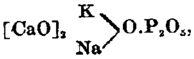
	Lignite (crude)	Lignite Briquettes
Domestic and small industrial uses	5·1	52·7
Marine and military	—	0·2
Rail and water transport	0·3	1·0
Water- and gas-works	0·5	0·5
Electricity works	22·7	4·2
Chemical industry	22·4	5·8
Stone, earth, glass and porcelain	6·6	7·6
Textile and paper industries	13·3	6·5
Iron and metal industries	11·5	11·6
Foodstuffs	5·7	3·6
Potash and salt works	6·4	1·4
Other industries	5·5	4·9

The power station at Zschornewitz uses 7200 tons of lignite per day. It supplies Berlin with current and is also connected with the large nitrogen factories of middle Germany, and other chemical works. These works themselves are large users of lignites, and those situated in the vicinity of lignite deposits are in many cases part-owners of the mines. In this manner is explained the fact that in 1921—1922, over 15 per cent. of the output of lignite in the Mid-German district was credited to "associated factories."

In former years a considerable amount of lignite was imported from Bohemia. This was of higher calorific value and readily accessible. Gradually this trade has been abandoned in favour of the home product, and more especially of briquettes manufactured in Germany, and the imports, which amounted to 7,960,000 tons in 1900, fell to 1,910,000 tons in 1919, rising again to 2,662,000 tons in 1921. The principal buyers are the glass, porcelain and textile manufacturers of Saxony and Bavaria.

About 1·74 per cent of the output of lignites is used, not as fuel, but as raw material in chemical industry. Certain varieties are suitable for treatment by the Schwel process of producing paraffin and lubricating oils, and more recently for making soap. The residue, known as "Grudekoks," is a popular fuel. The production of ozokerite and liquid fuels from lignites has recently been extending.

"Rhenania" Phosphate

By the production of this material it is claimed that the problem of making a high-grade fertiliser from low-grade phosphate, without the use of sulphuric acid, has been solved. The process consists in heating to 1200°—1300° C. an intimate mixture of crude phosphate, limestone, and alkali silicate, such as felspar, phonolith or leucite, and the product is a brown mass, which is finely ground before marketing. The composition of the fertiliser may be represented approximately by the formula  $[\mathrm{CaO}]_2\begin{matrix}\mathrm{K}\\ \mathrm{Na}\end{matrix}\!\!>\mathrm{O.P_2O_5}$, and its percentage composition varies as follows:—P_2O 15—25, K_2O+Na_2O 8—15 (of which $K_2O=8$), SiO_2 10—20, CaO 35—40. The phosphoric-acid content is but slightly soluble in water, but from 80 to over 90 per cent. dissolves in citric acid or alkaline ammonium citrate, and 75 per cent. is soluble in an aqueous solution of carbon dioxide.

Rhenania phosphate can be used on any type of soil, and, being strongly basic, obviates the use of lime. Over superphosphate it has the great advantages that sulphuric acid is not required in its manufacture and that the poorest grades of mineral phosphate can be utilised. Factories at Wolfersberg a. d. Lahn and Amberg (Bavaria) are producing it, and nearly one million tons has already been sold. The evidence of pot experiments and field trials is favourable.—(*Z. angew. Chem., Oct.* 3, 1922.)

The German Commission on Atomic Weights

A second detailed report on the determinations of atomic weights published during the period 1916 to 1920 has been issued by the German Commission on Atomic Weights, consisting of Professors Hönigschmid, Bodenstein, Hahn, and R. J. Meyer. The general principles followed in drawing up the tables are described, and then the atomic-weight determinations carried out (a) by physico-chemical methods, *e.g.*, vapour density, and (b) by gravimetric methods. Regret is expressed at the multiplication of national tables of atomic weights, as there are now Spanish, Swiss and German tables in addition to the International Table.—(*Chem.-Z., Sept.* 7, 1922.)

The Porcelain Industry

The Union of German Porcelain Factories (Verband Deutscher Porzellangeschirrfabriken) reports that the 97 plants comprised in the Union produced 62,925 tons of porcelainware in 1921 as compared with 48,151 tons from 92 plants in 1920. Shortage of coal kept the production below capacity and wood fuel had to be used because the industry only received 49 per cent. of the pit coal, 42 per cent. of the lignite and 80 per cent. of the briquettes required. In 1921, 13,929 men and 13,329 women workers were employed by the industry, in addition to 2090 men and 279 women employed in the offices. Production costs increased by over 200 per cent. between April, 1920, and January, 1922. Before the war the United States was the principal market for German porcelain goods. The percentage of the total exports taken by the United States was 41·9 in 1912, 4 in 1919, 12·77 in 1920, and 44·48 in 1921. In normal times about 60 per cent. of the German production is exported; in 1920 it was only 28 per cent. Japan is now Germany's chief competitor in this industry.—(*U.S. Com. Rep.*, *July* 10, 1922.)

UNITED STATES

The Camphor Industry

According to Dr. Stockberger, physiologist to the U.S. Department of Agriculture, the cultivation of the camphor tree and the extraction of camphor in the United States have ceased. Apparently the industry has been abandoned because of the ravages of the camphor "thrips," a pest for which no effective means of control has been discovered, and of inability to compete with synthetic camphor. The prospects were deemed not sufficiently hopeful to justify the costs incurred in waiting seven or eight years for the first harvest. Although large areas were planted to camphor in Florida (*cf.* J., 1921, 236 R, 388 R), and the various stages from planting to distillation were studied, no reliable data concerning yields or costs were obtained.—(*Oil, Paint and Drug Rep.*, *Oct.* 2, 1922.)

Mica in 1920

During 1920 the sales of mica in the United States amounted to 6565 short tons (842 t. of sheet and 5723 t. of scrap), valued at $713,898 at or near the mine, representing an increase of 76 per cent. in quantity and 188 per cent. in value compared with 1919. In order of importance the chief producing States were North Carolina, New Hampshire, Virginia, Alabama, Georgia, Texas, South Dakota, New Mexico, Idaho, and Colorado. Prices were high during the first half of the year, but declined afterwards, owing to foreign competition; the average price per ton of scrap mica increased by $11 to the record value of $29, but the average price per lb. of sheet mica only rose from $0·31 to $0·32. Exports of mica were valued at $316,169 ($109,348 in 1919), over 75 per cent. going to England, Canada, Belgium, Japan, Cuba, Newfoundland and Labrador, in the order named. Imports of sheet mica were valued at $3,189,377, the highest value recorded, and included 649 t. of unmanufactured mica valued at $1,177,943. —(*U.S. Geol. Surv.*, *Apr.* 12, 1922.)

JAPAN

The Artificial-Silk Industry

Owing to lack of technical experience and supervision and high costs of production, the Japanese artificial-silk manufacturers cannot compete with America and Europe, and they have suspended production pending the conclusion of an agreement for co-operation with German manufacturers. In contrast with the rapid extension of the manufacture of artificial silk in England and the United States, the Japanese industry, although it is twenty years old, has been on the verge of collapse for some time. The chief companies (Nippon Jinzokinuito Seizokaisha, Toyo Jinzokinuito Seizokaisha, Asahi Jinzokinuito Seizokaisha, Teikoku Jinzokinuito Seizokaisha and Tokyo Jinzokinuito Seizokaisha) were almost unanimous in taking the above decision, but they have not yet completely closed down. Methods of improving the industry are being considered; the Asahi Co. has bought a German factory and will begin to produce in the autumn; and other companies have engaged German experts and will buy directly from Germany.—(*Chem. Ind.*, *Sept.* 25, 1922.)

CANADA

Industrial Notes

Two British brewing firms have recently inspected sites in the Province of Quebec with a view to establishing plants, because of their inability to meet the demand for their products on account of the import tax.

This season the sugar-beet crop of Ontario has been light, owing to the shortage of rain, and as a result only the Wallaceburg and Chatham refineries of the Dominion Sugar Co. will be operated, the plant at Kitchener being closed.

The Dominion Glass Company, which operates two plants in Montreal, proposes to erect one large plant in the vicinity of Montreal, at a cost approximating $1,000,000, which will take over the business handled by the two present plants, and at the same time provide for expansion.

The firm of F. X. Baumert and Co., Inc., of Antwerp, has concluded negotiations for the erection of a large milk plant at Huntington, Que. This town is the centre of a large dairy industry, which is capable of delivering 2 million lb. of milk within a radius of six miles. Much of the milk went to the United States, but the new U.S. tariff has practically closed this market.

The United Kingdom was a better customer of Canada than the United States during the twelve months ending with July, according to a statement of the Dominion Bureau of Statistics. The total exports of Canadian products to the United States for that period were valued at $304,000,000, and to Great Britain and Ireland nearly $307,000,000. Under the new U.S. tariff, which came into force on September 23, it is expected that the export trade to that country will further decline. On the other hand, it is anticipated that there will be an appreciable development of Canadian trade with Europe and other continents.

The American Nitrogen Products Co., at Lake Buntzen, B.C., which is manufacturing nitrates from atmospheric nitrogen by the electric method, has approached the provincial government for a loan, under the Industries Act, to assist in the development of new products. The plant at Lake Buntzen has been producing nitrate of soda, which was largely exported to the United States, but the new tariff has placed such a prohibitory duty on the product that the company now proposes to manufacture nitric acid. The plant is stated to have cost $500,000, and was operating at a good profit. C. F. Graf, of Seattle, Wash., is head of the organisation.

It is claimed that the money spent to-day in Canada on rubber products is greater, *per capita*, than in any other country in the world. In 1910 the number of rubber companies did not exceed a half-dozen, with an invested capital of $8,000,000 and 5000 workers. The crude rubber imported was 1070 long tons and the value of the products $5,000,000. A decade later the rubber companies exceeded a score, operating 32 factories with an invested capital of $50,000,000 and a personnel of 15,000. The import of crude rubber is almost ninefold; the value of the products is approximately $56,000,000; and the export trade amounts to $15,500,000, which is more than treble the value of the whole output of 1910.

Petroleum

In boring a deep well for water near Vauxhall, about 28 miles north-east of Taber, Alberta, gas was struck at a depth of 840 feet. The gas flow exceeds two million cb. ft.

The Imperial Oil Co., Ltd., is to construct an oil refinery in south-east Calgary, Alberta, at a cost of $2,500,000. The company has secured 108 acres of land and will employ between 300 and 500 men.

The report that the "Discovery" well of the Imperial Oil Co., at Fort Norman, was flowing at the rate of 70 barrels per diem has been confirmed. The flow comes from a depth of about 1000—1100 feet.

GENERAL

Proposed Honour to Prof. H. B. Dixon

A committee of past and present students of the Chemical Department of Manchester University has been formed to honour Prof. H. B. Dixon on his retirement from 35 years' service as Director of that Department. It is proposed to hold a dinner in the Midland Hotel, Manchester, on Friday, December 8, at which Prof. Dixon will be the guest of the evening, and to invite subscriptions (*a*) to raise a fund, to be handed over to the University authorities, from which the income will be given as grants-in-aid to necessitous students of chemistry; and (*b*) to purchase a medallion portraying the head of Prof. Dixon, to be placed in the Chemical Theatre adjacent to the medallions of Frankland and Roscoe. Dr. J. E. Myers is hon. secretary, and Dr. Norman Smith hon. treasurer to the committee. Applications for dinner tickets (12s. 6d), and donations to the Harold Baily Dixon Fund, should be sent to Dr. Smith at The University, Manchester.

Vanadium

A small but valuable brochure on "Vanadium, 1913—1919" (pp. 19, price 6d.) has been issued by the Imperial Mineral Resources Bureau which contains considerably more recent information than is indicated by the title. As a source of supply of vanadium, Peru has recently ousted the United States from the first place, as the following table shows:—

Output of Vanadium (in terms of Metal) contained in the Ores produced

	Peru	U.S.A. Long tons	Total
1913	—	386	386
1914	4	404	408
1915	790	560	1,850
1916	760	411	1,171
1917	805	432	1,237
1918	229	246	475
1919	491	254	748
1920	1,095	455	1,550

The large deposits of patronite, a black carbonaceous mineral containing vanadium sulphide, which occur at Minasraga, near Cerro de Pasco, Peru, and are owned by the Vanadium Corporation of America, are estimated to contain ore in sight equivalent to 16,500 tons of metallic vanadium. The grade of ore now worked has recently fallen from 40—45 per cent. V_2O_5 in the calcined product to 30·4 per cent. (1919), and on this account the company has decided to erect an electric smelting plant to produce a concentrate containing 85—90 per cent. of the oxide. In addition to these deposits, there are extensive occurrences of vanadiferous asphalt to the south of Cerro de Pasco, in Yauli and other districts, but it is improbable that these will prove of commercial significance, except under abnormal conditions.

The chief deposits of vanadium ores, mainly carnotite, in the United States are found in south-eastern Utah and north-western Colorado. Production has declined, and in 1921 the only vanadium produced from native ores was that obtained as a by-product from carnotite worked for its radium-content. Exports of ferro-vanadium from domestic ores, of which a large proportion is shipped to the United Kingdom, amounted to 280 long tons in 1914, 1167 t. in 1917, 28 t. in 1918, 173 t. in 1919, and 100 t. in 1920 (the last three years are calendar years).

Mr. J. L. F. Vogel contributes some interesting notes on the metallurgy and uses of vanadium. The manufacture of steel claims practically the entire consumption. For steel subject to vibration, a content of 0·2 to 1·5 per cent. vanadium imparts greater resistance to fatigue or failure through recrystallisation, and the presence of 0·5 to 2 per cent., together with tungsten and chromium, greatly improves the efficiency and cutting-power of high-speed steel. Its addition to molten steel also removes nitrogen and reduces dissolved oxides.

British Chemical Plant Manufacturers' Association

The second annual report of this Association states that notwithstanding the recent critical state of trade, the Association has increased in strength and has established itself as representative of the industry it was designed to foster. The membership has increased from 28 to 33 firms. Mr. J. H. Rawson (The Widnes Foundry Co., Ltd.) has acted as chairman of committee and Mr. L. M. G. Fraser (W. J. Fraser and Co., Ltd.) as vice-chairman. Of the work undertaken during the year, mention is made of the standardisation of jacketed pans and cast-iron filter presses (*cf.* J., 1922, 52 R, 210 R). Investigations into the use of nickel for chemical plant have led to the conclusion that this metal is satisfactory for use in the construction of small vessels. A Directory of members has been issued, and the question of transport has been considered.

The Polish Iron Industry, 1922

The ore supply for the Polish and Upper Silesian iron industry has recently been the subject of a conference in Warsaw. The Poles wish to induce the ironmasters, especially those in that part of Upper Silesia which now belongs to Poland, to develop the exploitation of ores found in the country, in order not only to further the mining industry, but also to save losses on exchange. But the Upper Silesian smelters have estimated their needs at 400,00 tons per annum, whereas at present the Polish mines cannot supply more than 200,000 tons. The supply of Russian high-grade ores is practically cut off, and the Russian railways are incapable of handling large quantities of material. The coke supply is another difficulty. Supplies are obtainable from England, Czechoslovakia, and the Waldenburg district in Germany; those from the first two countries are plentiful, but prices are very high.

Mica Deposits in Austria

According to information published in the *Berliner Tageblatt*, the mica present in extensive deposits in Styria and Carinthia is well suited for electrotechnical use. Mica from Styria has already been used industrially, and a company has been extracting Carinthian mica for some time. The Kölflach fields are to be exploited by a new company, the Oesterreichische Glimmerwerk G.m.b.H., of Gratz, which will also work part of the Carinthian deposits. As there are no deposits of mica in Germany, the Austrian product should find a ready sale there.—(*Ch. of Comm. J., Aug.* 4, 1921.)

The Fertiliser Industry in the Ukraine

The reports for June announced that all except one of the Ukrainian factories constituting the ring called "Phosphatuk" were at work, but only 1920 long tons of superphosphate was produced, as against 480 t. in May. The output of sulphuric acid was about 450 t.; of hydrochloric acid, about 32 t.; English red (colcothar) 50 t.; Glauber's salt 2·5 t.; "hypo" 2·8 t. Adequate supplies of pyrites, phosphates and fuels, particularly peat, are on hand, but none of the factories has adequate working capital.

The Russian Platinum Industry in 1922

The dredging operations in the Russian platinum regions have had to be restricted owing to the difficulty found by Russian factories in executing repairs; the number of plants now at work is only about sixteen, *i.e.*, half the usual number. At the end of 1921 a trust—the Ural Platjina—was formed which included the six important gold and platinum mining districts, and also the platinum refineries at Ekaterinburg and Moscow. Production in the first six months of 1922 was 64·4 per cent. of that intended; the actual weight is not given, but it is stated that 46 pounds of platinum changed hands during the period from the end of April to the middle of July. It is probable that the production of the trust is small, and that considerable quantities of platinum are in the hands of the population.

Mineral Production in Russia

According to reports abstracted from the Bolshevist Press by the U.S. Department of Commerce, 97 mining plants are registered in Russia as being in working order. During the first half of 1921, 89 plants employing 15,000 men were operated, the number falling to 42 plants and 5682 men at January 1, 1922. The output of the chief ores during 1921 and the first quarter of 1922 was as follows:—

	1921	Jan.-Mar. 1922
Ores:—	Long tons	
Iron	133,831	43,013
Manganese	11,054	13,703
Copper	4,369	—
Chrome	3,512	97
Lead and zinc	4,063	2,099
Magnesite	9,037	4,323
Asbestos	6,083	1,032
Pyrites	2,593	—

The quantity of manganese ore dispatched from the mines during 1921 was 18,992 tons and during the first quarter of 1922, 5417 tons.—(*U.S. Com. Rep., June* 26, 1922.)

PERSONALIA

Prof. Arthur Smithells will shortly retire from the chair of chemistry in the University of Leeds, after 37 years' service.

Dr. Percy Longmuir, of Sheffield, has been appointed Director of Research to the British Cast-Iron Research Association.

Prof. G. Errera, professor of general chemistry in the University of Padua, has been elected director of the School of Pharmacy in the same University.

Dr. W. Rosenhain, Head of the Metallurgy Department of the National Physical Laboratory, will deliver the next May Lecture of the Institute of Metals.

Dr. George Senter, Principal of the Birkbeck College, London, has been elected by the science graduates of London University to fill a vacancy on the Senate.

Col. F. M. Gaudet, C.M.G., who during the past year has been Technical Executive Officer of the Research Council of Canada, has resigned and joined a large industrial firm in Montreal.

Mr. C. S. Garland, managing director of Lighting Trades, Ltd., a vice-president of this Society, has been adopted as the Conservative and Unionist candidate for South Islington (London), in place of Sir Charles Higham.

The following appointments have been made in the Massachusetts Institute of Technology:—Dr. G. B. Waterhouse to be professor of metallurgy; Mr. W. S. Hutchinson to the chair of mining; and Dr. F. G. Keyes, formerly chief engineer to the Cooper-Hewitt Co., to be acting head of the department of chemistry.

Following the resignations of Sir H. V. Kilvert, Mr. G. W. Currie, and Dr. M. O. Forster from the Advisory Licensing Committee appointed under the Dyestuffs (Import Regulation) Act of 1920, Sir Thomas Robinson, M.P., has been appointed chairman, and Mr. R. Waddington, M.P., and Prof. G. T. Morgan members of the Committee.

The Council of the Institution of Mining and Metallurgy has awarded the Gold Medal of the Institution to Sir Alfred Keogh on the occasion of his retirement from the Rectorship of the Imperial College of Science and Technology, and the Medal of the Institution to Sir George Beilby in recognition of his contributions to science, with special reference to his researches on fuel.

Dr. Max Bodenstein, professor of chemistry in the Technical *Hochschule* at Hannover, has been called to the chair of physical chemistry in the University of Berlin, in succession to Prof. W. Nernst. Professors B. Helferich and A. Sieverts have been appointed to professorships in the University of Frankfurt, the latter succeeding Prof. E. Ebler in the chair of physical chemistry. Dr. F. Straus has been appointed professor of chemistry in the Technical *Hochschule* at Breslau.

* * *

E. Stassono, the inventor of the electric steel furnace named after him, died in poverty on May 1, aged 63 years.

Mr. Frank Washburn, who was president of the American Cyanamid Company from its inception until a short time ago, died on October 9.

Prof. F. D. Brown, emeritus professor of chemistry and physics in Auckland University College, died at Remuera, New Zealand, on August 2, aged 71.

Mr. James Lund, Vice-President of the Merrimac Chemical Co., Boston, U.S.A., and for 30 years a member of this Society, died on September 29, aged 64 years.

From Germany are announced the following deaths:—Prof. Lassar-Cohn, of Königsberg, aged 64 years, who, besides contributing to the development of organic chemistry, achieved a well-earned reputation as the author of several books on chemistry written in a popular style. W. P. L. Beth, the author of the Halberg-Beth system of purifying blast-furnace gases, died in Lübeck on August 27; and Dr. H. Schelenz, the historian of pharmacy, died on September 28 in his 75th year.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for October 12 and 19)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of Firm or Agent	Materials	Reference Number
Australia ..	Castor oil	402
,, ..	Pottery, glassware, fibre-board ..	411
,, ..	Dry colours	412
,, ..	Glassware	*
Brazil ..	Paint, glazed bricks	442
Burma, Ceylon, Far East ..	Perfumery, pharmaceutical preparations, linseed and paint oils	439
Canada ..	Copper, galvanised and insulated wire, lighting glassware, tungsten-lamps, glass- and porcelain-insulators	9640/E.D./ E.C.
,, ..	Tinplate	†
,, ..	Galvanised sheets	9785/E.D./ E.C.2.
Denmark ..	Crude rubber	421
France ..	Tin-coated paper, fancy, kraft and printing paper	16925/F.W./ M.C.
Guatemala ..	Earthenware	443 *
Mexico ..	Drugs	398
,, ..	China, earthenware	399
Panama ..	Glass, glassware, pottery	225/68/F.O./ M.C.
Poland ..	Tin, copper, antimony, bearing metals, solder, steel, lead, coloured glass, cylinder oil, zinc white, white lead	429
South Africa ..	Tar or tar substitute (tender for) ..	9720/E.D./ M.P.
Switzerland ..	Chemicals for the paper, textile and tanning industries	388
Syria	Glass, glassware, pottery	225/51/F.G./ M.C.
United States	Pottery	225/4/F.G./ M.C./C.

TARIFF CUSTOMS EXCISE

Australia.—" Anti-dumping duties " have been applied to dairy thermometers and 4711 eau-de-cologne. An Act amending the Customs Act provides that *ad valorem* duties are to be based on the value of the goods in the exporting country or on the price f.o.b. paid by the Australian importer, whichever is higher. If the currency of the country of origin has depreciated to less than one-twelfth of its normal value, the *ad valorem* duty is replaced by a duty representing the difference of the cost plus duty plus profit in Australia and the wholesale price of similar goods made in Australia.

Ceylon.—Details of the proposed new customs tariff are given in the issue for October 19. Goods affected include acetic acid, cement, certain wares of glass, many metals, lubricating oil, perfumery, salt, soap, and sugar, but research chemicals and apparatus, copra, coconut oil, fertilisers, non-ferrous metals, unwrought metals, petroleum, quinine, crude rubber are not affected. The export duties on areca nuts, coconut products, plumbago, and rubber are also to be revised.

Esthonia.—The export duties on gold, silver, platinum and wares thereof have been revised.

France.—Goods bearing any mark suggesting that they are of French origin may not be imported unless bearing the name of the country of origin.

Gold Coast.—The differential export duty on palm kernels has been abolished.

Italy.—An export licence is no longer required for potassium permanganate or for small quantities of sugar.

Mexico.—The import duty on lard has been modified.

New Zealand.—Regulations have been issued controlling the importation, sale, etc., of opium, morphine, heroin, cocaine, codeine, or ecgonine.

Northern Rhodesia.—Revised rates of duty have been applied to crown corks and stoppers, bioscope films, medicinal preparations, essences, syrups, tinctures containing over 3 per cent. of proof spirit, and starch.

South Africa.—Rebates are allowed on the duties payable on oils, gums, turpentine, solvent naphtha, " Sealtite " and similar fluxes, when imported for industrial use.

Spain.—Under the commercial convention made with Norway, reduced import duties are applied to cod-liver and other animal oils, synthetic nitrogenous compounds, oxalic acid, commercial oxalates, and nitrate of soda.

United States.—A partial reprint of the new customs tariff is given as a supplement to the issue for October 12.

Vladivostock.—The following rates of export duty, based on the local market value, have been fixed:— 2·5 *per cent.*: Beeswax, calamine, zinc blende, copper ore, scrap metals, glassware; 10 *per cent.*: wolframite, nickel, cobalt, manganese ores; 5 *per cent.*: other goods, except linseed, pottery, and bricks, which are duty-free.

Mandated Territories.—By an Order in Council, dated October 13, from November 1 the Tanganyika Territory, the British Sphere of the Cameroons, and the British Sphere of Togoland, will be included within the definition of the British Empire for the purposes of Section 8 of the Finance Act, 1919, which confers preferential rates of duty on goods grown, produced or made within the British Empire.

---

* Official Secretary, Commercial Bureau, Australia House, Strand London, W.C. 2.

† Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C. 2.

REPORTS

RST ANNUAL REPORT OF THE SECRETARY OF MINES FOR THE YEAR ENDING DECEMBER 31, 1921, AND THE ANNUAL REPORT OF H.M. CHIEF INSPECTOR OF MINES FOR THE SAME PERIOD. *Mines Department. Pp.* 181. *H.M. Stationery Office*, 1922. *Price* 6*s.* 6*d.*

This report, which marks the completion of the st year of the existence of the Mines Department, ntains, in addition to the report of H.M. Chief spector of Mines, a review of matters outside his ovince. Part I is devoted to a review of the coal-ining industry during 1921, of the effect of the al stoppage, and of the scheme of organisation hich brought the dispute to an end. The number mines working under the Coal Mines Acts ineasd from 2851 to 3045; the number worked under e Metalliferous Mines Acts fell from 498 to 383, d the number of quarries decreased from 5479 to 66. Workers employed at the mines under the al Mines Act numbered 1,156,938 (including 4,649 workers underground) and at the quarries ,979. The numbers of persons killed and injured accidents were 768 and 86,888, respectively, inuding 756 fatal and 86,352 non-fatal accidents coal mines.

The output of minerals in the United Kingdom is own in the appended table:—

	1921	1920
	Long tons	
Coal	163,251,181	220,532,081
Iron ore, ironstone	3,477,955	12,706,895
Bauxite	2,269	11,020
Copper ore, dressed	36	81
Copper precipitate	100	194
Gold ore	—	1
Lead ore, dressed	6,787	15,399
Manganese ore	514	12,875
Tin ore, dressed	1,078	4,858
Tungsten ore, dressed	*	94
Uranium ore	76	60
Zinc ore, dressed	814	5,064
Alum shale	2,840	5,539
Arsenic, white and soot	1,032	1,997
Arsenical pyrites	—	1,178
Barium compounds	24,669	64,150
Bog ore	817	2,179
China clay	435,844	777,511
China stone	34,886	73,102
Chromite of iron	—	1,100
Fluorspar	23,137	54,683
Fuller's earth	20,242	28,906
Gypsum	264,840	286,978
Iron pyrites	3,943	6,659
Lignite	—	150
Natural gas (cb. ft.)	100,000	95,000
Ochre, umber, etc.	10,310	15.537
Oil shale	1,866,896	2,842,582
Petroleum	342	375
Salt	1,382,629	2,158,370
Soapstone	—	361
Sulphate of strontia	6,622	4,183
Chalk	3,434,357	3,747,165
Chert, flint, etc.	45,641	84,303
Clay and shale	8,351,450	8,021,484
Fireclay	1,352,587	1,966,040
Gravel and sand	2,489,817	2,757,052
Igneous rock	5,740,014	5,620,691
Limestone	7,335,862	11,227,817
Ganister	150,562	310,019
Sandstone	1,884,550	1,873,797
Slate	237,350	215,269
Total (excluding natural gas)	201,999,903	284,601,174

* Cannot be stated.

The decline in the total value of the mineral prouction from £427,444,884 in 1920 to £231,681,358 n 1921 reflects the reduced output due to low prices nd high working costs.

Coal.—The average net selling-value fell from 4s. 6·97d. in 1920 to 26s. 2·23d. in 1921. At the lose of the year, both the output per man-shift and he export improved. The total electric power used in coal mines was 1,148,103 h.-p., an increase of 67,281 h.-p., and the number of coal-cutting machines rose by 188 to 5259, but the output of coal by machine-cutting fell from 30,194,306 t. to 23,039,705 t. The total quantity of coal shipped abroad was 37·7 million t., leaving 129·1 mill. t., including 3·5 mill. t. of imported coal or its equivalent in coke, for home consumption (185·8 mill. t. in 1920), or 55 cwt. per head of population. Coal carbonised at coke ovens amounted to 6,885,940 t., and at gas works to 16,651,757 t., the output of coke being 4,575,618 t. and 6,798,492 t. (excluding coke used in the gas works), respectively. The number of coke ovens in use fell from 15,400 to 13,026, of which 4044 were beehive and 8146 by-product ovens.

Iron.—Owing to the collapse in prices and the coal stoppage, the production of iron ore, and of iron and steel was very greatly reduced. Retained imports of iron ore totalled only 1,887,642 t. Returns for the pig-iron industry in 1920 and 1921 are appended:—

		1921	1920
Works in operation		117	116
Furnaces built		486	481
Furnaces in blast	(average)	95¼	$284\frac{7}{12}$
Pig iron made	(tons)	2,616,300	8,034,717
Iron ore used	,,	5,604,093	19,137,460
Coal used	,,	651,077	2,062,370
Coke used	,,	3,075,947	10,036,219

Tin Ore.—Tin mining practically ceased early in 1921, but as the cost of fuel, materials, and wages has gradually fallen. it appears probable that work in mines that have kept their pumps going will be resumed when the price of metal improves slightly.

Zinc Ore.—There was no market for zinc concentrates during the year, and the zinc-smelting plants were at a standstill. Consequently the mines which produce chiefly zinc blende remained closed.

Manganese Ore.—The mining of manganiferous ore has almost ceased owing to its low grade.

Oil-shale.—There are 31 oil-shale mines in Scotland with a normal annual output of 3 mill. t. of shale, yielding about 60 mill. gallons of crude oil and 55,000 t. of ammonium sulphate. Many of the mines had to be closed during the coal stoppage and have not yet been reopened owing to the fall in price. The value of the products from one ton of shale was 29s. in January and 16s. in December.

Petroleum.—The petroleum well at Hardstoft is the only one now producing in England, all the others having been plugged and abandoned. Oil has been struck at the D'Arcy boring in Scotland and the West-Calder well is being plugged. Oilfields of England, Ltd. is prospecting for petroleum near Kelham, Notts.

Metals.—Figures showing the production of metals from home-produced ores and the mean monthly prices during 1921 are given below:—

		Production		Average monthly price during 1921		
		1921	1920	£	s.	d.
Copper	(tons)	72	127	—		
Standard		—	—	69	8	8
Electrolytic		—	—	75	1	1
Best selected		—	—	71	11	7
Iron, pig	(tons)	1,071,120	3,952,692	—		
Cleveland No. 3		—	—	7	1	11
Lead	(tons)	5,158	10,961	22	14	6
Tin	,,	679	3,065	165	8	2
Zinc	,,	292	1,655	26	4	1
Gold	(fine oz.)	—	34·5	—		
Silver	,,	12,229	76,344	—		

An important event of the year was the appointment of the Safety in Mines Research Board, to advise the Secretary for Mines on research work and to supervise its execution. The chief subjects investigated at the Eskmeals Experiment Station included the propagation of flame; the ignition of gaseous mixtures; the spontaneous combustion of coal; tests of mining apparatus and miners' lamps. No large-scale work was carried on, owing to lack of funds. A joint committee of the Department of Scientific and Industrial Research, the Chemistry Co-ordinating Board, and the Safety in Mines Research Board has undertaken an inquiry into the adequacy of the tests for permitted explosives. Research on miners' lamps was continued.

The retained imports and the exports of British minerals and their products in 1921 were as follows:—

	Imports retained		Exports
		Tons	
Iron ore (except chrome iron ore and pyrites)	1,887,642	..	1,566
Copper ore	24,338	..	242
Copper manufactures	80,792	..	29,330
Copper sulphate	11	..	27,997
Lead ore	819	..	3,857
Lead manufactures	122,451	..	15,998
Lead, red	1,059	..	2,588
Lead, white	3,463	..	6,182
Tin ores and concentrates ..	20,277	..	199
Tin manufactures	6,314	..	10,877
Zinc ore	5,945	..	1,416
Zinc, crude and manufactured ..	72,265	..	7,343
Zinc oxide	4,431	..	740
Cement	105,484	..	289,736
Clay, all kinds	5,539	..	325,303
Fluorspar	*	..	5,220
Salt, table	3,744	..	1,518
Salt, other	81,269	..	239,573
Strontianite, celestine	—	..	5,795
Talc, steatite, soapstone, unground	2,619	..	*
Talc, steatite, soapstone, ground..	3,867	..	237

* Figures not available.

REPORT ON THE ECONOMIC SITUATION IN THE NETHERLANDS EAST INDIES, TO MARCH, 1922. *By* H. A. N. BLUETT, *British Commercial Agent, Batavia. Department of Overseas Trade. Pp. 92. H.M. Stationery Office*, 1922. *Price 2s. 6d.*

Agriculture in the Netherlands East Indies progressed continuously until 1920, but since then trade depression has made necessary a reduction in the area under estate cultivation, particularly on rubber, tea and coffee estates. Agricultural research has been continued, however, and progress has been made in cultivating oil-palms and cotton; large areas of jungle in Sumatra have been cleared for planting cinchona, and other developments are proceeding. Sugar is the principal export of Java, and the sale of the output of 148 of the 183 sugar factories is controlled by the United Java Sugar Producers (*cf.* J., 1922, 402 R). Some 800,000 acres are now planted with Hevea rubber. Cinchona production is controlled by the Kina Bureau and the British Combine of Cinchona Planters in Java; the former controls, roughly, 45,594 acres planted to cinchona, and sells the output to the Bandoengsche Kininefabriek, which produces over 80 per cent. of the world's consumption. The British combine controls 3407 acres and sells its produce to a manufacturer in the United Kingdom. Production of bark from uncontrolled plantations is small, but several plantations will in time have a large output. The export of cinchona bark from Java and Madura in 1921 was 4601 metric tons (*cf.* J., 1921, 356 R) and of quinine 281·6 t. (310·3 t. in 1920). So far plantations of the oil-palm have been made only in Sumatra, where 22,230 acres have been planted; in 1921 the output was 2314 t., and the industry is gradually being established. The important copra industry is mainly in native hands; the factories established for extracting coconut oil during the war are finding difficulty in competing with European factories, as it pays better to export copra than oil. In 1921 exports of copra from Java and Madura amounted to 93,009 t., and from the other islands to 66,807 t., compared with a total of 182,000 t. in 1920.

Petroleum, coal, tin, gold, silver and iodine are produced in important quantities, and manganese, iron, nickel and copper ores, magnesite, phosphate rock, trass, sulphur and diamonds are either produced in small quantities or offer prospects of development. The petroleum resources are not so great as those of America, but the production is steady and will probably remain constant for many years. Development of petroleum and minerals is discouraged by the new mining law, which reserves a large share of any profit to the Government. The output of coal is increasing steadily and reached 1,117,432 t. in 1921; if the output continues to increase, external markets will have to be sought. Two gold and silver deposits in the Residency of Benkoelen (Sumatra) are being developed by the State, and a rich deposit of copper has been found at Tanim (Dutch Timor), but a body of ore sufficient to warrant exploitation has yet to be discovered. A deposit of iron ore, estimated to contain 5 million t. of surface ore and 155 million t. of clay ore, has been discovered in the island of Celebes near abundant water-power; the dry ore contains 48 per cent. of iron, 6·5 per cent. of aluminium and 10 per cent. of moisture. In 1920 there were produced: gold 8,864,771·3 fine oz.; silver 102,027,820·7 fine oz.; manganese ore 4179 t.; tin 2072 t.

The Government has fostered the establishment of new industries. Progress has been made in the manufacture of edible oils and of soap, factories for making firebricks, bricks and tiles, paint, etc. have been established, chemical industry is developing, and oxygen, carbon dioxide, iodine, sodium bisulphate, carbon bisulphide, calcium carbide, and pyrotechnical compounds are being made on a limited scale. An iron and steel works is being built at Cheribon by German interests, a paper mill with an (annual) capacity of 3000 t. is under construction, as are also a blast furnace in Sumatra and a lead factory at Gedangan. A British-Dutch-Norwegian combine is considering the erection of a factory for making synthetic fertilisers.

In 1920, the latest year for which statistics are available, exports from the Dutch E. Indies reached the record value of 2,254,000,000 guilders (guilder= 1s. 8d. at par, now about 1s. 9d.), of which 47·1 per cent. was for sugar and molasses, 8·9% for rubber and gutta-percha, 11·7% for tobacco, coffee and tea, 4·1% for quinine, 0·4% for cinchona bark and 25 per cent for minor agricultural, mineral and forest products. Since the war new markets have been found in the United States, Australia, and the Far East, and the future is regarded with optimism. Imports in 192 were valued at 1,116,200,000 guilders, derived, i order of importance, chiefly from the United Kingdom, the United States, Japan, and Singapore. Import statistics for 1921 will probably show a heav reduction both in quantity and value. At presen there is a growing demand for textiles, chemicals glass an paints, leather, earthenware, porcelain, lassware, but the market for iron and steel is dull. reat Britain, Germany, the United States and apan are competing keenly in the chemical trade, nports from Japan are decreasing, and Germany as almost recovered her pre-war position. British rade in the Dutch East Indies could be coniderably increased, the market offering very great ossibilities.

EPORT ON THE INDUSTRIAL AND ECONOMIC SITUATION IN CZECHOSLOVAKIA, DATED MAY, 1922. *By* R. H. B. LOCKHART, *H.M. Commercial Secretary, Prague. Department of Overseas Trade. Pp.* 44. *H.M. Stationery Office*, 1922. *Price* 1*s*. 6*d*.

Since the publication of the previous report on echoslovakia (*cf.* J., 1921, 372 R) this State has rogressed further in construction problems. The ood support accorded to a State loan floated in ondon and the establishment of an Anglo-Czech ank in Prague are indications of the interest and onfidence of English business men in the country. he continued decrease in purchasing power of eighbouring States has led to a crisis in the ndustry of the country, which relies on exports for ts prosperity. This was, however, foreseen by most anufacturers, and no serious failures have ccurred, nor are any anticipated. As a remedy trong efforts are being made to reduce wages and he cost of living. Glass holds third place in zechoslovak exports for 1921. To extend their arkets window-glass manufacturers have formed wo sales organisations under the names of "Vitrea" and "Fenestra." In the spring of 1921 ontrol of the sugar industry was taken over by a yndicate. The estimated output for 1921–22 is 50,000 metric tons. (For further details of the 921–22 sugar trade *cf.* J., 1922, 177 R, 315 R, 334 R.) he coal industry has suffered badly in the period nder review, though the output in 1921 was lightly greater than in 1920. In 1921 the output f hard coal was 11·65 million tons, and of lignite 1 million tons. The position of the metal industry as also declined owing to high costs. Of the total 921 imports, 3,961,716 metric tons, Great Britain upplied 2·5 per cent., and of the exports, ,645,765 t., took 1·6 per cent. (*cf.* J., 1922, 225 R). he quantities and distribution of certain groups of mports and exports in 1921 were as follows:—

	Metric tons	Percentage distribution
Imports:—		
olours, dyes, tanning materials	17,882	Austr. 19, Yugoslav. 18, Ger. 11
ums, resins	13,248	Ger. 37, Fr. 27, U.S. 12
ineral oils, tar, coal tar	104,256	Pol. 72, Rum. 18
lass, glassware	1,487	Ger. 85, Austr. 10
hemicals, chemical products	168,065	Ger. 36, Belg. 11, Austr. 6
Exports:—		
ugar	447,225	U.K. 21, Fr. 20, Austr. 14
ood, coal, peat	7,632,092	Ger. 41, Austr. 38, Hung. 14
olours, dyes, tanning materials	10,414	Hung. 48, Ger. 16
ums, resins	17,765	Pol. 42, Ger. 27
lass, glassware	132,741	Austr. 15, Italy 14, U.K. 11, Ger. 8
hemicals, chemical products	62,485	Ger. 22, Austr. 21, Pol. 16

Official statistics give the value of the total imorts and exports in 1921 as 22,435 million kronen nd 27,312 mill. kr., respectively, leaving a favourble trade balance of 4877 mill. kr., as against 85 mill. kr. in 1920 (present value of krone = bout 1·7d.).

TRADE NOTES

BRITISH

Gold Coast in 1920

This colony enjoyed great prosperity during the first half of 1920, but the fall in price of cocoa—the chief article of export—from £122 to £39 per ton caused much financial distress and the export decreased by 51,403 tons to 124,773 t. Less attention was paid to the palm-oil industry and only 629,612 galls. of pericarp oil and 7664 t. of kernels were exported, compared with 938,595 galls. and 9892 t., respectively, in 1919. Special steps were taken to foster the copra industry along the sea coast, but the export of coconuts declined by one-half to 427 t. Exports of rubber fell by 58 per cent. to 134 t. and those of kola nuts declined slightly, the demand remaining good. The experiments on the cultivation of sisal and groundnuts and the production of shea-butter (*cf.* J., 1921, 440 R) were continued.

Small diamonds of good quality were found in the lower Birrim valley and a company has been formed to exploit the diamondiferous area of the colony. An occurrence of gold recorded near Kwamang, in Eastern Akim, is not considered of economic importance. Deposits of low grade manganese ore were observed in the area north of Seccondee.

Exports of domestic produce and manufactures were valued at £11,336,046, an increase of 22 per cent. and imports increased in value by over 90 per cent. to £15,152,145. The United Kingdom still holds the largest share of the external trade of the colony, but has not yet regained the pre-war position. Ground was gained by the United States, which supplied most of the imports of sugar, kerosene, iron and steel, perfumery, etc. and took a large share of the exports of lumber, manganese ore, and cocoa.—(*Col. Rep.-Ann., No.* 1119, 1922.)

Chemicals, etc., used by S. African Mines

According to the Union Department of Mines and Industries the values of the chemicals, etc. purchased for South African mines in 1921 were as follows:—Cyanide, £414,801; disinfectants, £21,692; explosives, £2,035,958; iron, and products of, £339,294; lead, £4,727; lubricants, £347,149; oils, non-lubricating, £15,268; paint, tar, etc., £39,004; steel, £617,079; zinc, zinc discs, £166,568. —(*U.S. Com. Rep., Sept.* 11, 1922.)

FOREIGN

The Indigo Market in China

The chief dyestuff imported into China is synthetic indigotin, of which 90 per cent. is distributed in the form of 20 per cent. paste. It is estimated that 60 per cent. of the world's production of synthetic indigotin is consumed in China, and that the trade is worth nearly £2,000,000 per annum. Sales depend upon the price, as the Chinese use natural indigo if the price of the artificial product rises much above 40 taels per picul (equivalent to about 1s. per lb. in Aug., 1922). Stocks of indigotin-paste in China, excluding Hongkong, are being offered at 1s. 4d. per lb., and amount to about 6500 long tons, derived as follows (per cent.):—Germany 50, Switzerland 10, France 15, the United States 10, Germany ("reparation" deliveries) 15. Competition in the indigo trade depends upon the possession of an efficient sales organisation, and those Swiss, French and American firms which are able to compete with the Germans have their own organisations on the spot. Stocks of British-made indigotin have been shipped back to England, probably because they were unsuitable for the Chinese market, but it is anticipated that the British indigotin will be a factor in this trade in the future.—(*U.S. Com. Rep., Sept.* 18, 1922.)

The Chilean Nitrate Industry

H.M. Consul at Antofagasta reports that 447,197 tons of nitrate was produced in Chile during the six months ended June 30, 1922, as against 851,239 t. during the same period of 1921. Exports declined from 785,362 t. to 279,034 t., of which about 36 per cent. was shipped to Europe and Egypt, and 50 per cent. to the United States. Consumption during the first half of 1922 is estimated at between 900,000 and one million tons, the Nitrate Pool alone having sold 590,000 t. out of 800,000 t. it held in stock at the end of December, 1921. At the end of June, stocks in Chile were estimated at 1,609,000 t., and in Europe and Egypt at 217,500 t. Many factories which reduced output during the recent crisis have completed their stocks and closed down. Only 33 factories were working at the end of June, but it is anticipated that trade will improve early in 1923.—(*Official.*)

Exports of Carnauba Wax from Brazil

Carnauba wax, used in making phonograph records, physical apparatus, etc. is obtained from a palm tree which flourishes in the hot, dry zones of north-eastern Brazil (*cf.* J., 1921, 319 R). The quantity and value of the exports during recent years have been as follows:—1918, 4215 metric tons, 20,432,956 milreis; 1919, 6224 t., 20,539,680 milreis; 1920, 3516 t., 10,873,046 milreis; 1921, 3906 t., 10,394,627 milreis (milreis = 2s. 3d. at par, now about 6·5d.). The chief ports of shipment are Fortaleza in the State of Ceara, and Ilha do Cajueiro, in the State of Maranhao.—(*U.S. Com. Rep., July* 17, 1922.)

Proposed Capital Increases in the German Dye Industry

The capital of the Farbwerke vorm. Meister Lucius u. Brüning, Höchst, is to be increased from 470 to 940 million marks. Of the new shares to be created, there will be 400 million ordinary shares, participating in this year's dividends, which will be taken over by a bank at 150 per cent. and offered to existing shareholders on a share for share basis; and 30 million preference shares with dividend rights as from January 1, 1923, to be taken up by the other firms constituting the "I. G" (who also contemplate doubling their capital). The directors of the company are of the opinion that the company will be able to pay dividends commensurate with the increased capital.

The following table gives a survey of the capital increases during the last few years of the various companies belonging to the combine:—

The Italian Market for Paint and Varnish

Most of the paint and varnish made in Italy is second-grade material. About 10 per cent. of the requirements in high-grade paints and varnishes is made in Italy, Great Britain supplying 70 and the United States 20 per cent. Germany practically controls the market for dry artificial colours, linseed oil and red lead are imported from Great Britain, rosins and turpentine from the United States, France and Greece, size from Great Britain and China, and wood oil from China. Most of the mineral colours needed are produced in the country. In 1913 Italy imported about 8500 m.t. of paints and colours and 3000 t. of varnish, but owing to trade depression the imports in 1920 fell to 6350 t. and 2250 t., and in 1921 to 4400 t. and 1158 t., respectively.

The World's Trade in Dyestuffs

The following statistics concerning the world's trade in colours and dyestuffs is based upon the classification adopted by the United States. This classification includes coal-tar dyes, turpentine, linseed oil, chalk and crayons.

Exports in 1920:—	Value $	Destination Per cent.
United States ..	.. 28,600,608 ..	America 56, Europe 26, Asia 8·7 Austral. 7·1, Afr. 1·6
England ..	.. 25,693,000 ..	Brit. Col. 35, Europe 35
Germany ..	.. 9,679,000 ..	Chiefly Europe
France ..	.. 5,271,000 ..	Europe, Egypt
Holland ..	.. 6,776,000 ..	Belgium, U.K., France, Dutch E Indies
Japan ..	.. 3,815,000 ..	China 60, Rest of Asia 40
Canada ..	.. 1,756,000 ..	U.K. 70, U.S.A. 30

Imports in 1920:—	Value $	Origin Per cent.
England ..	.. 9,791,000 ..	U.S.A., Can., France, Holl. Germ.
Holland ..	.. 3,999,000 ..	Germ. 74
France ..	.. 2,324,000 ..	U.K., Holl., U.S.A.
Italy ..	.. 1,684,000 ..	Germ., U.K.
Sweden ..	.. 1,599,000 ..	Germ., U.K.
Switzerland	.. 1,385,000 ..	Germ. 50, France 25
Spain ..	.. 1,323,000 ..	U.K. 50, Germ., U.S.A.
Norway ..	.. 1,112,000 ..	Germ., U.K.
Denmark	.. 1,104,000 ..	Germ., U.K.
Canada ..	.. 4,251,000 ..	U.S.A. 83
British India	.. 6,661,000 ..	U.K. 80
Brazil ..	.. 4,392,000 ..	U.S.A., U.K.
Argentina	.. 3,817,000 ..	U.S.A., U.K., Germ.
New Zealand	.. 2,756,000 ..	U.K. 40, Austral. 30, U.S.A. 15
Cuba ..	.. 2,384,000 ..	U.S.A. 84
South Africa	.. 2,221,000 ..	U.S.A., U.K.
China ..	.. 2,000,000 ..	Japan 60, U.K., U.S.A.
Philippines	.. 1,743,000 ..	U.S.A. 90
Australia ..	.. 1,679,000 ..	U.K. 60, U.S.A. 30
Egypt ..	.. 1,560,000 ..	U.K. 50, France 25
East Indies	.. 1,470,000 ..	Holl. over 67
Chile ..	.. 1,200,000 ..	U.S.A. over 50, U.K.
United States	..<1,000,000 ..	—

In 1913 Great Britain, Germany, and the United States were the chief countries exporting dyestuffs, their exports being valued at $15,000,000, $15,000,000 and $7,328,000, respectively, and this position was maintained during 1920. In 1921 prices fell heavily and the value of the exports during the first ten months of the year fell to $10,437,000 for the United States and to $8,818,000 for Great Britain, compared with $24,058,000 and $13,339,500, respectively, for the same period of 1920. The value of the world's trade in dyestuffs during 1921 was less than one-half that in 1920.

In million marks	Oct., 1919 O.Sh.	Oct., 1919 P.Sh.	April, 1921 O.Sh.	April, 1921 P.Sh.	Dec., 1921. O.Sh.	Dec., 1921. P.Sh.	Sept., 1922 O.Sh.	Sept., 1922 P.Sh.	Dividends: 1920.	Dividends: 1921.	Share of profits %
Höchst ..	180	72	400	30	440	30	880	60	20	30	24·82
Bad. Anil. ..	180	72	400	30	440	30	880	60	20	30	24·82
Bayer	180	72	400	30	440	30	880	60	20	30	24·82
Treptow ..	63	25	136	10	149	10	298	20	20	30	8·08
Griesheim ..	45	18	100	8	110	8	220	16	16	27	6·0
Weiler-ter-Meer	16·64	6·66	31	2·33	33·65	2·33	67·30	4·66	15	25	1·65
Casella	81	32	152·20	—	152·20	—	304·40	—	20	3	9·81
Total ..	745·64	297·66	1,619·2	110·33	1,764·85	110·33	3,529·70	220·66			100

REVIEWS

MICAL TECHNOLOGY AND ANALYSIS OF OILS, FATS AND WAXES. *By* J. LEWKOWITSCH. *Sixth edition. Vol. II. Entirely revised by G. H. Warburton. Pp. xii.+959. London: Macmillan and Co., Ltd.*, 1922. *Price 42s. net.*

The many and widespread interests which are ncerned with the preparation and use of oils, ts and waxes, are of such magnitude, and their tional importance so great, that they rank ongst the great industries of the Empire. The orking-up of the prime raw materials, the pro- ction and preparation of which are of the utmost portance to many, if not all of our Colonies, in- lves such an amount of capital and labour that ere exists every justification for the production of encyclopædic treatise which should contain a atement of all modern improvements in the pro- ction, purification and manipulation of the rious oils, fats and waxes, as well as the fullest tails as to their analysis, composition and roperties.

Dr. Lewkowitsch's book is the only work in our nguage which approximates to this standard, nd his wide experience enabled him to write with uthority on the subject. There can be no doubt at his death before he had completed any more an the first volume of the fifth edition of his ok, which appeared in 1914, made it extremely ifficult to maintain in the later portion of that, nd also any subsequent editions, the high standard hich he had set. So long as the living personality f the author was behind his writings, the peculiar yle and diction which he adopted could be cepted, they were characteristic of the man, but is to be regretted that they have been retained the edition now current which bears a date eight ears after the author's decease.

It may be questioned always how far a revision ould involve alterations of text, but if revision is be anything more than reprinting, then state- ents in the older editions which refer to periods f time should be amended. In very many cases hroughout the volume now under review such ording as "during the last decade," "during the st few years," "recently," is found in sentences hich have been changed in no way since they ppeared in the 1909 edition. If any reason could e advanced for their appearance in the 1914 dition, surely none can be put forward for their resence in the new publication of 1922. Most of he statements so introduced have no bearing what- ver on current conditions.

The volume contains two chapters. The first, hich consists of 39 pages only, deals very briefly ith the commercial preparation of the raw aterials used in the oils, fats and waxes industries. t is to be regretted that so important a branch of he industry receives such scant attention, and specially is this so when up-to-date plant and ractice are ignored. Only two examples of this eed be cited. The paragraph on p. 16, dealing ith the Anderson "expeller" continuous oil- ress, although introduced by the word "recently," as not been altered since it appeared in the 1909 dition, and it altogether ignores, in its possibly ustified condemnation of the press for the purposes ndicated, its more modern and quite extensive pplication, especially in American practice, to the reliminary crushing of such oily materials as copra. Further, the square box-press, which has largely superseded the circular cage-press for the pressing of palm-kernels and copra, both in this country and abroad, is not mentioned.

The second chapter, which forms the major portion of the volume, consists of a series of monographs dealing with the principal oils of commerce, whilst lesser known oils are described in short paragraphs or tables. This undoubtedly is the most useful part of the volume, since it contains practically all the published information concerning the materials about which it treats, though it might be claimed that much of the older matter could be eliminated without any sacrifice of utility.

The outstanding need of the volume is an alphabetically-arranged index of its contents. In previous editions a general index has been appended to Vol. III of the work, and it is to be presumed that this will be continued, but the inconvenience of referring to an index in one volume in order to locate matter contained in another is obvious. The indexes of botanical and zoological names contained in this volume are of somewhat doubtful utility. In spite of the above-indicated shortcomings, the appearance of this volume must be welcomed by everyone who is concerned with industries involving a knowledge of the preparation and properties of oils, fats and waxes, as a large proportion of the information contained in it is not obtainable elsewhere without an immense amount of labour and extensive reference to innumerable other publications. From this point of view the work is most valuable.

JOHN ALLAN.

FOURTH REPORT ON COLLOID CHEMISTRY AND ITS GENERAL AND INDUSTRIAL APPLICATIONS. *Pp.* 382. *London: H.M. Stationery Office*, 1922. *Price 5s. 6d. net.*

This report, which is issued by a Committee of the British Association for the Advancement of Science under arrangement with the Department of Scientific and Industrial Research, is similar in plan to the three reports already issued, the subject-matter being arranged under two heads, namely, (1) classification according to scientific subject; (2) classification according to industrial process. The sections included under the first head are:—"Colloid Problems in Analytical Chemistry," by H. Bassett; "Cataphoresis: The Motion of Colloidal Particles in an Electric Field," by E. F. Burton; "Colloid Systems in Solid Crystalline Media," by C. H. Desch; "Molecular Attraction and the Physical Properties of Liquids," by Edwin Edser; "Membrane Equilibria," by W. E. Garner; "Disperse Systems in Gases," by W. E. Gibbs; "The Theory of Lubrication," by W. B. Hardy; "Application of Colloid Chemistry to Mineralogy and Petrology," by Alex. Scott.

The technical papers included under the second heading are:—"The Colloid Chemistry of Soap. Part II. The Soap Boiling Processes," by J. W. McBain and E. Walls; "The Concentration of Ores by Flotation," by Edwin Edser; "Colloids in Catalytic Hydrogenation," by E. F. Armstrong and T. P. Hilditch; "The Role of Colloids in Electrolytic Metal Deposition," by H. J. S. Sand; "Rubber," by H. P. Stevens; "Colloidal Fuels, their Preparation and Properties," by A. E. Dunstan.

If the various scientific and technical journals published during the last few years are examined only cursorily, one cannot fail to notice that colloid chemistry is attracting more and more attention, as is indicated by the large number of papers dealing with various aspects of the subject. This increased interest is indicated by the fourth report, which contains more than twice the number of pages in the third report.

With advance in knowledge it becomes increasingly difficult to offer a definition of colloid chemistry. Such substances as the proteins have been looked upon as typical emulsion colloids, but in recent years it has been shown that many of their properties can be explained by the application of ordinary stoichiometrical relations. Again, the work of Laue and Bragg, Langmuir, etc. indicates the existence of residual valencies at the surface of solids, and this, together with an increase in knowledge of the laws underlying the formation of complexes, will undoubtedly throw fresh light on the subject of adsorption, a subject which is particularly dear to the colloid chemist. This difficulty of definition is indicated by the subjects included in the present report, since some of them a few years ago would undoubtedly have been classed as pure physics and not as colloid chemistry.

A decade or so ago it was considered that the various processes of analytical chemistry could be explained by the application of the dissociation theory. Difficulties were then glossed over; now one endeavours to meet many of them by a consideration of the colloid chemistry involved. Prof. Bassett discusses the fundamental colloid phenomena underlying many analytical operations, especially in connexion with the formation, purity, filtration and washing of precipitates. Attention is also called to a phase of the subject which is generally neglected, viz., the colloid properties of filter paper, surfaces of vessels, etc., and there is a valuable section which illustrates the application of the principles discussed to various important analytical estimations.

In the section on cataphoresis, Prof. Burton summarises the main points of the subject, and includes recent work on technique carried out in his laboratories.

The dispersion of solid particles throughout a crystalline solid, when the state of sub-division is sufficiently fine, introduces colloidal characteristics of interest in metallurgy and mineralogy. Prof. Desch writes a critical article on the application of our knowledge of colloids to such questions as the hardening of steel and of certain non-ferrous alloys, and the colouring matters in crystalline minerals. Very often the use of the blessed word "colloid" is considered to offer an explanation of a subject which is little understood, as was the case with the word "catalysis," but Prof. Desch is careful to point out where it is doubtful whether the solution of a problem is to be found in the application of colloid chemistry.

Mr. Edser's article on molecular attraction and the physical properties of liquids is different from the others in that it consists mainly of the development of a theory of the author's on the law of molecular attraction. It is found that in all liquids the result of analysing the experimental data is to indicate that the molecules attract each other inversely as the eighth power of the distance separating them. Expressions are deduced for calculating the latent heats and surface tension of liquids. One
the assumptions made, and with which many wi
not agree, is that the molecules of a liquid an
those of its vapour are identical in structure so fa
as association is concerned, and the degree of ass
ciation does not vary with the temperature.

Mr. Garner discusses the potential difference
occurring at the surfaces of membranes in contac
with electrolytes, special attention being paid t
Donnan's theory. Loeb has recently made extende
use of the Donnan equilibrium in dealing with pr
teins, but this is not referred to. It would hav
been interesting to have had a criticism of Loeb'
results by an independent worker on the subject.

Gas-solid and gas-liquid disperse systems are
importance in connexion with various natur
phenomena, with industrial operations such as th
precipitation of dust, and with chemical warfar
and Dr. Gibbs gives a valuable *résumé* of the resul
hitherto obtained and of the underlying theory.

Mr. Hardy discusses the various theories
lubrication and then gives an account of his ow
theory and work on the subject. Dr. Scott gives
very valuable bibliography and discussion of th
application of colloid chemistry to mineralogy an
petrology, and is careful to point out many dire
tions in which further investigations are needed.

Prof. McBain and Mr. Walls give first a bri
account of actual soap-boiling practice, then
theory of soap-boiling based on laboratory and sem
technical experiments, and finally the application
the theory to the several industrial processes. Th
authors state that "neither scientist nor exper
enced soap-boiler is in a position even now to gi
a connected and reasoned account of all the ph
nomena upon which this vast industry is base
Improvements are still effected by purely empiric
trial." Nevertheless, the work of McBain and h
collaborators at Bristol University, in which the
is strict application of scientific method to
industrial problem, is making sure progress in th
direction of eliminating empiricism. This repor
together with Part I, goes a long way towards th
objects aimed at, namely, a clear description of th
experimental behaviour of soap and their solution
and the development of a rational theory to accou
for them, so that ultimately the various factors ca
be controlled quantitatively.

Mr. Edser's article on the concentration
minerals by flotation is one which contains a co
siderable amount of original work and many ne
observations. It is thought-provoking and will u
doubtedly give rise to much discussion and fre
experiment, since in many of his views he is total
at variance with many physical chemists, especial
with Bancroft.

In the hydrogenation of gaseous or liquid orga
compounds colloid phenomena are concerne
(1) because of the surface at which interacti
occurs; (2) when catalysts in the colloidal conditi
are employed. The various physical and chemi
conditions involved, as well as the various theori
of catalysis, are considered and critically discuss
by Drs. Armstrong and Hilditch.

The effect of colloids in giving bright and cohere
deposits from electrolytic plating solutions is
which has long been known, but it is only compa
tively recently that more or less satisfacto
attempts have been made to give explanations
the phenomena. Dr. Sand gives an interesti
summary of this subject.

Dr. Stevens's report on rubber is an extension of the first report published in 1917, the bibliography being brought up to date and the properties of rubber discussed from the colloidal view-point. The question of vulcanisation is treated in detail.

Dr. Dunstan's report on colloidal fuels is very brief, and refers, more particularly, to work done in the United States. It could have been expanded with advantage.

As will be seen from the brief summaries given above, the various reports are written by well-known workers on the subjects about which they write, and their importance to all who have to deal at some time or other with colloids cannot be over-emphasised. The results obtained in the study of colloid chemistry are now being utilised in so many branches of science, that the literature on the subject has become very scattered, and all interested in the matter owe a great debt to the special Committee of the British Association for the work it has done in arranging for the drawing up of such admirable and critical summaries.

T. Slater Price.

Modern Gasworks' Practice. *By* Alwyne Meade. *Second edition, rewritten and enlarged. Pp. xi+815. London: Benn Brothers, Ltd.*, 1921. *Price 55s. net.*

If anything more were required to confirm that he industry concerned with town-gas manufacture in the forefront of chemical-engineering industries -as regards size, capital value, extent of its amifications, and the multiplicity of its opportunies for rendering national service—this book by lwyne Meade would suffice. Those best able to udge tell us that there are very few chemical ngineers amongst us: there are many able echnical chemists who are poor engineers, and here are many excellent engineers engaged in the hemical industry who are very poor chemists. None ut a fully qualified chemical engineer—in the idealtic sense—could have compiled and written this ook on modern gasworks' practice. The author emonstrates unquestionably that he not only possesses a thorough theoretical knowledge of his ubject but that he is in the closest association in an xecutive capacity with many of the processes, lants and operations described and excellently llustrated in this voluminous work. The book is ell arranged, well bound and well printed, and the ublishers are to be congratulated on their part of e work. We would, however, suggest that it ould be an advantage if the *third* edition were ublished in two or three slightly smaller volumes, articularly as the author draws our attention to e fact that the bulk of the second edition is 50 per nt. greater than that of its predecessor; and "as t there is no indication as to when finality in this rection may be reached."

The book justly claims to be one on modern gasorks' practice, and all the advances that have been ade in the gas industry up to the middle of the ar 1921 are faithfully and adequately handled. would, however, have been better if the author d dealt less fully with obsolete plants and ocesses and if he had been contented with ferences to fuller accounts. Undoubtedly everying that is touched on is of great interest particular specialists, but the subject of modern sworks' practice is such an extensive one that the author cannot afford space to make the book an historical treatise on the gas industry. The author depends, perforce, for much of his information relative to the results obtained in plants and processes on accounts published, in good faith, by interested parties. This is a misfortune that is not peculiar either to this book or to the gas industry.

As the volume of work done by such research committees as the Gas Investigation Committee rapidly increases, it will become less and less necessary to depend on, and refer to, the less reliable workers. A perusal of this book brings conviction that the gas industry no longer depends for its progress on the "practical" man alone—with his rule-of-thumb methods and lack of vision—but is now at long last making good use of scientifically-trained men.

One here realises, too, the enormous debt the industry owes to the Fuel Department of the Leeds University for the work, of immediate value to the industry, which has been carried out by members of its staff during the last fifteen years. Few industries are served by the universities so well as the gas industry, and it is an excellent and rejuvenating thing that this should be so. Mr. Meade creditably draws heavily for his inspirations from the reports on work carried out at the Leeds University—re-assembling their results in more digestible form—and enhances the value of his book proportionately.

"Alwyne Meade" should be found on the shelves of all progressive gas engineers and students, as it is an incomparable book of reference and text-book combined.

E. W. Smith.

Grundzüge der angewandten Elektrochemie. Band I: Elektrochemie der Lösungen. *By* Prof. Georg Grube. *Pp. xii+268. Dresden and Leipzig: Theodor Steinkopff*, 1922. *Price* 8*s*. 6*d*. (10*s. bound*).

In many ways this book resembles Foerster's well-known "Elektrochemie wässriger Lösungen," but it is less detailed. It begins with 140 pages of theoretical principles, in the form usual in German text-books, and not always up-to-date. Thus, in considering dilution laws, no mention is made of Washburn's important experiments, and the work of Krüger and Krummreich on absolute potentials, although given extremely briefly without mention of the names, has no reference beyond Foerster's book. In other respects the literature references are usually good, and comprise work done in 1921.

The introductory section includes the lead and nickel-iron accumulators, the "combustion" cell, and electro-endosmose and its applications. The electro-deposition and refining of metals are next treated. The section on the electrolysis of alkali-chlorides (pp. 171—218), which deals with alkali, chlorine, hypochlorite, and chlorate, is very good; the descriptions of the principal cells are brief but clear, and numerical data are given when these are known. Electrolytic oxidation and reduction processes, the electrolysis of water, and the electrolytic prevention of boiler-corrosion follow, and there is a good index.

Prof. Grube's book is a very useful and concise text-book of the electrochemistry of solutions, and provides a readable account of an important branch of technology.

J. R. Partington.

OBITUARY

J. TAKAMINE

We are indebted to Dr. Allen Rogers, hon. secretary of the American Section, for the following facts concerning Dr. Takamine, an original member of this Society, who died in New York on July 22, aged 67 years.

Jokichi Takamine was born in Takaoka, Japan, and received his scientific and technical education in the Imperial Engineering College, now the Imperial University, of Tokyo, where he graduated in chemical engineering in 1878; later as a government student, he spent three years at the University of Glasgow. The degrees of doctor of engineering and doctor of pharmacology were conferred upon him by the Imperial University of Tokyo in 1899 and 1904, respectively. Among the many important positions he filled were those of chief chemist to the Department of Agriculture and Commerce, director of the Government Chemical Laboratory, and Patent Commissioner for the Empire of Japan. He founded the Government Saké Experimental Station, and also the Tokyo Artificial Fertiliser Co., which owns the first superphosphate works in the country; during Takamine's direction the capital of this company rose from 250,000 to 25 million yen.

Much of Takamine's best work was done in his private laboratory. He took out many patents on the improvement of *Moyashi* diastatic substances; he invented a process for extracting cobalt oxide from Japanese manganese ore which proved an invaluable aid to the pottery industry of Japan; and he developed the use of the improved *Koji* process in alcoholic fermentation. In the early 'nineties he settled in the United States, at Clifton, New Jersey, where he isolated the active principle of *Koji*, known as Taka-diastase, which has been much used in medicine, and also, under the name "Polyzime," in the textile industry, in cereal foods and in baking. In 1900 he isolated adrenaline, the active principle of the suprarenal glands, which has found such a wide application as a hemostatic agent. He is also the inventor of a process, still in use, for recovering glycerin from printers' rollers.

Dr. Takamine received two orders from the Emperor of Japan, in one of which, the Fifth Order of Rising Sun, he rose to Court rank; he was also appointed, by Imperial Decree, a member of the Imperial Academy of Science in Japan, of which the active membership is limited to sixty.

PUBLICATIONS RECEIVED

The Manufacture of Dyes. *By* Dr. J. C. Cain. *Pp.* 274. *London: Macmillan and Co., Ltd.*, 1922. *Price* 12*s.* 6*d.*

Inorganic Chemistry. *By* E. J. Holmyard. *Pp.* 560. *London: Edward Arnold and Co.*, 1922. *Price* 6*s.* 6*d.*

A Comparison of British and American Foundry Practice with Special Reference to the Use of Refractory Sands. *By* Prof. P. G. H. Boswell. *Pp.* 106. *Liverpool: The University Press of Liverpool, Ltd.; London: Hodder and Stoughton, Ltd.*, 1922. *Price* 4*s.* 6*d.*

Atomic Form with Special Reference to the Configuration of the Carbon Atom. *By* E. E. Price. *Pp.* 140. *London: Longmans, Green and Co.*, 1922. *Price* 5*s.*

Investigations on Oil Palms. *By* Dr. A. A. L. Rutgers. *Pp.* 125. *Medan, Dutch East Indies: Experiment Station, A.V.R.O.S.*, 1922. *Price* 10*s.*

The Volatile Oils. *By* E. Gildemeister and Fr. Hoffman. *Second edition, translated by E. Kremers. Vol. III. Pp.* 777. *London: Longmans, Green and Co.*, 1922. *Price* 32*s.*

Physical and Chemical Examination of Paints, Varnishes, and Colours. *By* Henry A. Gardner. *Pp.* 220. *Washington: P. H. Butler, 1845, B Street, N.W.*, 1922. *Price* $9.

Researches on Cellulose, 1910—1921. *By* C. F. Cross *and* C. Dorée. *Vol. IV. of the "Cross and Bevan" Series. Pp.* 253. *London: Longmans, Green and Co.*, 1922. *Price* 15*s.*

Chemical Engineering Catalog. *Seventh annual edition. Pp.* 1183. *New York: The Chemical Catalog Co., Inc.*, 1922. *Price* $10; *on loan for 1 year* $2.

Coal, Coke, and By-Products. 1913—1919. *Part III. Pp.* 173. *The Mineral Industry of the British Empire and Foreign Countries. War Period. Imperial Mineral Resources Bureau. H.M. Stationery Office*, 1922. *Price* 7*s.*

Critical Survey of Questions Affecting the Coke-oven Industry. *By* Dr. Carl Still. *Pp.* 137—300. *Translated from the German by Coke and Gas Ovens, Ltd., Salisbury House, London Wall, E.C. 2, and published by permission of "Glückauf."*

Report of the Food Investigation Board for the Year 1921. *Department of Scientific and Industrial Research. Pp.* 47. *H.M. Stationery Office*, 1922. *Price* 2*s.*

Memorandum and Draft Regulations in Connexion with the Bulk Storage of Petroleu Products. *H.M. Petroleum Department Bulletin No.* 2. *Pp.* 11. *H.M. Stationery Office*, 1921. *Price* 3*d.*

Mineral Resources of the United States in 1921 Preliminary Summary. *U.S. Geological Survey. Department of the Interior. Pp.* 102 *Washington: Government Printing Office* 1922.

The Bacteriology of Canned Meat and Fish. *B* W. G. Savage, R. F. Hanwicke *and* R. B Calder. *Department of Scientific and Industrial Research. Food Investigation Board Special Report No.* 11. *Pp.* 72. *H.M. Stationery Office*, 1922. *Price* 2*s.* 6*d.*

First Annual Report of the Secretary for Mine and Annual Report of H.M. Chief Inspecto of Mines for the Year ending December 3 1921. *Mines Department. Pp.* 181. *H.M Stationery Office*, 1922. *Price* 6*s.* 6*d.*

Report on Structural Materials along the S Laurence River, between Prescott, Ont., an Lachine, Que. *By* J. Keele *and* L. H. Col *Mines Branch, Department of Mines, Canad Report No.* 549, *Pp.* 119. *Ottawa: F. A Acland*, 1922.

REVIEW

Vol. XLI] NOVEMBER 15, 1922 [No. 21

UNVEILING OF THE RAMSAY MEMORIAL

THE medallion tablet to the memory of Sir William Ramsay was unveiled in Westminster Abbey on November 3, by H.R.H. the Duke of York, in the regretted absence of H.R.H. the Prince of Wales, who had met with a slight accident in the hunting field on the previous day. The tablet, executed in bronze by Mr. C. L. Hartwell, A.R.A., represents in profile the head of the great chemist; it is set in a marble frame and bears the simple inscription: "William Ramsay, Chemist." During the short and impressive service, the Duke of York removed the veil which covered the tablet, and said:—"On behalf of my brother I ask the Dean and Chapter to accept this tablet as a lasting memorial to Sir William Ramsay, the great chemist." In accepting the memorial, Bishop Ryle, Dean of Westminster, said that it would be the duty of the Dean and Chapter of Westminster to preserve the mural tablet, and to add it to the galaxy of memorials to distinguished men of science placed in the adjoining North Aisle and including those dedicated to the memory of Darwin, Wallace, Lister, Adams, Stokes, Joule, and Hooker.

There was a large and distinguished congregation. Lady Ramsay was present, with many of her family and relations. The officers of the Ramsay Memorial Fund were represented by the Rt. Hon. H. A. L. Fisher, Sir Charles Sherrington, the Rt. Hon. Lord Chelmsford (vice-presidents), Sir Hugh Bell (chairman), Prof. J. Norman Collie (treasurer), and Dr. W. W. Seton (organising secretary). The large attendance of the Diplomatic Corps included Ambassadors (United States, France, Belgium, Japan, Spain, Germany); Ministers (Chile, Denmark, Finland, Greece, Lithuania, Netherlands, Serbia, Sweden); *Chargés d'Affaires* (China, Norway); representatives of the Italian Ambassador and the Swiss Minister; and several Consuls-General. Among the many representatives of Science were Prof. H. Le Chatelier (delegate of the French Academy of Sciences), Sir W. Bayliss, Sir G. Beilby, Sir W. Bragg, Prof. F. G. Donnan, Prof. F. E. Francis, Sir R. Glazebrook, Sir R. Gregory, Sir R. Hadfield, Sir H. Jackson, the Hon. Sir Charles Parsons, Prof. J. R. Partington, Sir R. Robertson, Prof. S. Smiles, and Dr. M. W. Travers. It had been arranged that His Excellency the French Ambassador should present the Prince of Wales with the Gold Medal of the Ramsay Memorial Fund, but this ceremony had necessarily to be postponed.

We take advantage of this occasion to offer our tribute to the memory of our Past-President, from the pen of one of his most distinguished pupils, Dr. Morris Travers, who was intimately associated with him in the discovery of neon, krypton and xenon.

WILLIAM RAMSAY

The beautiful ceremony in Westminster Abbey on November 3, was the world's homage to the genius of one of the greatest scientists of our time. His name is enrolled with those associated with the highest achievement by men of our race; it passes into history. Though much has been written on Ramsay's life and work since his death in 1916, it may still be permitted to those who were associated with him, many of them members of this Society of which he was one time President, to pay personal tribute to the memory of their well-loved friend and leader.

To one who was privileged to serve him for many years it seems that the quality in Ramsay's nature which drew men to him, was his unshakable belief in human integrity. Suspicion and distrust were absolutely foreign to him. Never did a student appear so worthless but that Ramsay had hopes for him. Over-confidence in associates may have led to the exploiting of his name, to his own grief and annoyance; but in his confidence in the reliability of fellow scientists lay the springs of some of his greatest successes. The discovery of argon, the discovery of helium, the part he played in the development of the chemistry of radio-active substances, had their origin in the belief that the facts stated by Lord Rayleigh, Hildebrand, and Rutherford, were worthy of acceptance and investigation, and were not mere errors of experiment. In pursuing investigations, those who served him knew that they had his entire confidence, demanding only an equal confidence in themselves, and in him. Scientific friends, students, and colleagues were freely admitted to his laboratory, in which there were no secrets.

It has been suggested that Ramsay was *lucky* in his scientific career. Nothing is further from the truth. He had hardly the advantage of a university training in the modern sense of the term. While in Germany he studied in a laboratory in which originality was at a discount. At Bristol he was loaded with the work and responsibility falling on the shoulders of the

Principal of a small and struggling college. In 1887 he took over the laboratory at University College in which research was a dead letter, and when the spirit of research throughout the country was at a low ebb. Yet in ten years he had built up a school of chemistry which drew students and investigators from all parts of the world.

Ramsay's early work, carried out under considerable difficulties in University College, Bristol, consists mainly of a series of brilliant experimental researches on the properties of liquids and vapours, with occasional excursions into other fields. During his early years in London he completed some of these investigations, carried out some important work on the molecular weights of liquids, and other researches in which his students took part. The building-up of a school of research was the object which he had in view, but he did not bind himself to any particular line of investigation. He wrote a large text-book of inorganic chemistry, undertaking this work partly with the view of arranging and systematising contemporary knowledge of inorganic chemistry on the basis of the Periodic Law. One edition only appeared, and it was never revised or rewritten. It is of historical interest, as the Periodic Law was the basis of some of his greatest discoveries.

During the early nineties the development of the new theories of solution gave a fresh direction to the study of chemistry, and Ramsay became keenly and critically interested in the work of the Continental school of chemists, which at the time, found many opponents in this country. He was not, however, inclined to follow in other mens' footsteps. Students in his laboratory worked at problems relating to solutions; but, although he was then casting about for new lines of research he did not take an active part in this work. It was Lord Rayleigh's observation of the abnormal density of atmospheric nitrogen which provided the key to the series of discoveries which occupied his individual attention for the last years of the century, and which determined the future course of his investigations.

Reading the original "argon" paper, one is impressed by the fact that, even when it was written, Ramsay realised that he stood on the threshold of greater discoveries. The discovery of helium, the logical sequel to the discovery of argon, confirmed him in the belief that these gases formed members of a series of terrestrial elements, and in the autumn of the year 1895 he definitely embarked on the search for the missing members of the group. Two years later, in his address to the Chemical Section of the British Association at Toronto, he took the characteristic step of describing the progress of the search for the "undiscovered gas," predicting its properties, and inviting competition in the quest. Three years after the discovery of helium the reward came to him in the simultaneous discovery of neon, krypto and xenon, but it was only after two furthe years of strenuous work that the five "rar gases" were completely isolated and thei properties fully described. The isolation o niton many years later set the crown on thi work.

These discoveries had their origin in Ramsay' power of grasping the significance of fact observed by others rather than of passin them over as possible errors of experiment The development of them was based upon clear understanding of the simple fundamenta laws of chemistry. The conduct of the lon drawn-out investigations, in face of real difficulty and often of adverse criticism, called fo enthusiasm, courage, and perseverance, an the character of the work demanded experimental skill of the highest order. Thes qualities Ramsay brought to bear on hi researches, and with them he in some measur endowed those who served him.

Space does not admit of further reference to Ramsay's scientific researches, nor to hi activities in connexion with scientific an educational organisations. Suffice it to sa that the election of the man most renowne for his investigations in the domain of scientifi chemistry to the office of President of thi Society, and his acceptance of that office may be regarded as a landmark in the histor of the relations of British science and Britis industry, which he did much to foster.

In building up the school of chemistry a University College, and in maintaining th spirit which pervaded it, Ramsay's personality was a dominating factor. Even in his busiest time he rarely failed to make a daily tour o the laboratory, seeing all but the junior students, and having a word of advice or criticism fo everyone. To the juniors he lectured personally, and would often visit the practical classes. Every student who passed more than a yea in the department was in turn invited to one of his Saturday evening dinners, and made to feel that he was a friend in whom the Chief and Lady Ramsay took a personal interest. Letters from former students and assistants invariably met with a cheery reply, generally containing something new and interesting.

Many of Ramsay's greater discoveries are, in a sense, complete in themselves. They were the forerunners of many recent advances in science and technology, which are based on the foundation which he laid. During the last two years of his life, years of war, he devoted more attention to matters affecting science and the Empire than to experimental chemistry. Had he lived we may believe that he would have been an active force advocating and promoting the principle of frank co-operation between men of science, and between those engaged in science and industry.

MORRIS W. TRAVERS.

SOME RECENT WORK ON ANTHELMINTICS

T. A. HENRY

IN a recent report Dr. F. A. Miller states that in the course of the anti-hookworm campaign, of which he is director, in olombia, out of 53,390 persons examined in 921, 49,940 (93 per cent.) proved to be infested nd that of 47,822 treated, 37,488 (78 per cent.) ere cured. This report relates to the work of ne of the many similar campaigns against ookworm now in progress in tropical countries nder the auspices of the Rockefeller Founation. Work on the same lines is also being arried on by Governmental and other agency, o that the number of people now being treated or hookworm disease (ancylostomiasis) proably runs into millions, and they still represent nly a fraction of the victims needing treatnent, 75 per cent. or more of the native popuation in many tropical countries being freuently infested with hookworm. Everyone ngaged in this work recognises that the best nethod of dealing with the disease is prevention, ut this implies the education of natives into leanly habits and the immediate provision f sanitary appliances on a gigantic scale, and hough neither is being neglected, both can nly be accomplished slowly.

It is clear that if mass remedial treatment is o be successful, the drugs used must be safe, fficient and cheap, and it is to the credit f the Hookworm Commissions that they spare o pains to secure these three desiderata in he order given.

Two species of hookworm are concerned, *ncylostomum duodenale* and *Necator americanus*. hese parasites infest the duodenum, where they e firmly attached to the intestinal wall and rotected by a copious exudation of mucus.

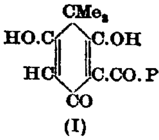
The worms (*Taenia, Ascaris, Ancylostomum*, tc.), which are parasitic in man and other nimals, are comparatively highly developed rganisms, and as such should be susceptible attack by drugs in various ways; but it eems to be true that, with the exception of the ixture of alkaloids known commercially as pelletierine," and possibly santonin, all the nthelmintics in use act by paralysing, more or ss completely, the external musculature of e parasites. Several of the text-books on harmacology and materia medica state that ere is, "pelletierine" again being an excepon, nothing specific about the action of anthelintics on worms, that the substances so used re toxic to both parasite and host, and that e host escapes damage from the drugs only ecause the latter are not readily absorbed. he case does not seem to be quite so simple as is, since there are numerous substances which lfil these conditions and yet the number of fective anthelmintics is small. In hookworm isease the drugs have to be given in comparaively large doses to secure a local concentration sufficient to render the parasites harmless and the amount of drug absorbed is often considerable, although the technique of administration is constantly being improved to avoid this secondary action. It is also difficult to explain on this view why santonin should be active against round worm (*Ascaris*) and inactive against tapeworm (*Taenia*), the reverse being true as regards filicic acid and its allies (extract of male fern), though both are believed to be effective in virtue of their action on the external musculature.

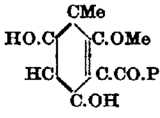
Perusal of the voluminous medical literature on the treatment of hookworm disease shows that a great variety of drugs has been used in practice, including extract of male fern, quassia decoction, a mixture of chloroform with eucalyptus oil, and in certain parts of South America the latex of two species of ficus, called higueron or higuerote. All these drugs still have their advocates, but in the organised campaigns against hookworm, the drugs used are β-naphthol, thymol and chenopodium oil, which are named in ascending order of importance. Many efforts have been made to extend this range of drugs, but the only addition that need be referred to is carbon tetrachloride, with which promising results have been obtained recently in Fiji by Hall, and have been confirmed by Nicholls and Hampton in Ceylon and by McVail in India. Carbon tetrachloride is said by Joachimoglu to be 50 per cent. more powerful as a general anæsthetic than chloroform and it is probably this greater activity which makes it more effective than chloroform since Caius and Mhaskar have shown that the latter merely acts on the worms as an anæsthetic and in their view is not a true anthelmintic. The soporific action of carbon tetrachloride on hookworm patients has been noted by McVail in India.

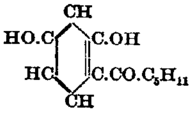
β-Naphthol and thymol are both phenols, and most of the recent work on possible new anthelmintics has been devoted to the study of phenols and especially derivatives of phloroglucinol and resorcinol, following a suggestion made by Fränkel that the active constituents of a number of well-known anthelmintics contain butyric or *iso*butyric acid residues, with or without phloroglucinol, *e.g.*, filicic acid derived from *Filix mas* and other ferns, rottlerin from kamala, kosotoxin from cousso flowers, and ascaridole from chenopodium oil. The examples are not very impressive since filicic acid and its allies are at best uncertain in their action, kamala and cousso flowers are now but little used, and ascaridole, though like other terpene derivatives it yields *iso*butyric acid on oxidation does not contain, strictly speaking, an *iso*butyric acid residue.

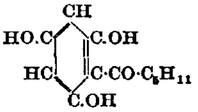
Following Fränkel's suggestion, Karrer and his co-workers have prepared an extensive series of condensation products of aliphatic acids with phloroglucinol and resorcinol analogous to filicic acid (Formula I) and aspidinol (Formula

II) which may be regarded as the nuclear units on which the complex and more active constituents of *Filix mas* and other ferns are built up.

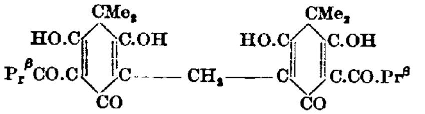

(I)

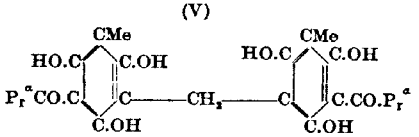

(II)


(III)


(IV)

Of these synthetic compounds Karrer has stated recently that the *iso*hexoyl derivatives of either resorcinol (reso*iso*hexophenone : Formula III) or phloroglucinol (phloro*iso*hexophenone : Formula IV) are the most promising, and that the *iso*acyl residue appears to confer greater activity than the normal acyl residue, phloro*iso*butyrophenone being twice as active as phlorobutyrophenone. The naturally-occurring fern compounds become more active with increasing complexity, albaspidin (Formula V) being more active than filicic acid (Formula I) and less active than filixic acid, which is represented by Boehm as containing three rings. The synthetic compounds on the contrary become less active with increasing complexity : thus methylphlorobutyrophenone condenses with formaldehyde in presence of alkali to form 2 : 4 : 6 : 2′ : 4′ : 6′-hexahydroxy-5 : 5′ -dibutyro-3 : 3′ -dimethyldiphenylmethane (Formula VI) which should have an activity similar to that of albaspidin, but is in fact less active than the starting material.

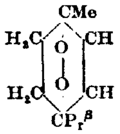

(V)

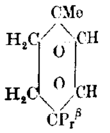

(VI)

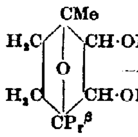
It is probable that the simple mono-, di-, and tri-hydric phenols are all capable of yielding anthelmintics of practical value in proportion as their solubility and toxicity are modified by the nuclear substitution of either alkyl or acyl groups. Phenol itself is used as a remedy for thread worms, but is too irritant for general use and that also applies to its methyl, ethyl, propyl, and butyl homologues, but thymol (methyl*iso*propyl phenol), which is solid at ordinary temperatures and sparingly soluble in water, is a valuable anthelmintic, which is not toxic to the host even in large doses, provi that it is given in the absence of oils or ot substances in which it is soluble and wh would increase its rate of absorption by t intestinal walls. Its isomeride, carvacrol, Darling has shown, is also a valuable anth mintic for hookworm, but being liquid it sprea and penetrates better than thymol, and therefore too irritant for use.

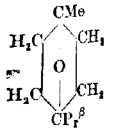
Attempts have also been made to lower t toxicity of alkylphenols by converting th into non-irritant esters, such as carbonat carbamates and *N*-dimethylcarbamates. O of these, thymol carbonate, is stated to ha given good results in the outbreak of hookwo disease which occurred during the boring of t St. Gothard Tunnel, but recent trials by I Wilson G. Smillie in Brazil (*private commu cation*) and by Caius and Mhaskar in Ind show that the drug is of little value. Anoth of these preparations, *p*-benzylphenyl carbama has been reported on favourably by Koslows as a remedy for oxyurids (thread worm Alkyl ethers of the phenols have been show to be inactive.

The other known effective remedy agai hookworm, chenopodium oil, has been examined recently in these laboratories and constituents isolated and tried in field oper tions in Brazil by Dr. Smillie as part of general investigation of possible new remedi for hookworm disease. The clinical result which are not yet published, show that the so constituent of the oil which is active agai hookworms, is the organic peroxide, ascarid (Formula VII), and that the variation fou by different observers in the action of chen podium oil is due largely to the varying qua tities of this somewhat unstable compone in the commercial oil. On heating, ascarido passes into the isomeride, ascaridole glyc anhydride (Formula VIII), and this on hydr tion yields a mixture of α- and β-ascarido glycols (Formula IX) which in turn can b converted into thymol and carvacrol. Th three intermediate products, which may and d occur in carelessly distilled oil, are all inactiv against hookworm so that this series of change begins with an active substance (ascaridole)


(VII)

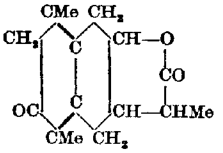

(VIII)


(IX)

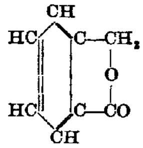

(X)

sses through three that are inactive and ends
th an active compound (thymol). It is
eresting in this connexion to mention that
ıeole (Formula X), which has had some
gue in the treatment of hookworm but has
en found by Smillie and by Caius and Mhaskar
have but little action, is fairly near to
aridole glycol in constitution, but the latter
fers from cineole in containing two secondary
ohol groups and, so far as they have been
ed, secondary and tertiary aromatic alcohols
ve proved useless against hookworm in man.
Ancylostomiasis is in the main a tropical
ease, and though it is not unknown in tem-
rate regions, the parasitic worms usually
evalent in Northern Europe, viz., *Ascaris*,
enia and *Oxyuris*, are much less dangerous
d receive less attention. Against *Taenia*
pe worm) the drugs most commonly used are
le-fern extract, the constituents of which
ve been discussed already, and "pelletierine"
nate; the latter is not the simple substance
name implies, but is the precipitate formed
the addition of tannin to an extract of
megranate bark and so contains all the
kaloids known to occur in the bark of which
o—pelletierine and *iso*pelletierine—probably
rm the most active constituents. "Pelle-
rine," according to von Schröder, is a specific
ison for *Taenia* spp.; thus *Taenia serrata*,
ich infests the intestinal canal of the cat,
ll live for several days in a warm (37° C.)
intly alkaline solution of sodium chloride,
t is killed in 5 to 10 minutes if 1 part in
,000 of "pelletierine" is added, whilst the
und worm (*Ascaris mystax*) is only killed in
uch stronger concentration of the alkaloid.

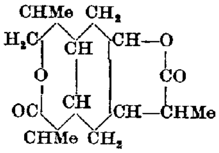
Of the drugs used against round worm
scaris spp.), the most important is santonin.
enopodium oil is as good or better, and its
e for this purpose is common in the United
ates, and may extend to other countries if
e present scarcity of santonin continues.
ntonin, as every reader of this *Journal*
no doubt now aware, is at present only
tained from one source—Soviet Russia—
ing made in a factory in Tashkent from
ntonica flowers (wormseed) collected locally.
reenish, Simonsen and Goodson have shown
dependently that it is also present in *Arte-
isia brevifolia*, found in India. According to
autenschläger, and in confirmation of obser-
ations by Trendelenburg, the activity of
ntonin is associated with the lactone ring
ormula XI), the sodium salt of the corre-
onding acid being inactive, an observation
hich is difficult to reconcile with the existing
se of sodium and other salts of santoninic
cid as anthelmintics, though it is true that
e sodium salt is no longer largely employed
wing to its toxicity. These observations
ppear to be based solely on the results of
xperiments in the application of the drugs
o worm muscle, and they need confirmation
y clinical trials. If confirmed they will be of considerable practical importance since Lautenschläger found that whilst open-chain lactones have no action on worm muscle, such action is not confined to lactone-groups in association with dimethylnaphthalene, as in santonin, but is also shown by phthalide (Formula XII), and its dimethoxy derivative (meconin) and can be increased by the replacement of one of the methylene hydrogen atoms by an alkyl group or diminished by similar substitution of an aromatic group, *e.g.* phloroglucinol.



(XI)



(XII)



(XIII)

It is interesting to note that the introduction of a second lactone-group into the santonin molecule, as in Wedekind's α-tetrahydrosantonilide (Formula XIII), reduces the anthelmintic action.

Wellcome Chemical Research Laboratories,
September 20, 1922.

THE PRESENT POSITION OF FAT-HARDENING

In a recent issue of the *Zeitschrift für Angewandte Chemie* (1922, pp. 437-440), Dr. W. Normann, one of the earliest authorities on the subject, discusses in detail certain technical, scientific and economic aspects of the fat-hardening industry. In the summary of the article which follows only brief references are made to those topics which have been treated recently in these columns (*cf.* J., 1922, 384 R, 392 R, 415 R).

The pivot upon which the whole art of fat-hardening turns is the catalyst, which nowadays is almost always the metal nickel. The noble metals that were used to a limited extent in the past have been abandoned owing to their prohibitive cost. Neither cobalt nor copper is employed alone; the use of mixtures of them with nickel has been proposed, but whether they have been utilised on a manufacturing scale is unknown to the author.

The method of preparing the catalyst has become practically a standard procedure, viz., the precipitation or decomposition of an easily decomposed nickel compound upon some inert material as carrier. Generally the carbonate is precipitated upon kieselguhr but sometimes gaseous nickel carbonyl is either decomposed upon a carrier or directly in the oil. Usually the catalyst is reduced in the dry state and then immersed in the oil, precautions being taken to prevent it coming in contact with air; but a class of compounds that has won much popularity includes the carbonate, formate and oleate of nickel, which can be added directly to the oil and there reduced with hydrogen at a temperature slightly above that commonly employed for hydrogenation. In this process the surrounding oil prevents the sintering of the metallic particles, consequently the nickel is obtained in an almost colloidal condition, the oil then having the appearance of ink. Whilst this method has the advantage of permitting the reduction and hydrogenation to be performed in one vessel, this gain is counterbalanced to some extent by the difficulties experienced in filtering the finished product owing to the extremely finely-divided state of the catalyst; but this can be mitigated somewhat by the addition of a carrier.

A process of American origin, based, however, on the researches of Prof. Frerichs, is the use of block nickel, that metal being obtained in very fine subdivision by grinding or milling it under oil or water. This catalyst works far better than might be expected. Moreover, very little care need be exercised in its preparation, and when spent, it is recovered in a very simple manner; after filtration it is re-melted, whereby the organic impurities are destroyed, and then cast and re-milled again to make it ready for further use.

Generally speaking, the methods of working employed in fat-hardening resemble very closely those used in the early days. Mechanical appliances have been introduced for the violent agitation and mixing of the hydrogen, oil and catalyst, but for the most part these are superfluous, for with a good oil the reaction proceeds quite smoothly without such extraneous aid. It must be borne in mind that the reaction is exothermic, consequently, to avoid overheating of the oil, the hydrogenation should not proceed at too great a pace.

The old controversy as to whether the nickel functions in the elemental state or as a sub-oxide has not yet been settled satisfactorily. That it is probably in the metallic form may be deduced from the mode of preparation from block nickel.

The catalytic "poisons" most likely to occur in the nickel salts used as starting material are lead, zinc, and sulphur. The halogens have been proved to be harmless; in fact, nickel has been employed as catalyst in reactions involving the substitution of halogens by hydrogen in organic compounds. Carbon monoxide, the most likely impurity in hydrogen made from water-gas, does not "kill" the catalyst, but merely renders it dormant, Normann having found that nickel inactivated by carbon monoxide can be revivified by treatment with pure hydrogen. Of the "poisons" in the oil itself, some may be removed mechanically by filtration through fuller's earth, and others are converted into harmless substances by raising the temperature of hydrogenation to 230°—250° C. Many patents have been granted for the preparation of catalysts which are said to be highly resistant to "poisons," but it is probable that all forms and kinds of catalysts are equally susceptible to them.

Of particular interest is the work of Rosenmunde and Zetsche, who found that when certain substances were added to the catalyst the reaction d not proceed to completion, as might be expecte but came to a definite halt at some intermediate stage. Their researches so far have not been extended to fat-hardening, where the possibility of making a catalytic mixture capable, say, of reducing linolenic and linolic acids to oleic acid might prove of practical value, as, for example, in the manufacture of the semi-solid fats used in cooking. According to Moore, at a proportionately higher temperature the remaining double bonds of an unsaturated acid are more easily reduced than the 9—10 bond in oleic acid; but Moore's observations are not sufficiently satisfactory to support this statement. During hydrogenation there are formed iso-oleic, elaidic and other hitherto unknown isomers of oleic acid that are not present in the original oil. This phenomenon cannot well be due to the wandering of the double bond, as is known to happen in the Varrentrapp method of fusing oleic acid with alkali, rather is it to be explained by the assumption that in hydrogenation no selective action is shown towards any of the two or more ethylenic bonds that may exist in a molecule, and that any double bond may be reduced as it comes into fortuitous and simultaneous contact with a particle of catalyst and hydrogen. In this manner, it will be seen that linolenic acid can give rise to three linolic and three oleic acids.

The formation of these different isomers is to a large degree rendered explicable by the idea outlined above, but another possibility to be entertained, though perhaps happening to a smaller extent, is that of dehydrogenation, which can be effected catalytically by nickel under certain conditions. Normann points out that often towards the end of the hardening the iodine value of the fat rises instead of falling to zero. Dehydrogenation of oils has, in fact, formed the subject matter of an American patent granted to Levey (U.S. Pat. 1,144,589), who claims that by treating oils at 220°—250° C. with a current of gas in the presence of a nickel catalyst he is able to convert a non-drying oil into one having a higher iodine value and with drying properties to correspond. Different gases may be used, even hydrogen, but best results are obtained with carbon monoxide. Oils with high iodine values but with inferior drying properties can be converted into good drying oils by a preliminary partial hydrogenation followed by this dehydrogenation process, for it is maintained that the hydrogen atoms split off are not the same as those primarily added.

In view of our very great ignorance of the colloidal state in non-electrolytes the following observations and inference of the author are of interest. As explained above, when a catalyst i prepared directly in the oil an inky-black liquid i obtained which is very difficult to filter. However after partial or complete hydrogenation of the oi the nickel tends to coagulate and become flocculen and consequently is easily filterable. This was firs remarked by Erdmann. Now when this nickel which may be either settled or filtered off, is adde to fresh oil it disperses in that medium and a inky-black fluid difficult to filter is again obtained Mixed with petroleum ether this same nicke remains flocculent and can be readily filtered, bu when mixed with benzene the nickel gives a brownish-black liquid which is unfilterable or very diff ult to filter. Normann suggests that the formation f this apparently colloidal solution of nickel is ssociated with the double bonds contained in the olvent.

Owing to the paucity of published data and tatistics relating to the fat-hardening industry and he natural reluctance of individual firms to dislose information concerning their production, it is ery difficult to obtain a true measure of the present position of the economic development of this omparatively new industry. During the last fteen years the industry has become firmly established and works for fat-hardening are now to be ound in all parts of the world. The first plant to e erected was that at Crosfield's in 1907, which ad an output of 2 tons per day. Although statements have been made to the contrary, the second plant to be operated was at the works of Leprince nd Siveke in Herford in 1908, whilst the third was rected by Wilbuschewitsch at Nijni-Novgorod in 910.

In 1914 there probably existed altogether 24 works for fat-hardening, 18 of which were in Europe, having an annual output of approximately 230,000 tons of hardened oil. At the present day here are about 60 factories in Europe alone. Of this number 11 at least are in Germany, but more than half of these are not controlled by German capital; this figure is probably underestimated, for t is extremely difficult to ascertain the precise number, a remark which also applies to the following information concerning other countries. The number of works at the present day in England is given as 3, in France 5, in Holland 5—6, in Belgium 2, in Denmark 3, in Norway 4, in Sweden 4, n Russia 2, in Bohemia 2, and in Hungary 5, only one of which is known to be working. In other European countries the number of works averages about one in each; in countries outside Europe, there are 14—15 works in the United States, 8 in Japan, 1 in Manchuria and 1 in Egypt. Owing to trade conditions it is more than probable that at the present time many of these works are either dle or not producing to their full capacity.

Practically all oils met with in commerce are used as material for hardening. The suitability and application of hardened fat in the manufacture of soap is now so well known that lengthy reference to it is unnecessary; at first a great deal of prejudice had to be overcome before it was employed. Of much more interest is the use of hardened fats for edible purposes, an application that quickly resulted after it had been established that they were not only digestible and wholesome but also completely assimilated by the body. In Germany most of the edible hardened fat is manufactured into margarine; in America its use for the preparation of lard substitutes seems to be preferred.

The above-mentioned 14—15 works in the United States have a total productive capacity of 142,000 tons per annum, but during the last few years their output has been little more than half this quantity, as is shown by the following annual returns: in 1919, 54,635 t.; in 1920, 81,891 t.; and in 1921, 98,071 tons. The oil hardened in these works was of vegetable origin, for fish oils are apparently not treated in the United States, though the possibility that this source of raw material will be utilised in the near future seems very likely. This hardened fat was used mainly for edible purposes, very little entering into soap manufacture, because it cannot compete against the considerably cheaper animal fats. In this connexion Normann quotes a reliable communication received from America to the effect that the fat-hardening industry in that country is in a parlous condition because the margin between the price of liquid oils and that of natural hard fats is less than the working costs of hardening.

The following figures give the amounts of hardened fat absorbed by the margarine industry in Germany during the war, when food restrictions were in force; in the year 1915, 4945 t.; in 1916, 12,978 t.; in 1917, 7714 t.; in 1918, 15,247 t.; and in 1919, 30,421 tons. The part played by the fat-hardening industry in Germany during the war cannot be too highly praised, for, supplied with the very worst of oils, such as whale, poor linseed, and very bad rape-seed oils, it had to convert these into tasteless and odourless fats, the shortage of other oils and fats suitable for edible purposes being very acute. Hardened whale oil, however, was in use before the war as an edible fat; in 1914 Denmark consumed 3000 tons of it in the production of margarine, for which purpose it is quite suitable. So enormous has been the demand for whale oil to supply the needs of the fat-hardening industry that the whale and similar sea animals have practically been exterminated in the northern hemisphere, and unless international restrictions are made to prevent it, a similar state of affairs appears imminent in the southern waters whither the whaling industry has migrated. A gradual diminution in the supply of this comparatively cheap oil may therefore be expected in the future, but this will hardly influence the industry of fat-hardening to any great extent for an abundant source of raw material is to be found in the vegetable oils.

NEWS FROM THE SECTIONS

NOTTINGHAM

The first meeting of the session was held on October 18, when the chairman, Mr. S. F. Burford, Public Analyst of Leicester, gave his inaugural address on "Industrial Chemistry, its Importance and Progress."

The Society of Chemical Industry, founded on broad and catholic lines, has been organised to pool the wealth of chemical knowledge. It is to our younger chemists, coming into this heritage, that we look for further developments. Many examples show how greatly the chemist has added to the sum of human happiness and security. This is partly known to the man-in-the-street, who makes many demands on his power and supposed omniscience. The commercial man, whilst appreciating the value of insurance against fire and trade risks, demands of the chemist immediate returns, and expects by placing a penny in the slot to make fortunes, like a broker, from the power of transmutation. In reality all exploration is costly. The disinterested worker places freely at the disposal of his fellow-men the results of laborious researches. Trading corporations must not be content to make their profits out of such results, but on their own account should subsidise research for the public, as well as for their own benefit. Examples were given of such enlightened action. On the other hand, civic corporations, in particular, have not yet risen to their responsibilities in the disposal of their waste products by financing schemes of investigation as a matter of public duty, and of great contingent benefit and profit.

MONTREAL

The first meeting of the Session 1922-1923 was held in the Queen's Hotel, Montreal, on October 16. The chairman, Dr. A. R. M. McLean, presided, and the speaker of the evening was the ex-President, Dr. R. F. Ruttan.

Dr. Ruttan recounted his experiences in Great Britain and France on the occasion of his visit for the Annual Meeting. He spoke of the hospitality so lavishly extended to him as a compliment to Canadian chemists rather than a personal one, and many interesting souvenirs of that meeting were passed round to the members. Dr. Ruttan also spoke of the status of the chemical engineer in the Old Country and the efforts that were being made to secure men trained to be good chemists and good engineers but not specialists, introducing the analogy of the general medical practitioner. Referring to the chemist in Canada he said: "No class in the community is more interested in such national questions as technical education, utilisation of waste products, controlling and directing the application of scientific methods to the development of industries and of the resources of the country. Members of no profession are so well qualified as are chemists to direct legislation along effective and economic lines. We chemists, as a body, are too much inclined to shut ourselves up in our own interests, whether academic or commercial. It seems time for the chemist to take greater cognisance of public affairs and to assume an active part therein."

In dealing with the need of closer union between not only academic and industrial chemists, but also scientific organisations generally in Montreal, Dr. Ruttan urged the formation of a Science Club. Such a club in Montreal would bring together the Natural History Society, the Montreal Chirurgical Society, mining, engineering, and other organisations which are now housed separately. In order to bridge the gap between academic and industrial chemists a fifth year should be added to the university course in which the student would, under direction and tuition, do work on industrial processes. He also spoke of the need of inducing the Legislature to create an advisory committee of chemists to act for the Government in connexion with the Customs and other departments, as he found there was no one who could advise the Government departments on questions that are now, more than ever before, arising in connexion with imports and the use of chemicals. The Government should be compelled to subsidise the exhibits of resources, production, and those showing the development of new chemical industries at the 1924 Imperial Exhibition, to be held in England to illustrate the natural resources of different parts of the Empire.

After Dr. Ruttan's address Mr. A. Neighorn moved a resolution, which was seconded by Mr. H. W. Matheson and adopted unanimously, that a prize of $50 be offered to a third-year McGill student for the best essay on his practical experience of chemistry as applied to industry.

Mr. G. E. Sanders, formerly of the Department of Agriculture, in charge of research on insecticides, spoke briefly on the development and spread of insects destructive to crops and trees.

GLASGOW

The new session was opened by a meeting held on October 20 in the Institute of Engineers and Shipbuilders, Glasgow. Mr. W. E. Moodie, the new chairman of the section, presided and introduced Dr. H. Hepworth, who gave a most interesting account of "The Syntheses of the Tannins."

Following a historical introduction, the lecturer reviewed the work of Emil Fischer and traced the various steps in the synthesis of pentadigalloylglucose, which has a molecular weight of 1700 and a rotatory power resembling that of natural gallotannin. It was emphasised that much of Fischer's success was due to the control which he was able to effect upon the hydroxyl-groups during a condensation, a control made possible by treating the hydroxy-compound with chloroformic ester prior to condensation. An example of such control was afforded by the synthesis of a depside, a substance able to coagulate gelatin and formed by the condensation of a hydroxyl-group of one molecule with a carboxyl-group of another. Such a substance was digallic acid formed by the condensation of two molecules of gallic acid. Reference was made to the synthetic compound prepared by Fischer shortly before his death in 1919, which had a molecular weight of 4021 and a molecule containing not fewer than 220 carbon atoms, and which had been prepared with the aid of phenylhydrazine, Fischer's "guiding star." This substance was the condensation product of tribenzoyldigalloyl chloride with the osazone of maltose and *p*-iodophenylhydrazine. The work of Nierenstein was then discussed and it was shown that Fischer's formula for gallotannin could not be upheld and correlated with the production of tetramethylglucose, as obtained by Nierenstein in the hydrolysis of purified gallotannin. In conclusion, it was stated that nothing was known regarding the constitution of the other natural tannins, except that they were not all glucosides.

EDINBURGH AND EAST OF SCOTLAND

Dr. H. E. Watt presided at the first ordinary meeting of the present session, held on October 24 in the Hall of the Pharmaceutical Society, Edinburgh. The Secretary announced that Mr. J. Henry, of Leith, had been approved by the Committee for admission as an Associate, and on the motion of Mr. J. Rutherford Hill this was approved.

The chairman then delivered his opening address entitled "Some Thoughts on the Training and Career of the Industrial Chemist." The importance of a university or college training for industrial chemists was emphasised. The training in pure chemistry should be as wide as possible, specialisation in any particular branch being left until the completion of the university course qualifying for the degree or the Associateship of the Institute of Chemistry. Additional subjects of study should include mathematics and physics, and, if possible, biology. Dr. Watt also discussed the uestion of looking for employment and gave some und advice to prospective industrial chemists on e bearing of candidates at interviews. The career the chemist was then outlined with many light nd humorous touches and much instructive riticism and advice. A good discussion followed which Mr. W. A. Williams, Dr. Lauder, Messrs. utherford Hill, Baxter, Cottrell, Merson, Ludlam, nd Williamson took part.

LIVERPOOL

On October 27, in the Muspratt Lecture Theatre f Liverpool University, Mr. W. M. Inman read a aper on "Developments in the Use of Bléaching gents for Textiles and Paper Pulp," of which an bstract is given below. Dr. G. C. Clayton, hairman of the Section, presided over a good ttendance.

Methods of bleaching did not change materially rom ancient times until the middle of the ighteenth century, Scheele's discovery of chlorine nitiating the first real development. Bleaching y chlorine gas was, however, not very successful, nd it was left to Charles Tennant to develop the pplication of Scheele's discovery. In 1798 Tennant repared "bleach liquor" by passing chlorine into ilk of lime, and subsequently solid bleaching owder, which obviated the difficulty of transport. Much attention was given to making a bleaching owder containing more than 35 per cent. of available chlorine, but the solid sodium and calcium ypochlorites were a failure owing to difficult and xpensive methods of manufacture. In recent ears liquid chlorine has been much used. In uture it is probable that the method of 1798 (*cf. s.*) will return to favour, the hypochlorite being tilised on the spot. This method is used in many aper mills in North America; the chlorine, from ank wagons containing the liquid element, is passed into stoneware towers down which milk of lime is flowing. In this way the bleach-mixing plant is dispensed with and there is less residual sludge. A comparatively small plant can furnish a large utput, and the process is economical. It is possible that the old-fashioned "gas bleach" for the resolution of lignified fibres may again come into prominence, especially if the gas be derived from liquid chlorine. In America the new paper mills use a liquid-bleach plant, but it is quite feasible to make bleach liquor from milk of lime and chlorine in the common type of bleach-mixer that is used in British paper mills. All that is necessary is to provide dip pipes through which the chlorine can be introduced. The mixer is filled with milk of lime and agitated at a fairly high speed. The chlorine is absorbed slowly at first but more readily later, and a bleach liquor of any convenient strength can be made. Alternatively, it is suggested to chlorinate the free lime which is present in all bleaching powders during the operation of mixing it with water to produce bleach liquor. The liquid chlorine is contained in 70-lb. cylinders and the content of one cylinder suffices to chlorinate 6 cwt. of bleaching powder. Advantages of this process are: reduction in amount of sludge; more rapid working due to quicker sedimentation; less bleaching powder is used and less irritant dust gets into the air. This process has been used in Germany for many years; it was first tried here in 1919. In the future the user will make his own bleaching agent from an alkaline base and liquid chlorine.

BRISTOL .

The second meeting of the Session was held in the University on November 2, when Mr. C. J. Waterfall presided over an excellent gathering numbering 60. Among the visitors present were members of the Bristol and District Boot and Shoe Trade Managers' and Foremen's Association. Mr. Stanley Hirst, of Messrs. Cox and Co.'s Successors, read a paper entitled "From Hide to Leather," and illustrated his remarks by showing numerous specimens and samples of tanning materials, leather made by various processes, and sources of damage to hides. An excellent discussion followed, and a vote of thanks to Mr. Hirst was proposed by Mr. M. W. Jones (vice-chairman) and seconded by Mr. Arthur Marsden. The president of the Boot and Shoe Trade Managers' and Foremen's Association expressed thanks on behalf of its members for the invitation to be present. In conjunction with the paper, arrangements were made for members to visit the tannery of Messrs. Cox and Co.'s Successors on November 8.

MANCHESTER

The meeting held on November 3, when the attendance was over two hundred, was the second of the intended series of annual joint meetings arranged by the Manchester Sections of the Society of Chemical Industry, the Institute of Chemistry, the Society of Dyers and Colourists, and the Manchester Literary and Philosophical Society. Dr. E. F. Ardern presided at the outset, and explained that as the arrangements for the meeting had been made by the last-named society, and would have been held in its rooms if they had been large enough, Prof. W. L. Bragg had been asked to preside. Prof. Bragg then took the chair and introduced Dr. F. W. Aston, who gave an address on isotopes, of which the following is the official summary:

Dalton's atomic theory postulated that atoms of the same element are equal in weight. Beyond mere speculation the first attack on the validity of this wholly unproved hypothesis was made about 1910, when Soddy put forward his theory of isotopes and predicted the existence of varieties of lead having different atomic weights, a prediction amply verified later. The same possibility was suggested in the case of the non-radioactive elements by the positive-ray analysis of neon. By this analysis one compares the weights of individual atoms, and this can now be done with an accuracy of one part in a thousand by means of the mass-spectrograph. This instrument gives a focussed spectrum depending only on the weights of the particles forming the positive rays, and as these are charged atoms and molecules, their weights can be directly compared. It is found that many, probably the majority, of the elements consist of mixtures of isotopes. Thus chlorine (atomic weight 35·46) consists of two isotopes of atomic weights 35 and 37 respectively. Some of the heavier elements are exceedingly complex, xenon having no less than nine constituent isotopes. By far the most important result is that the atoms of all elements except hydrogen have integral weights when expressed on the oxygen scale to a considerable degree of accuracy. This "whole number" rule enables sweeping simplifications to be made in our ideas of mass. All atoms may now be considered simply as different aggregations of primordial atoms. The latter are of two kinds, positive and negative, protons and electrons, the particles of electricity itself. The fact that the elements of fractional atomic weight are mixtures of isotopes of whole-number atomic weight explains at once anomalies in order, such as the atomic weights of argon and potassium. On Rutherford's nucleus-atom theory, isotopes are elements whose atoms have the same net positive charge on their nuclei (Moseley's atomic number) but different numbers of protons and electrons in these nuclei and therefore different weights. Isotopes have practically identical chemical and optical properties. Their separation is a matter of extreme difficulty and only the minutest changes of atomic weight have been experimentally detected so far. The weight of the hydrogen atom is found to be greater than unity; this is of great importance for if it were possible to transmute hydrogen into any other element prodigious quantities of energy would be liberated. This transmutation is probably going on continuously in the sun and other stars.

BIRMINGHAM

Dr. E. B. Maxted, chairman of the Section, presided at the dinner held in the Queen's Hotel on November 4, when the guests included Dr. E. F. Armstrong and Mr. and Mrs. F. R. O'Shaughnessy. To mark the retirement of Mr. O'Shaughnessy after 17 years' service as hon. secretary of the Section, the President, on behalf of the members, handed him a laboratory microscope with complete accessories and a scroll testifying to the esteem in which he was held, and Mrs. O'Shaughnessy was presented with a gift of jewelry.

In proposing the health of Mr. and Mrs. O'Shaughnessy, Mr. H. Silvester referred to the ability and tact with which the late hon. secretary had performed his duties and recalled that although the Section was formed shortly after the foundation of the Society in 1881, it remained in existence only a short time. Sir W. Tilden then initiated the Birmingham Chemical and Metallurgical Club, but as there were no facilities for publishing papers read at the meetings, the Birmingham Section was re-formed, largely through the enterprise of Mr. O'Shaughnessy. During his period of office the late hon. secretary organised annual meetings of the Society in 1907 and 1917, and 157 papers had been read before the Section. Dr. Armstrong observed that not only had Mr. O'Shaughnessy's work enriched chemical science but it was for the public benefit, and he hoped that the microscope would enable him to amplify it; on behalf of the Society he expressed deep indebtedness to the hon. secretaries of the Sections for their loyal service.

In returning thanks for the gifts Mr. O'Shaughnessy observed that the tendency had been to enhance the technical side of the Society's activities and pleaded for more attention to the social side.

The toast of the Society was proposed by Mr. E. R. C. Marks, chairman of the Midland Section of the Institution of Mechanical Engineers, who pleaded for closer co-operation between the mechanical engineer and the industrial chemist. Replying to the toast, Dr. Armstrong stated that this year the Society had a very definite policy, viz., to raise the position of the chemical profession to that of the legal, medical and engineering professions. Within the next few years chemists would have to decide whether they would rehabilitate their profession or be content to remain in the wilderness. Practice and research were necessary, but the importance of observing professional etiquette, and of cultivating a broad outlook and ideals, were not yet sufficiently recognised. Prof. A. R. Ling proposed the toast of "The Guests" and Mr. J. G. Smont, president of the Birmingham Metallurgical Society, who replied, remarked on the harmonious relations that had existed between that Society and the Section, and observed that if, in the past, metallurgy had developed mainly on the engineering side, metallurgists were now returning more to basic principles—to chemistry. Dr. E. B. Maxted, responding to the toast of his health, expressed the hope that the evening would mark the first of a long series of annual dinners. The credit for the success of the arrangements for the dinner was due to Mr. G. King, the new hon. secretary.

MEETINGS OF OTHER SOCIETIES

THE FARADAY SOCIETY

The latest of the series of useful discussions promoted by the Faraday Society was held, in conjunction with the British Cold Storage and Ice Association, on October 16 in the Institution of Electrical Engineers. Papers were received from several distinguished foreigners, Prof. H. K. Onnes and Dr. C. A. Crommelin, of the Cryogenic Laboratory, Leyden, and M. Claude, of Paris, but of these only Dr. Crommelin was able to attend.

"On the Lowest Temperature yet obtained" was the subject of Prof. Onnes's paper, and in it he describes attempts that have been made to prepare solid helium by the boiling of liquid helium under reduced pressure, the latest attempt—made in 1920—being given in detail. The actual pressure on the surface of the helium was 0·012 to 0·014 mm. and the lowest temperature 0·9° Absolute; but no solid helium was obtained.

Dr. C. A. Crommelin described in detail the methods used in the Cryogenic Laboratory in Leyden, and particularly those for liquefying various gases and obtaining any desired temperature below °C. and maintaining it constant within 0·01° C. The advantages of ethyl chloride as a refrigerating agent were discussed by Prof. C. F. Jenkin. The high inflammability of this substance can be counteracted by mixing it with ethyl bromide. Most metals are not corroded by it, but rubber and woods are affected. Moisture must be rigorously excluded from the refrigerating machines, since ice-crystals may be formed which choke the valves.

Dr. Ezer Griffiths and Mr. J. H. Awbery discussed the thermometric lag in cold-storage practice, a subject which they have investigated at the National Physical Laboratory; and the former, in a paper on some materials of low conductivity, described some of the lesser known substances which have been found to be very efficient insulators. Among these are "expanded rubber," or rubber in a highly cellular form, of density 0·06 (ordinary vulcanised rubber has density 1·5), and Balsa wood from Ecuador, which is extremely light, a cubic foot weighing from 5·7 to 8·6 lb., compared with 45 lb. per cb. ft. for mahogany. This wood has little strength but, unlike cork, it can be worked with ordinary wood-working tools. Other materials described were: fibres of *Kingia Australis*, eel grass, and compressed peat.

Mr. C. R. Darling contributed a short description of a thermo-couple designed for low-temperature work, and a paper of great practical interest on industrial methods of liquefaction and practical applications of low temperatures was read by Mr. S. K. Murray, of the British Oxygen Co., who gave a full account of the Linde and Claude processes, together with some figures of cost. The disused barium-oxide process of making oxygen is economically the equal of the air-liquefaction methods, but the oxygen produced by it is less pure. The secret of cheap oxygen is large liquid-air units worked to their full capacity. Ninety-six per cent. of the oxygen sold in this country is used in industry, mainly for metal-cutting. It is doubtful whether it is yet economic to use oxygen for enriching air for blast furnaces (a subject discussed by Mr. Cosmo Johns), or, in conjunction with steam, for the continuous gasification of fuel. The only uses of oxygen in chemical industry, known to the author, are in the manufacture of nitric and acetic acids in Germany. Practically all the oxygen used throughout the world is oxygen stored in cylinders; about 300 million cub. ft. per annum is distributed in this form in this country, even in the present bad state of trade. In France the output is about the same, in the United States three times and in Germany more than twice as much as in Great Britain.

Monsieur G. Claude's paper on the manufacture of hydrogen from water gas and coke-oven gas described his methods of separation by partial liquefaction. It would appear that the production of hydrogen from water gas has hardly any advantages over other processes, but the author believes that his process is likely to be of great service to the coke-oven industry, owing to its many indirect advantages, *e.g.*, the recovery of benzol and ethylene.

A paper which gave rise to considerable discussion was that by Mr. E. A. Griffiths on the use of liquefied gases in æronautical work. An efficient all-metal vacuum vessel was described in which either charcoal or silica gel is used as absorbent, and also a modified form of metallic vacuum vessel which permits the rate of vaporisation to be regulated.

SOCIETY OF GLASS TECHNOLOGY

The first meeting of the session was held in York on October 18, Prof. W. E. S. Turner presiding. In a lecture on "Processes and Methods of Mediæval Glass Painting," Mr. J. A. Knowles, of York, said that mediæval window glass was a potassium-calcium-silicate, and practically all the glass used for painting was imported, supplies for the school of glass-painting at York being derived from Hesse and other Rhenish provinces and for the London school from Lorraine, Burgundy and Normandy; the uncoloured glass used in the north of England was much whiter than that used in the south. The statement that no modern colours equalled those of old windows was erroneous. With the exception of "ruby" glass, mediæval coloured glasses were those most easily produced, and being made from impure native oxides containing other metals, each of which imparted a slight tint to the glass, the colours obtained were not pure but slightly secondary, so that they always harmonised. The glass at York, particularly that of the 14th century, was liable to corrode. There was no cure for pitting and corrosion, which were effects due entirely to bad manufacture, deficiency of silica, excess of alkali, and bad founding. Corrosion was not a sign of age.

A paper on "Modern Developments in the Making of Stained and Painted Glass" was presented by Mr. H. J. Powell, of London, who was unfortunately absent through illness. Decay of the actual substance of mediæval window glass was not inevitable; much Roman glass and window glass of the 12th and 13th centuries were perfectly preserved. Some mediæval glass, however, had become opaque and very friable, and all the observed forms of decay originated in the use of an excess of alkali, which caused the glass to become hygroscopic. Considering the haphazard way glass was made in mediæval times, it was more remarkable that most of it had survived than that a little of it had failed.

Members were given the opportunity of inspecting the Roman glass, etc. in the Yorkshire Museum, the windows of the Minster, and the workshops where glass from the latter was being treated.

SOCIETY OF PUBLIC ANALYSTS

The first meeting of the current session was held on November 1 in the Chemical Society's Rooms, Mr. P. A. Ellis Richards presiding.

In a paper on the "Colorimetric Estimation of Pyrogallol, Gallotannin, and Gallic Acid," Mr. C. A. Mitchell described the use of a ferrous-tartrate reagent which gives a violet coloration with the pyrogallic group, and which is applicable as a quantitative measure of that group in various compounds. Using this method a constitutional formula for gallotannin was deduced which agreed best with that proposed by Nierenstein. In determining gallotannin in presence of gallic acid, both substances are estimated together colorimetrically in terms of gallic acid or pyrogallol, the tannin is precipitated with quinine hydrochloride, and the gallic acid estimated in the filtrate. The difference between the two results, multiplied by a factor, gives the gallotannin. The method has been used to estimate tannin and gallic acid in various natural and commercial products, to follow the course of the enzymic hydrolysis of gallotannin, and so on.

Dr. H. E. Annett and Mr. M. N. Bose described "The Estimation of Narcotine and Papaverine in Opium" by a method which requires the use of only 1 to 2 g. of the drug. On adding sodium acetate to an aqueous opium extract under specified conditions, narcotine and papaverine are precipitated completely and narceine partially. The last-named is removed from the precipitate by washing with water, and the narcotine is purified further and estimated polarimetrically.

"The Estimation of Codeine" was the subject of a paper by Dr. H. E. Annett and Mr. R. R. Sanghi. The codeine is extracted with toluene from an aqueous alkaline extract of opium, converted into hydrochloride, re-extracted with toluene (any residual codeine being converted into hydrochloride), and weighed as hydrochloride (*cf.* J. 1920, 702 A).

A paper on "The Estimation of Morphine," by Mr. J. R. Nicholls, described a method based on the fact that if 2 volumes of 50 per cent. alcohol is shaken with one of chloroform and allowed to separate, the two layers are approximately equal in volume, the upper containing about one-third of alcohol and the lower consisting of 2 parts of chloroform to 1 of alcohol. If the 50 per cent. alcohol contains morphine liberated by ammonia, about 85 per cent. of the total alkaloid will pass to the lower layer; when this is run off, half a volume of alcohol added (bringing up the strength to 50 per cent), and the whole shaken with 1 volume of chloroform, the second layer contains about 85 per cent. of the remaining morphine. Three extractions remove over 99 per cent. of the base and in practice 4 extractions only are needed to remove more than 0·1 g.

In some "Notes on the Estimation of Potassium by the Perchlorate and Cobaltinitrite Methods," Mr. R. Morris described a modification of a previous method (*cf.* J., 1920, 767 A) to make it applicable to the direct determination of potassium in the presence of certain insoluble phosphates. A method is put forward of precipitating sulphates—which must be removed—with barium chloride, which obviates practically all loss of potassium in the precipitated barium sulphate. Drushel's modification of the cobaltinitrite-permanganate process gives good results, especially for small quantities of potassium; the precipitate should be washed finally with a semi-saturated solution of sodium chloride; the presence of sulphates is immaterial.

SOCIETY OF DYERS AND COLOURISTS

At a meeting of the Manchester Section, held on October 27, Prof. E. Knecht presiding, Messrs. L. G. Radcliffe and W. Gibson presented a paper on "A Hydroxystearic Acid and Some of its Derivatives," which was a continuation of a previous paper on the action of nitric acid on saponifiable oils (*cf.* J., 1920, 305 A).

The authors have prepared a hydroxystearic acid of m.p. 85° C. from an oleic acid by the action of sulphuric acid, as previously described, and from it have obtained, for the first time, the methyl ester in the form of white flakes (m.p. 46° C.), the ethyl ester (m.p. 48·5° C.), and an acetyl derivative (m.p. 32° C.), but they have failed to isolate a benzoyl derivative in a state fit for analysis. A study was made of the interaction of bromostearic acid and silver nitrite with the object of preparing true nitro-compounds of stearic acid, but no such compound was obtained, even when silver nitrate was used. By acting on hydroxystearic acid with nitric acid a yellow crystalline substance (m.p. 82° C.) was obtained from which derivatives were prepared, but the analytical results were not sufficiently concordant to enable a constitutional formula to be deduced. The yellow substance contains no nitrogen and molecular-weight determinations gave contradictory results; but it is possible that its molecular weight may be 291. The esters have been prepared.

INSTITUTE OF CHEMISTRY

The Sections for the Leeds area and Huddersfield were addressed by the Registrar on "The Present Position and Future Prospects of the Institute and of the Profession," on October 23 and 24, respectively. His address, he said, was intended to provide material for debate. He compared the position of the Institute with its position in the past, having regard to the services which it rendered to the community, and compared it also with that of similar bodies. The chartered professional institutions generally had become recognised as part of the machinery of the State; they supplied the hallmark whereby the trained practitioners in any profession could be recognised; they exercised greater influence and received greater recognition from the community than formerly. They existed for public service, but their most valuable work lay in upholding the status of their professions, whilst each individual member reaped the benefit of being acknowledged by his professional body as a whole. The result in the case of the Institute was the establishment of an organisation of nearly 4000 members with a very high standard of professional competency and integrity, an organisation which rendered the country good service and of which every member had good reason to be proud.

In the eye of the public there was still a misunderstanding as to the word "chemist," but he thought progress had been made in the matter; not so much with the man-in-the-street but with the people that count. Chemists were coming into their own title by the natural process of assuming it. They could not take any other.

The position of the profession might be gauged by the extent to which it was employed. After the war and at the end of 1920 only 13 members of the Institute were without employment, and even now, in view of the very large increase in the number of recruits to the profession and the depression in industry, it was remarkable that only 130, or less than 3 per cent. of their members, were seeking employment. Compared with other professions, the training for chemists was as prolonged, the order of intellect required was higher than most, and the services rendered, so far as they could be compared, were as valuable.

In the discussion at Leeds, the chairman, Mr. W. M. Mackey, in opening the debate, referred to Mr. Pilcher's long connexion with the Institute and to the growth of the Institute during that time. It was, he said, a great advantage, particularly to those about to enter the profession, to hear criticism from one who, although not a chemist, had an inside knowledge of the profession.

Mr. F. W. Richardson said that manufacturers and industrialists required educating as to the value of the qualifications conferred by the Institute. He was decidedly pessimistic in regard to the position of trained chemists.

Mr. B. A. Burrell said he was in substantial agreement with Mr. Richardson's views. There was no doubt that the profession of analytical chemistry was overcrowded and one wondered what was to become of the many young chemists who were being turned out by the universities.

Mr. F. W. Branson disagreed with Mr. Richardson's remark that manufacturers in West Yorkshire did not encourage members of the Institute of Chemistry.

Dr. R. B. Forster said he was glad to hear that Mr. Pilcher attached great importance to the word "chemist." He had always held the view that only those who were members of the profession were entitled to be called "chemists." They had made some progress and he felt sure they would ultimately succeed if they persisted. He did not agree with the pessimistic remarks of some of the speakers; it was true trade was bad, but employers were much more enlightened than formerly, and to support his argument he mentioned that out of the 31 students who took their B.Sc. in Colour Chemistry in Leeds University last June, only four were still seeking employment.

Mr. R. Gawler said that the Institute was sometimes described as the Institute of Chemists instead of the Institute of Chemistry. He considered the advancement of science to its true place in the national life a far loftier motive than might be read into the title "Institute of Chemists" by a member of the general public.

Mr. G. Ward, in proposing a vote of thanks to Mr. Pilcher, said that the lecturer had dwelt on many points which gave food for reflection. He did not agree with the deprecatory remarks of some of the speakers. Much of the future of the younger members lay in their own hands.

At Huddersfield, the chairman, Dr H. H. Hodgson, agreed that the work of the Institute was largely one of patriotism. The chemist was a valuable asset to the State. It was possible that if this country failed to develop its dyestuff industry the textile industry would eventually pass into the hands of the country possessing the strongest dyestuff industry.

Mr. H. W. Moss thought the note of optimism in the Registrar's address very useful at the present time, when a number of qualified and experienced chemists found it difficult to secure employment.

Mr. H. T. Lea put in a plea for a more comprehensive register of chemists to be available in all public libraries.

Mr. G. B. Jones urged the need of chemists on the commercial side of industry, so that customers might get into direct contact with those possessing a broad scientific outlook.

Dr. J. Bruce said that business men must realise that research could be made to pay. Results could not be expected at once. A good understanding between the chemist and the management was essential.

Mr. H. S. Foster deprecated the assumption that chemists are lacking in general culture. He thought that the Institute might usefully issue a pamphlet pointing out that a chemist of sound training without special experience is a better investment than one with special experience but an inferior training.

Mr. S. Robson suggested that chemists should get a place in the management by forcing out the non-technical man, and that this was largely a question of personality.

Dr. A. E. Everest thought the formation of local Sections was an enormous step forward in that it had brought about a more intimate relation between the individual chemist and the Institute.

Dr. L. G. Paul compared the status of the chemist in the works 40 years ago with that of to-day. There had been a vast improvement.

CORRESPONDENCE

PHOTOGRAPHIC SENSITISERS

Sir,—I am sorry that the note on "A Green Photographic Sensitiser" on page 293 R of your issue of July 15 escaped my notice until just recently, as it contains several errors which should not be passed over without comment.

The deficiency of sensitiveness which has longest withstood efforts to remove it is not in the green and greenish yellow as suggested, but in the blue-green in the neighbourhood of $\lambda = 5000$ to $5200 \mu\mu$. This point was certainly recognised by Sir William Pope in the paper in question, which contains the sentence: "It is noteworthy that the failure to sensitise gelatino-bromide plates for a short region in the bluish-green which occurs so frequently with sensitisers for the yellow and red regions of the spectrum, does not occur with the substance now described." The existence of this blue-green gap is, however, not such a drawback as is suggested, since it enables the use of at least a small amount of light in the manufacture and treatment of panchromatic plates which would otherwise have to be not only handled, but manufactured, in complete darkness.

Secondly, the suggestion that this is the first green sensitiser of which the constitution has been published, shows very slight acquaintance even with the work of Sir William Pope himself. In a paper published in the *Photographic Journal* in May, 1920, by Sir William Pope and Dr. Mills, at least four dyes are described which confer sensitiveness to the green and yellow green, and one of these has been in regular use for the manufacture of panchromatic plates for a considerable time.

The constitution of some of these dyes was discussed, if not satisfactorily settled, as long ago as 1905 by König, and later by Shepherd (Photogr. J., 1908, 300—318).—I am, Sir, etc.,

Ilford, Oct. 24, 1922. B. V. Storr.

In the interests of strict accuracy, thanks are due to Mr. B. V. Storr for his courteous correction of the unfortunate slip which was made in the insertion of the words "yellowish-green." The whole purpose of the note was, firstly, to show why our very busy eminent scientists thought it worth while to devote their talents to the preparation of dyes which confer colour sensitiveness upon the ordinary photographic emulsion; and, secondly, to intimate to the readers of the *Review* that, whilst the particular green sensitiser under consideration had in all probability been prepared at an earlier date by Dr. König, of Höchst am Main, to Sir William J. Pope must be accorded the honour of publication of the details concerning its method of manufacture and constitution. As Sir William Pope himself states, in the communication to the Chemical Society: "This substance . . . . the most powerful sensitiser for *green* light yet known for gelatino-silver bromide photographic plates. The new sensitiser is the simplest member of a *novel* series of compounds," the writer of the article may perhaps be excused the offence of having used the sentence beginning: "This is the first green sensitiser of which the constitution has been published"—the word "green" being used by the writer in exactly the same sense as that accorded to it by Sir William J. Pope.

The Writer of the Note.

STREATFEILD MEMORIAL LECTURE

THE METALLURGICAL CHEMIST

C. H. DESCH

On November 2, in the Finsbury Technical College, London, the Streatfeild Memorial Lecture was delivered by Prof. Cecil H. Desch, professor of metallurgy in the University of Sheffield, to whom the Streatfeild Medal was presented by Mr. A. Chaston Chapman, F.R.S., the Chairman. The Streatfeild Prize for excellence in practical chemistry was handed to Mr. F. L. B. Revis by the lecturer.

THE chemical industries have received an unusual share of attention during the last few years on account of their importance in the war and of their position among what are popularly but loosely called "key" industries. Whatever view we may take as to the economic conditions under which such industries best flourish, all who have any claim to speak on the matter are agreed that the first requirement, without which no chemical industry can live, is an adequate supply of trained chemists, not merely for the analysis of materials and products and for the conduct of routine manufacturing operations, but also for investigation and discovery. It is not enough for industrial chemists to preserve and use existing technical knowledge, but they must add to it. Many of us hold that the actual direction of the industry should be largely in the hands of such technically trained experts, and that the frequent absence of such direction is one of the most potent causes of weakness in the industry. The transfer of the control of manufactures from the technical chiefs to boards of financiers and commercial men is a serious fact of the day, deserving the careful attention of all who are interested in the relations of science and industry. It leads inevitably to concentration on finance rather than on manufacture, and to the making of profits assuming greater importance than the making of goods. To follow up this subject would lead me into controversial regions, and I must turn to the safer ground of technical training.

Whatever branch of industry we may take as an example, a training in its methods and processes must be based on a broad foundation of general science, that is, of mathematics, physics, and chemistry. Once that foundation, common to all technical work, has been laid, we may proceed to specialise. But not too early. Specialisation in science and in technology is necessary and inevitable, but it is an evil if uncontrolled, and may result in a dangerous narrowness of outlook. Some day, when we have escaped from the meshes of the examination system, we may see a truly scientific education in which the physical, biological, and social sciences will be so correlated that even the technological student of moderate attainments may gain a synthetic view of science as a whole, as a background to the special studies which are his immediate object. In the meantime we can take measures to avoid, by a thorough training in these three fundamental sciences, the dangers of a too partial view. In this respect the old Finsbury training was highly successful.

The present position of chemistry is a good illustration of the increasing tendency of science towards subdivision and specialisation. A chemist—without further qualification—is rarely met with at the present day. In his place, we meet with physical chemists, organic chemists, food analysts, colloid chemists, chemical engineers, and many other specialists. It is commonly taken for granted that a chemist who has chosen one of these specialisms as a life-study cannot be expected to have much acquaintance with any of the other departments of the science, and ignorance of other branches of chemistry is scarcely considered to be a reproach. We have all met with chemists who have become in course of time so intimately associated with some small section, such as the chemistry of the azo-compounds, as to abandon all interest in the remainder of the science. The opinion is widely held that chemistry is too vast a subject for an individual to master, and if by any chance an exceptional person should be found who persists in retaining an interest in the whole field of chemistry, refusing to regard his science as an aggregate of unrelated specialisms, he is lucky if he avoid the taunt of being a mere populariser of science, a smatterer among experts. I venture to hold that this view is wrong, and that chemistry needs more men who, whilst acquiring as full a knowledge as possible of some restricted field, yet retain a mental picture of the science as a whole, and follow with interest its general progress.

My subject to-day is the metallurgical chemist, the representative of one of those specialisms of which I have spoken. There is some excuse for his separate existence, for he has a history of his own. Whilst the alchemist, engaged in laboratory experiments with metals, was the ancestor of the modern scientific chemist, the practical metallurgist, extracting and smelting the ores of those metals, has a long record of independence. The miner and the metal smelter, the first scientific representative of whom was Georgius Agricola in the 16th century, laid the foundations of the new science of geology, whilst accumulating a mass of material to be utilised, when the time came, by the scientific chemist. Even now, theoretical chemistry finds a rich field of experimental facts in the processes of smelting and alloying metals, whilst the needs of the metallurgist have been the impetus to the development of a large part of analytical chemistry.

The dominating position of the metallurgical industries in our Western civilisation—all our industries, even that of agriculture, being so largely dependent on a supply of suitable metals, especially of iron and steel—gives particular importance to the metallugical chemist in an industrial society. His training is undertaken by special colleges or departments of universities, and has to combine instruction in the chemical and physical principles of metallurgy with practice in the typical operations of the works and laboratory. Quantitative analysis rightly occupies a foremost place in the training of chemists, no other practical discipline giving quite the same combination of manipulative skill with confidence in the reality of the facts observed and in the conclusions drawn from them. When metals are the special object of study, this character of work in quantitative analysis is particularly conspicuous, hence the stress laid upon it in any good course of metallurgical instruction. To make a full analysis of a high-speed tool steel, which may contain, in addition to carbon, silicon, phosphorus, sulphur, and manganese, which have to be estimated in every steel, nickel, cobalt, chromium, molybdenum, tungsten and vanadium, is an exercise demanding a high degree of skill and also an understanding of questions of valency, reactions of oxidation and reduction, and other matters of theoretical importance. The degree of accuracy required in such analyses for commercial and technical purposes is surprising to a chemist unaccustomed to such work, and far in advance of the standard usually accepted in academic laboratories. When a steel specification fixes an upper limit for the phosphorus of 0·40 per cent., and a delivery may be rejected if the analysis shows 0·41, and this is a typical case, great accuracy is essential, and the young chemist must be prepared to have his results challenged and the analysis repeated by referees in cases of doubt. Speed as well as accuracy are required, and the methods employed in works frequently differ from those adopted in outside laboratories, not in being less exact, but in being more rapid. The analysis of the bath samples taken from an open-hearth furnace during the working of a charge may be taken as an example.

It is true that the manipulative skill necessary to enable an analyst to estimate the usual elements in ordinary steels may be acquired by practice and by constant observation of expert workers, since the analytical methods have been reduced to a standardised routine, and a practised hand may make accurate analyses by following a prescribed ritual, without an understanding of the underlying principles. It is a fact that much of the work in steel laboratories and assay offices is performed by such empirically trained assistants, and it is not inconceivable that it may at some future time be done by mechanical means, as the composition of flue gases is now determined automatically by a CO_2-recorder. But when the analytical work embraces a variety of complex alloys, something more than mechanical skill and accuracy is required, and the analyst finds the necessity of a scientific training, and it may be said that no analyst devoid of chemical knowledge could deal satisfactorily with the wide range of materials passing through a modern steelworks laboratory. Dexterity in analysis, however, is only one of the requirements of the metallurgical chemist. Comparatively few of the graduates or holders of college diplomas in metallurgy intend to remain in the laboratory during their professional career. In many large steelworks it is the practice for the young graduate to enter the works laboratory, and to spend such time there as is necessary to become familiar with the methods, materials, and products of the establishment, and then to pass out into one of the other departments of the works, such as the melting shop, forge, or rolling mill. The head chemist is necessarily a permanent official, controlling all the analytical work, but his assistants may be drawn largely from such temporary colleagues.

Chemical knowledge is required in the conduct of other metallurgical operations, and the working of an open-hearth charge of steel, for example, is an operation on the large scale, involving the delicate control of a number of complex and highly interesting chemical equilibria. But the properties and the uses of metals depend on their physical condition as well as on their chemical composition, and it may be said with truth that metallurgy is the application of the laws of physics and chemistry to the special case of metals. Hence the necessity of a good knowledge of physics. Physical instruments are in every-day use in the works. For instance, temperatures are measured by means of the thermo-couple or the electric-resistance pyrometer, or, if too high for metal wires to be used, by instruments that measure either the total radiation or the intensity of radiation of a particular wave-length. Such instruments may be set up and read by an intelligent but untrained workman, but to direct their use, to calibrated them when installed, and to determine their errors after wear, calls for a good understanding of the principles on which they are designed and of the possible sources of error. The heat treatment of steels, again, is governed by a knowledge of their critical or transformation temperatures, and such knowledge is obtained by making certain delicate determinations of the development or absorption of heat, or of discontinuous changes in the volume, electrical resistance, or magnetic permeability, introducing a large range of instruments, so that a steel-works laboratory may rival that of a college in the completeness of its physical equipment.

Microscopical metallography, that wonderful method of investigation introduced by H. C. Sorby, has established itself so firmly that no modern metallurgical or even engineering works can afford to be without microscopical equipment. The mechanical and physical properties of metals and alloys depend on their crystalline arrangement and on the distribution of their constituents as well as on their composition. Physical chemistry has shown that alloys are to be considered as solidified solutions, and the metallurgical chemist has therefore to master the technique of metallography, which is not difficult, and also to learn how the structures observed are to be interpreted, which is less easy. The study is a fascinating one, and skill in it is one of the most valuable accomplishments that the young metallurgist can acquire. A later development has even found its way into industry. The work of Laue and the Braggs has shown how the internal architecture of metallic crystals, on which depend such properties as strength and ductility, may be determined by means of X-rays, and a whole new field of work is thus opened up.

There is another side of metallurgy besides that which deals with cast or worked metals that may appeal to many students, namely, that which concerns the mining and preparation of ores. For such work a training in geology is required, and the student may specialise in the study of raw materials, and undertake prospecting work or find occupation in connexion with mines. Every metallurgist needs an acquaintance with mineralogy in order to understand ores, fluxes, and refractories, all of which he encounters in his daily work. Above all, however, the metallurgist must be a chemist, so fully trained in the fundamentals of his science as to adopt immediately and unconsciously a scientific attitude towards the problems that present themselves in the course of his work. He must have a knowedge of the sources of information at the disposal of the chemist, and must be prepared to follow the progress of chemistry, closely as regards his own special section, and in broad outline that of the science in general. This involves the ability to abstract literature, if possible French and German as well as English.

It may be thought that I have been describing an Admirable Crichton, possessed of all the accomplishments, but such a training is actually within the capacity of a good student pursuing a three or four years' course after matriculation. All branches of industrial chemistry, metallurgy among the number, need a supply of such trained men as managers, chemists, and research workers, and the universities and colleges will have to provide, in an increasing degree, such men for the needs of industry. There is one danger against which I would warn metallurgical, or indeed any technical students. It is that of despising the practical man in the works, the skilled smelter, steel hardener, shop foreman, or roller, because he makes dogmatic statements in unscientific language. The skilled workman is usually right in his facts, allowance being made for some old prejudices, and his explanations are less absurd than they appear to the academically trained novice in industry. Long experience of metals in the workshop often gives a wonderfully thorough, and apparently instinctive, knowledge of their behaviour. Even the explanation may be merely the survival of an obsolete mode of expression. When one watches the process of puddling iron one sees at a certain stage of the process small flames on the surface of the molten mass. The puddler will explain that these are the "sulphur" burning off. The chemist, knowing that sulphur is not eliminated at that stage, and that the flames are of carbon monoxide, may regard the statement as nonsense. It is, however, merely a survival from the time when chemists generally used the word "sulphur" to denote the combustible constituent of any substance, and in this case the carbon is actually being removed, the puddler expressing the fact in the scientific language of an earlier generation. The trained chemist must learn to respect the knowledge of the practical man, and to utilise his wide experience in the construction of his own more orderly and logical system of technological doctrine and practice. The best way of avoiding the dangers that beset a purely academic chemist when he enters industry is to gain experience by direct contact while still pursuing the course of college instruction. This may be done, in most instances, by passing a part of each summer vacation in works, an arrangement for which metallurgical employers have ungrudgingly given facilities. Such experience is essential in order that the student may acquire the sense of the importance of scale on which success in technical processes so largely depends. So, too, he learns to know the machines and plant in a more direct way than from diagrams or models. Some engineering knowledge he must have, the outlines of which are imparted to him in his academic training, and whilst comparatively few metallurgical chemists specialise on the side of machinery, they must all be prepared to co-operate with engineers, and to understand their point of view.

As representing a university situated in the midst of a great industrial area, and in the closest touch with the dominant industries, I can speak of the vital importance of technical education to the city, the nation, and the wider civilised community. The methods of industry are changing; rule-of-thumb and secrecy are disappearing, and with the growing recognition that the reckless waste of natural resources is a crime against society, a more scientific period is in sight. All who look forward to that improved state of things will recognise with gratitude the pioneer work of Finsbury in that direction, the great services of its able and devoted staff, and the debt that all its students, of whom I am proud to have been one, owe to them, and not least among them to Streatfeild, the patient, admirably efficient, and well-loved teacher in whose memory this lecture has been established.

PERSONALIA

The Nobel Prizes for Chemistry for 1921 and 1922 have been awarded, respectively, to Prof. F. Soddy and Dr. F. W. Aston. The Prizes for Physics have been awarded to Prof. A. Einstein, of Berlin, and Prof. N. Bohr, of Copenhagen.

Dr. S. W. Stratton, for 21 years director of the U.S. Bureau of Standards, has accepted the presidency of the Massachusetts Institute of Technology; and Mr. F. B. Tough has succeeded Mr. A. W. Ambrose as chief petroleum technologist to the U.S. Bureau of Mines.

The Howard N. Potts medal of the Franklin Institute has been awarded to Messrs. C. R. Downs and J. M. Weiss, of New York, for their work on the catalytic oxidation of benzene to maleic acid and on the development of an industrial process for converting aromatic into aliphatic compounds.

The gold medal for the best paper presented at the Annual Meeting of the American Society for Steel Testing has been awarded to Mr. E. J. Janitzky for his thesis on "The Influence of Mass in Heat Treatment," and the second prize to Messrs. Gill and Bowman for their paper on "The Constitution of High-Speed Tool Steel."

Among the awards made by the President and Council of the Royal Society are:—The Copley medal to Sir Ernest Rutherford, for his researches in radio-activity and atomic structure; the Rumford medal to Prof. P. Zeeman, for his researches in optics; the Davy medal to Prof. J. F. Thorpe, for his researches in synthetic organic chemistry; the Buchanan medal to Sir David Bruce, for his researches and discoveries in tropical medicine; and the Hughes medal to Dr. F. W. Aston, for his discovery of the isotopes of a large number of the elements by the method of positive rays. The Royal medals have, with the approva of the King, been awarded to Mr. C. T. R. Wilson for his researches on condensation nuclei an atmospheric electricity; and to Mr. J. Barcroft for his researches in physiology, and especially fo his work on respiration.

NEWS AND NOTES

FRANCE

Industrial Notes

Chemical Industry.—The Chamber of Deputies is now considering a Bill to develop the production of sodium carbonate and caustic soda in France. Until recently there were only three factories producing these chemicals, all of which were situated in the district of Nancy, and consequently exposed to destruction in case of invasion. For this reason a company named La Société d'Etudes et Produits Chimiques was formed early in 1918, to manufacture sodium carbonate and caustic soda at Mouguerre, near Bayonne, but owing to the high costs of materials and labour, the progress made in the construction of the factory was very slow, production was not started until the end of 1919, and even now the daily output does not exceed 20—30 tons. The Government now realises the importance of a steady production in a locality not exposed to invasion, and it is considering the grant of a loan of 8 million francs, at 6 per cent. interest, to enable the company to raise the capacity to 100 t. of sodium carbonate (96—98 per cent.) per day, a quantity which could be converted into 75 t. of 72 per cent. caustic soda. Until the loan has been repaid the company cannot raise further money without the consent of the Treasury. This proposed rrangement is also interesting in that it probably ndicates the intention of the State to take in hand he organisation of production for war-time requirements.

Coal Dust as Fuel.—The question of finding a mbstitute for petrol as a fuel for internal-combustion engines loses none of its importance, and ests have recently been made in the northern nining areas on the inflammability of coal dust in arious degrees of sub-division and concentration. The results show that very finely-divided coal dust emains suspended in the air almost indefinitely, nd that when rich in volatile matter it forms a very xplosive mixture with air. Tests are now to be arried out to ascertain the possibility of using uch an explosive mixture in internal-combustion ngines. Progress has been made by the successful se in these engines of "colloidal" coal—a suspenon of "coal" dust in heavy vegetable oils—the ust being prepared from French lignites, and the ls derived from French West Africa. According Monsieur Lance, 150 g. of powdered lignite will eld on combustion in one cb. m. of air 825 calories, as much as 75 g. of petrol. Allowing for different nsities, 1 litre of petrol costing 1·80 francs could replaced by 1·45 kg. of pulverised lignite worth out 0·45 fr.

Metallurgy.—The following statistics of producon of pig iron and steel during the period nuary 1 to June 30, 1922, have been prepared by Comité des Forges de France:—

	1922	1921 1st half	1921 2nd half	Pre-war
	Metric tons	gain or loss per cent.		
Pig iron ..	2,294,895* ..	+27·5 ..	+42 ..	—49·5
Steel ..	2,057,406 t. ..	+33·7 ..	+31·5 ..	—41

* 34,895 t. in electric furnaces.

greatest increase in production of both iron steel has occurred in Eastern France, including raine. There are now 92 blast furnaces in ration, compared with 73 on January 1 last. Of total steel production, Thomas and Martin steel now represent 98·1 per cent.; the manufacture of Bessemer steel is declining steadily.

Extraction of Bromine and Potash in Tunisia

An article on the extraction of bromine and potash from the salt marshes at El Hanèche in Tunisia during the war is published in the September issue of *Chimie et Industrie.* Owing to the high price and insufficient supplies of bromine then being obtained from the United States, a factory was erected at El Hanèche, which from April 28, 1916, up to the date of the armistice supplied a total of 1050 metric tons of bromine to the Allies. To-day the factory no longer exists, but it was in operation long enough to provide the essential data that would be required to establish a bromine industry in Tunisia. The remainder of the information given is covered by an article which appeared in the *Bulletin de la Société d'Encouragement* in Jan.-Feb., 1919, and was abstracted in this *Journal* (1919, 146 R).

AUSTRALIA

British Phosphates Commission

The report of the Commission for the year ended June 30, 1922, states that exports from Nauru and Ocean Islands reached the record total of 364,251 tons, of which 72·96% went to Australia, 4·70% to New Zealand, 4·59% to the United Kingdom, and 17·75% to other countries. This output approaches the maximum possible with the existing plant. Sales of phosphates and sundry credits amounted to £1,304,740, and the cost of phosphate f.o.b., together with £222,521 for interest, sinking fund, etc., was £688,957, and freights £613,097. The credit balance of £2685 was transferred to reserve account, and cash in hand amounted to £18,853. The phosphate rights, plant, etc. are valued at £3,325,770 and stocks at £298,250. Liabilities are divided as follows:—British Government, £1,571,483; the Commonwealth, £1,517,113; and New Zealand, £577,860.—(*Ind. Austr.*, *Aug.* 31, 1922.)

Cane-Sugar Crop in Queensland

Returns published by the Registrar-General of Queensland show that in 1921 the crop from 184,513 acres of sugar-cane was 2,287,416 tons, which yielded 282,198 tons of sugar (94 n.t.) and 10,734,399 gallons of molasses. In 1920 the crop from 162,619 acres was 1,339,455 t. and the yield of sugar and molasses 167,401 t. and 6,175,868 galls., respectively.—(*Ind. Austr.*, *Aug.* 10, 1922.)

Lead-Poisoning at Broken Hill

The final report of the Barrier Technical Commission appointed to report on health conditions at the Broken Hill mines states that of 6538 mine workers examined, only 61, or 0·9 per cent., were found to be suffering from lead poisoning, and only 27 of these had worked exclusively underground. Among surface workers, 5 out of 823 general labourers, and 1 out of 774 mill-hands were found to be affected. It was concluded that all men working in or about the mines were exposed to the action of lead circulating in the blood, but chemical analyses showed that the concentration of lead was low. The Commission recommends that susceptible persons be removed from exposure to lead poisoning and that the disease be made notifiable in certain localities.—(*Mining Mag.*, *Sept.*, 1922.)

CANADA

Industrial Notes

The Canadian Salt Company has commenced the manufacture of liquid chlorine at Sandwich, Ontario. The present output is ten tons a day.

The Hull Electric Co. has acquired the riparian rights to the Paugan Falls, on the Gatineau River, Quebec, about 35 miles north of the city of Ottawa. The company will establish a hydro-electric plant with an ultimate capacity of 150,000 h.-p., at a cost of approximately $10,000,000.

The Shawinigan Water and Power Co. is contemplating the development of 150,000 h.-p. at Gray Falls, on the St. Maurice River, about six miles below Shawinigan. This work will be commenced next spring, and will entail an investment of approximately $10,000,000 to $15,000,000.

Lakefield, Ont., will probably be the first place in Canada at which the development of electric power from surplus heat will be carried out. The Canada Cement Co. is planning to secure 2000 h.-p. for its new plant there by converting the waste heat from the kilns into electrical energy, which will be utilised to raise steam. This system is successfully operated in other countries.

The experimental lignite-briquetting plant, near Bienfait, Sask., which is under the direction and control of the Advisory Council for Scientific and Industrial Research, and upon which $1,000,000 has been expended, is not giving satisfaction. The Press states that the Federal Minister of Mines is not satisfied and is calling for an independent report upon the plant. It is intimated that the Government is not favourable to further expenditure under the present circumstances. The ex-Minister of Mines had certain features of this undertaking investigated and the report was unfavourable.

Mining and Metallurgy

The Manganese and Steel Foundry, Ltd., of the United States, is erecting a branch factory in Sherbrooke, Quebec.

The Globe Mining Co., operating about 36 miles from Cranbrook, British Columbia, has discovered a seam of sienna from 8—10 feet wide.

The Government of Quebec announces that the royalty on asbestos has been reduced from $5·00 to $2·50 per ton. The reduction, however, is subject to certain provisions contained in the Order-in-Council.

The returns of the Department of Mines, Ontario, for the first half of 1922 show a record gold production of 476,322 oz., and it is probable that the value of the output for the full year will exceed $20,000,000. The production of silver was 4,774,666 oz., and that of copper, nickel, and cobalt also improved.

The offer of the British Government to collaborate in financing the Coast Range Steel Co., British Columbia, is contingent upon thorough investigations being made independently by the Provincial Government, the Dominion Government, and the British Government; if satisfactory, the last-named will advance certain monies to be expended in Great Britain on purchasing equipment for the steel-mill.

The estimated value of the minerals produced in the Dominion during the first six months of 1922 is $57,682,944, metals being worth $26,475,544 and non-metals $21,207,400. This result shows an increase, in value, of 9·1 per cent. over the coresponding period in 1921. The principal returns are as follows:—Coal $24,346,959, gold $12,410,202, silver $5,997,199, lead $2,882,047, natural gas $2,448,824, copper $2,337,093, asbestos $1,894,232, nickel $1,401,820, zinc 1,370,460, and salt $849,133. Owing to strikes there is a marked decline in the production of coal, nickel, and copper.

The entry of the H. W. Johns-Manville Co., of New York, into the Quebec asbestos mining area, by securing an option upon the Martin-Bennett properties, and the erection of a large plant for the manufacture of all kinds of asbestos products, has been followed by the possibility of the company obtaining possession of the Black Lake and East Broughton properties, controlled by Jacob A. Jacobs, Montreal. The American company is not going to have the field to itself, as a large British asbestos firm, with head office in London, has decided to merge with an Eastern Township (Quebec) mining firm, and the Asbestos Manufacturing Co., Ltd., of Montreal. The new company will be known as the Asbestos Manufacturing Co. of Canada, and its capital will be $2,000,000. The present plant, at Lachine, Que., will be enlarged and improved to meet the requirements of the new company, which will manufacture packing, textiles, and all kinds of asbestos products. It is probable that the Hon. P. J. Paradis, M.L.C., will be the president of the new company.

UNITED STATES

Earnings of Chemical Companies in 1920

Financial returns for 1920 forwarded to the internal revenue authorities by 5826 manufacturers of chemicals and allied products, disclosed a total gross income of $5,565,125,606 and a total net income of $344,929,904, on which taxes amounting to $98,163,376 were paid. Only 3047, or 52·3 per cent., of the companies reported a net income; the remainder had a gross income of $1,027,030,330 and a deficit of $96,439,756.—(*Oil, Paint and Drug Rep.*, *Oct.* 2, 1922.)

Talc and Soapstone in 1920

The total production of talc and soapstone in the United States in 1920, according to the U.S. Geological Survey, was 224,290 short tons, valued at $3,090,265, an increase of 21 per cent. in quantity and 31 per cent. in value compared with 1920. Output increased in all producing States, except North Carolina, which, however, is only a small producer. No soapstone is imported, but the import of talc, 22,680 t., was the largest on record. Imports from Italy returned to the pre-war level, and those from France recovered substantially, but the largest quantity (15,123 t.) came from Canada. As there were no exports of talc, the apparent consumption was 246,970 t., the average value per ton being $14.34.

Investments in Chemical Education, 1920-21

The National Research Council has collected the following information concerning the amount of money invested in the teaching of chemistry in about three-fourths of all the universities and colleges in the United States during the academic year 1920-21:—

The 417 institutions that reported possessed buildings and equipment valued at approximately $28,230,784, in addition to new buildings under construction and their equipment valued at $7,553,300, the latter sum including $2,000,000 for Cornell University and $1,866,900 for Yale University. Endowment funds received during the year totalled $525,868, and the cost of maintaining the chemistry and chemical-engineering departments, including salaries, chemicals, etc., was $7,739,970. There were 3643 graduates and 109,128 undergraduates taking courses in chemistry, and 302 graduates and 5585 undergraduates studying chemical engineering (where a separate department is maintained). The State of New York had the largest amount, viz., $6,790,015, invested in chemical education.—(*J. Ind. and Eng. Chem., Mar.*, 1922.)

SOUTH AFRICA

Life of the Rand Gold Mines

The Transvaal Chamber of Mines estimates the ore-reserves of the Rand gold mines as follows (million tons):—Producing mines 695; old producers, closed down, 60; partly developed, but not promising, 60; undeveloped areas 225; total 1040 million tons, or sufficient to last 50 years at a high rate of production or 70 years with normal vicissitudes and a languishing end. Extensions of the gold field to the south-west are probable, but when once the great mines are exhausted there will be no chance of revival under conditions at present conceivable.—(*Mining Mag., Sept.*, 1922.)

GERMANY

The Gasification of Crude Brown Coals

In order to elicit possible solutions of the problem of completely gasifying raw, ungraded, earthy brown coals with a high moisture content, the Brennkrafttechnische Gesellschaft is offering a prize for open competition. Competitors have to submit either a process or a plant and must supply an illustrated account supported by accurate quantitative data. The Gesellschaft acquires the copyright of all theses submitted but will have no right to use the processes described.

High-Pressure Steam

According to the *Industrie-und Handels-Zeitung* of October 1, a steam turbine is being erected in Berlin which will work under a steam pressure of 1600 lb. per sq. in. The steam is discharged from this turbine at about 190 lb. per sq. in. and then enters an existing turbine in which its expansion is completed. It is stated that the technical difficulties of generating steam at this high pressure have been overcome by using the recent invention of a Swede and that the experiments made have given very good results.

Is Radium a Medicament?

A German court of justice decided that radium is not a medicament because its action, like that of Röntgen rays, is purely physical, and because when used it does not suffer an appreciable loss within a limited time. This ruling has, however, recently been put aside by the Berlin Court of Appeal on the grounds that according to the methods of preparation and packing, radium is clearly intended for use in curing, alleviating or preventing diseases in man and animals, and the case is to be re-tried in another provincial court.—(*Chem.-Z., Sept.* 23, 1922.)

"Weinschenkite," a New Rare-Earth Mineral

In the *Berichte* for October 14, F. Henrich reports the occurrence of a new mineral containing 52·47 per cent. of rare earths (about 4 parts of yttria to 1 of erbia), and 30·2 per cent. of phosphoric anhydride, the loss on ignition being 16·42 per cent. These figures agree fairly well with the formula XPO_4+2H_2O (X=Er, Y, etc.). The mineral, which has been named "Weinschenkite," occurs in small quantities in the iron-ore district of Amberg-Auerbach in Bavaria, and appears as white, felted, round masses, and also as stellate needles on limonite. A very rare mineral containing 2 to 3 per cent. of rare earths and 13 per cent. of calcium oxide named "pseudo-wavellite" occurs in the same locality.

BRITISH INDIA

First Forecast of the Indigo Crop

The following statistics refer to the six provinces which contain practically the whole area under indigo in British India:—

First Forecast

Province	Area (acres)		Yield (cwt.)		Yield per acre (lb.)	
	1922-23	1921-22	1922-23	1921-22	1922-23	1921-22
Madras	102,600	114,500	23,000	28,000	25	27
United Provinces	35,000	42,000	4,200	4,800	13	13
Bihar & Orissa ..	35,200	39,900	4,300	4,900	14	14
Punjab	37,500	21,200	7,600	2,900	23	15
Bengal	7,300	11,100	300	400	5	4
Bombay and Sind (including Indian States).	9,300	8,600	1,600	1,500	19	20
TOTAL ..	226,900	237,300	41,000	42,500	20	20

—(*Ind. Tr. J., Oct.* 19, 1922.)

GENERAL

Manchester College of Technology

The degree of Bachelor in Colour Chemistry has been created at this college with the object of training chemists for the dyestuffs industry. From the present session onwards it will be possible to obtain the degree of B.Sc. Tech. in the section of colour chemistry. At the annual meeting of the Evening Students' Chemical Society the following officers were elected:—President: Prof. F. L. Pyman; Vice-presidents: The Principal, Prof. Knecht, Capt. Sinnatt, and Messrs. Huebner, Radcliffe, Roberts and Allan. Joint hon. secretaries: Messrs. S. Rowbottom and J. Haslam.

The Logwood Industry in Haiti

Logwood is one of the leading articles exported from Haiti, and the United States is the chief consumer. Statistics showing the reserves of logwood are not available, but the Bahon district, which produces well-matured wood, yielding one barrel (about 500 lb.) of extract per ton, is estimated to contain 500,000 to 1,000,000 tons. Large quantities have been obtained from the district around Port de Paix and Molo St. Nicholas, but the district near Cape-Haitien is largely exhausted and the wood now obtained from it is of secondary growth. Haitian logwood is mainly exported in a crude form, but shipments of extract are increasing, and an American corporation has erected plant at Grande Rivière at a cost of $150,000 to produce 400 barrels of extract per month. At present the industry is only occasionally active, and exports of logwood have declined from 108,106 tons in 1920 to 33,434 t. in 1921; in 1920, 31 t. of extract was exported, as compared with 119 t. in 1919. Prospects are not favourable, but trade would improve with a revival in the textile industry of the United States.

Prospects of an Alcohol Industry in Palestine

The Department of Commerce and Industry of Palestine has collected information relating to the possibility of establishing an alcohol industry in the country. Imports of alcohol in 1921–22 were 561 tons, and the production was 117 metric tons, all from grape juice; also 0·62 tons made in experiments on the fermentation and distillation of durra. Barley and wheat are suitable raw materials as they yield 31 and 33 litres of alcohol per 100 kg. of grain, respectively, and production is in excess of the demand. The durra crop is another useful source, and maize, which yields 19 to 37 l. per 100 kg., could be grown in certain areas if a market were available. The potato crop, though increasing, is too small to be used except for food, and the use of sugar-cane, now being grown experimentally, for the manufacture of power alcohol, would be too costly. Data are needed of the yields from prickly pears and acorns, of which ample supplies are available.

Monazite in the Malay Peninsula

An account of the occurrences of monazite in the Malay Peninsula, and of the properties and identification of the mineral, has been prepared for the Federal Council of the Malay States. There is good reason to believe that monazite is present in the granites and granitic rocks of Malaya, but probably not in quantities worth exploiting. It is found in many localities in detrital deposits, often in association with tin ore, and occurs most abundantly in the alluvium of the rivers of Kemaman, a concentrate from which contained 5·30 per cent. of thoria (ThO_2). The content of thoria in monazite from other localities is given as follows (per cent.):—Sempam (concentrate) 8·38, Baias Tujoh (sample) 4—5, Dindings 8·7, Puchong Babi 3·40, Kulim (Kedah) 3·53, Kelantan 9·41. Proximate analyses of specimens from the three last-named localities showed contents of 66·27, 64·05, and 60·00 per cent., respectively, of ceria, lanthana, and allied oxides. A copy of the paper may be consulted at the Malay States Information Agency, 88, Cannon Street, London, E.C. 4.

The World's Production of Sugar

Figures showing the world's production of sugar in 1921–22 and the preliminary estimates of the 1922–23 crop are given below:—

	1921–22	1922–23
	Thousands of Short Tons.	
United States:		
Beet	911	581
Louisiana cane	290	208
Cuba	4,000	3,600
Porto Rico	385	510
Dominican Republic	225	
Java	1,650	1,659
Australia	299	300
Fiji Islands	65	52
Mauritius	200	250
Natal	150	140
Formosa and Japan	425	325
British India	2,500	2,500
Europe	4,088	4,600
Other countries	2,302	2,275
Total	17,490	17,000

—(*U.S. Com. Rep., Sept.* 4, 1922.)

Fertilising Value of Basic Slags and Rock Phosphates

In the *Journal of the Ministry of Agriculture* (Sept., Oct., 1922) Dr. G. Scott Robertson summarises recent work upon the relative value of different types of basic slag and rock phosphate. On hay and pasture rock phosphates produce the same type of improvement as the most soluble types of open-hearth basic slag, and they are more effective than the open-hearth, low-soluble fluorspar slags. In districts with high rainfall and acid soil the efficiency of the low-soluble slags may approximate closely to that of the more soluble types. In general, the value of the fluorspar basic slags is 50—70 per cent. of that of the high-soluble slags. Rock phosphates were found to have a much higher fertilising value than has been admitted, and on sour, damp soils they may even prove superior to the best grades of basic slag.

Mercury Ore in China

The chief deposits of mercury ore in China occur in the provinces of Kweichow, Hunan, Yün-nan and Szechwan, of which the most important is that in Kweichow, which consists of a broad belt of cinnabar associated with stibnite and extends into Hunan. The largest mines at Yuanshankiang, 15 miles from Lungchikow, were opened in 1898 by a foreign company, but development has been slow. Cinnabar occurs in Hunan to the west of Fenghuangting, near the Kweichow border, and the chief mines are at Hontzeping and Tatungla. This mineral is also obtained by washing in the bed of streams in western and northern Yunnan, and especially in south-western Szechwan. At Hangeho, in the Yenyuan district of Szechwan, a mine worked on a fairly large scale supplies cinnabar to the important vermilion industry at Chungking.—(*Ch. of Comm. J., July* 7, 1922.)

Organisation of the Mining Industry in Russia

After Soviet government had been established in Russia, the industrial resources of the country were placed under a Supreme Board of Industrial Economy which controlled a number of general committees appointed to administer particular industries; the chemical industry was one of these, but a specific Section of Mines was not formed until the end of 1919, and in the following year a Council of Mines was also appointed. The organisation of the Council was very systematic, but it did not work, owing to lack of skilled direction, political friction, deficient means of communication, etc. Commissions of specialists were sent from time to time to inspect and report upon mines, particular attention being given to the coalfields in South Russia owing to the fuel crisis. In the summer of 1921 these coalfields were organised in a separate unit, and some improvement ensued; but the petroleum industry in the Caucasus remained in a critical position and metalliferous mining practically ceased. In October of the same year a general reorganisation took place, and the Council of Mines was converted into the General Administration of Mining Industry, the general committees becoming sections each under a technical department consisting o mining specialists.

The only important work done by the Genera Administration has been the collection of statistica data, and the compilation of geological and othe reports which will be of great use to the investor Very little real work has been done on the mine. during the last four or five years, and there is a great lack of tecnnical equipment.—(*Min. and Met., Aug.*, 1922.)

REPORTS

Report of the Food Investigation Board for the Year 1921. *Pp. 47. London: H.M. Stationery Office, 1922. Price 2s.*

The Report of the Food Investigation Board for 1921 includes accounts of a number of investigations of interest to the chemist, especially in the sections dealing with the work of the Meat Committee, the Oils and Fats Committee and the Fruit and Vegetables Committee.

The only point to be noted in the report of the Fish Preservation Committee is that autolytic reactions were found to proceed in the liver of herrings stored at the low temperature of about -7° C.

The report of the Meat Committee includes an account of researches carried out by Miss D. L. Foster and Miss D. M. Moyle on the effect of exposure to low temperature on the lactic-acid metabolism of amphibian muscle, the results of which have already been published in the *Biochemical Journal*, as have also the results of an investigation on the source of energy of muscular contraction. It was shown that during chopping, rigor and recovery from fatigue there is a change rom glycogen to lactic acid or *vice versa*; another mportant fact that has been discovered is that the muscle possesses the power of synthesising hexosephosphate from glucose and sodium phosphate. Miss Foster has also repeated experiments on the ffect of the rate of freezing on the autolysis of beef. She has confirmed her earlier observation hat the more rapidly the beef is frozen the more closely does the autolysis on thawing follow the course in that of fresh unfrozen beef.

The inquiry of the Fruit and Vegetables Committee follows three main lines, the preservation of apples by cold and gas storage, the chemistry of the ripening processes and the diseases of the stored fruit. The results of the cold storage tests have shown, as might be expected, that 1° C. is a better temperature of storage than 3° or 5° C. It also appears that the soil on which the apple trees grow influences the capacity of the fruit for storage, a silt soil being more suitable than clay or greensand, whilst chalk, clay and fenland are stated to be progressively less suitable. But as the fruit was not all gathered from trees of the same age it is not clear how far the results are really to be attributed to soil differences or to the age of the tree, or possibly to other factors.

The gas-storage method consists in keeping apples in an atmosphere containing 5 to 8 per cent. of oxygen, and 12 to 15 per cent. carbon dioxide, the rate of respiration of the fruit being presumably reduced by this means. In this connexion the rate of respiration of the apple Bramley's Seedling was followed throughout its storage at three temperatures: 2·5°, 10° and 22·5° C. The rate of respiration at first increases, reaches a maximum and then falls. At the three temperatures employed the maximum is reached on the 180th, 28th and 7th day of storage, respectively.

Mrs. M. W. Onslow has investigated a large number of fruits for the presence of oxidising enzymes; the results have already been published in the *Biochemical Journal*. Work has now been commenced on acids in the apple, and methods have been devised for the estimation of malic acid and malates, including titration and estimation of acid and malates as the lead salt. Special attention has been devoted to the estimation of the acid in small quantity. Tests for a number of enzymes in the apple have been made and tyrosinase and reductase have been detected.

In the work of the Oils and Fats Committee Prof. R. Robinson and his collaborators have continued investigations on the nature and constitution of the acids occurring in natural fats. Work on the synthesis of unsaturated acids of the C_{18} series has been continued; octyl bromide was condensed with the compound $AgC{\vdots}C\cdot(CH_2)_8CO_2Me$ in boiling isoamyl ether and this gave a small yield of the ester, $CH_3(CH_2)_7-O{\vdots}C\cdot(CH_2)_8CO_2Me$, which after catalytic reduction and hydrolysis gives homostearic acid. Heptyl bromide leads in the same way to stearic acids.

Prof. A. Lapworth and Mrs. L. Pearson have commenced the study of oleic acid and have come to the conclusion that the subject needs complete revision; the existing methods for isolating the acid are unsatisfactory, and the properties of the pure substance have not been ascertained with certainty. A method has been devised by which the proportion of saturated acid in the final product is reduced to a minimum; this is based on freezing out the ether or benzene solutions of the mixed lead salts with subsequent recrystallisation of the barium salts from mixtures of moist benzene or toluene and amyl or ethyl alcohol. Other investigations carried out under the auspices of this committee include one on the constitution of mannitol fat (the synthetic fat obtained by the interaction of mannitol and olive oil) by Miss H. Gilchrist, and a study of the conditions affecting the formation of fat by yeast by Dr. I. S. MacLean.

Accounts of the work of the Engineering Committee and the Canned Foods Committee are also included.

Report on Tanganyika Territory for the Year 1921. *H.M. Stationery Office, 1922. Cmd. 1732. Price 6d.*

Sisal and coffee of excellent quality are grown in the Tanganyika Territory (formerly part of German East Africa) chiefly by European planters, and the cultivation by natives of groundnuts—for which the conditions are very favourable—is extending. The cotton crop of 1921 was poor, owing to late planting and the ravages of insect pests, whilst the output and quality of copra were unsatisfactory. Lack of transport facilities prevents an extension of agricultural production, but it is proposed to increase the value and decrease the bulk of crops by partial manufacture on the spot. There are several experiment stations and a veterinary laboratory. A survey of the forests has shown the presence of large quantities of valuable timber such as cedar, yellow woods, West African mahogany, mangroves, etc.; a concession has been granted to exploit the Rau Forest (Kilimanjaro area) and tenders have been invited for leases of the mangrove forests.

When the Mining Ordinance came into force in June, 1921, 395 claims were registered for prospecting for gold, silver, diamonds, copper, asbestos, mica, molybdenum, coal, salt, and soda, and exclusive licences were granted to prospect for coal over a total area of 950 sq. miles in four localities.

There are indications of the presence of petroleum, but exploration is forbidden pending the enactment of legislation.

Except the Nyanza (Gottorp) salt mines, which are worked by the railway and supply salt to the Congo, and a small salt factory maintained by the Administration in the south-west area, there are no manufactures of commercial importance in the territory. Soap, ice, soda-water, etc. are made on a small scale for local use, but the produce of the country is exported in a raw state.

In 1921 imports were valued at £1,426,125 and exports at £1,246,870, representing increases of £308,000 and £784,000, respectively, compared with 1920. Among the exports were:—Sisal 7923 tons, cotton 1096 t., hides and skins 356 t., copra 4514 t., groundnuts 8448 t., and beeswax 183 t. The United Kingdom and British possessions supplied imports to the value of £1,384,125 and took 72 per cent. of the exports.

REPORT ON THE ECONOMIC AND FINANCIAL SITUATION OF EGYPT, DATED APRIL, 1922. *By* E. H. MULOCK, *British Commercial Agent for Egypt, Cairo. Department of Overseas Trade. Pp.* 39. *H.M. Stationery Office*, 1922. *Price* 1*s.*

The financial situation of Egypt on March 31, 1922, was more satisfactory than it was a year previously, in spite of low prices for cotton and general trade depression. The total foreign trade for the calendar year 1921 amounted to only £E. 91,864,046, as compared with £E. 187,348,024 in 1920, exports falling 35 per cent. to £E. 36,356,062, and imports 45 per cent. to £E. 55,507,984. The United Kingdom took 47 per cent. of the exports and the United States 18 per cent., whilst the imports were derived mainly from the United Kingdom 37 per cent., the United States 15, France 7, and Germany 3 per cent. German firms are making great efforts to regain their trade by offering to complete, at pre-war prices, contracts that were made before the war and abandoned, and by other means. Compared with 1920, the total imports from Germany increased by nearly 50 per cent.; those from the United Kingdom fell considerably below 50 per cent. The Leipzig Fair brought German firms much trade, but now that they demand payment in foreign currency, their competition may be less strong. In comparison with the United Kingdom, Germany supplied more glassware, indigotin, coal-tar dyes and paints, but less chinaware and fewer medicinal preparations. Some of the chief classes of imports and exports were evaluated as follows:—

	Imports		Exports
		£E.	
Hides, skins, leather goods	534,665	..	443,248
Spirits, beverages, oils	3,817,557	..	238,406
Paper, etc.	998,545	..	106,801
Stone, earthenware, glassware	1,128,880	..	6,933
Dyestuffs, tanstuffs, colours	467,233	..	53,241
Chemicals, medicinal products, perfumery	2,399,716	..	309,955

In agriculture the area planted to cotton was restricted and the crop much reduced. An extension of the control of sugar importations was advocated on the ground that the 57,000 acres under cane, grown for the refinery, would be reduced by one-half if sugar were imported freely. No progress in the mining and industry was recorded, but active prospecting for petroleum was undertaken in new areas. The Government continued drilling operations on both sides of the Gulf of Suez and proceeded with the erection of a small refinery. The Anglo-Egyptian Oilfields, Ltd. produced, mainly at Hurgada, 178,284 metric tons of crude petroleum, as against 145,226 t. in 1920. Home production is insufficient to meet requirements and large quantities of petroleum products have to be imported. In consequence of reduced demand the output of manganese ore fell from 77,562 t. in 1920 to 55,065 t. in 1921, but phosphate production rose by 7211 t. to 122,024 t., although the demand was poor and many mines were closed. A small Egyptian firm has begun to make dry colours and mixed paints at Helouan, near Cairo, utilising materials from mines worked by the ancient Egyptians. The firm intends to erect shortly a large factory with a capacity of 20,000 tons of dry colours and 2000 t. of mixed paints per year of 300 days.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for October 26 and November 2)

TARIFF CUSTOMS EXCISE

Australia.—Drawback of the full duty may be allowed on imported ammonium and potassium nitrates used in manufacturing explosives within the Commonwealth when such explosives are exported.

Belgium.—An export licence is no longer required for sugar, syrups and molasses.

Bulgaria.—Information on the new customs tariff can be obtained from the Department of Overseas Trade.

Canada.—Crude groundnut oil for refining for edible purposes is transferred to the list of duty-free goods.

Ceylon.—The text of the revised schedule of import duties is given in the issue for November 2.

Federated Malay States.—All rubber goods manufactured in the F.M.S. are exempted from export duty until September 1, 1927.

Germany.—Increased import duties have been levied on certain kinds of perfumery, wares of soft indiarubber, hollow glassware, and wares of precious metals.

Guatemala.—Import duties have been reimposed on building materials, *e.g.*, cement, fibro-cement, tarred roofing material, galvanised sheets.

New Zealand.—It is proposed to abolish the 25 per cent. *ad valorem* duty on certain goods imported from countries with depreciated currencies and to replace it by an *ad valorem* duty to be determined from time to time. The agreement for reciprocal tariff treatment with Australia has been passed.

Portugal.—Until further notice, agricultural fertilisers may not be imported.

Spain.—The text of the tariff treatment accorded to British goods under the new commercial treaty with Spain is published in the issue for November 2. Among the chief goods affected are coal, earthenware, iron, steel, metals and products thereof, coal-distillation products, paint, varnish, alkali silicates (solid), insecticides, fungicides, soap, glycerin, superphosphate and chemically-prepared phosphatic fertilisers, salts of nickel and cobalt, and rubber tyres.

Trinidad.—Amendments to the import duties ffect glass, glassware, kinematograph films, lard, ard substitutes, matches, metals, vegetables, ssential and perfumed oils, soap, and paper. In nost cases the duties under the British preferential ariff are half those of the general tariff.

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the epartment of Overseas Trade (Development and ntelligence), 35, Old Queen Street, London, S.W. 1, rom firms, agents or individuals who desire to epresent U.K. manufacturers or exporters of the oods specified. British firms may obtain the ames and addresses of the persons or firms referred o by applying to the Department and quoting the pecific reference number.

Locality of Firm or Agent	Materials	Reference Number
ustralia ..	Glassware, cellulose products, artificial silks	446
" ..	Galvanised iron, porcelain ware, crockery, glassware	412/7/1*
Belgium ..	Varnish, enamel, colours	456
British India ..	Incandescent mantles (tender for)	†
British India, Burma, Ceylon	Heavy chemicals	451
Bulgaria ..	Drugs, graduated measures (tenders for)	9346/F.E./C.C.
Canada ..	Citric and tartaric acids, saccharin	9700/E.D./C.C.
"	Steel sheets	9815/E.D./T.C.2
East Africa ..	Fertilisers, insecticides, scientific apparatus	9595/E.D./C.C.
Egypt	Wood naphtha, "tierol" (tender for)	9321/F.E./C.P.
Mexico	China, earthenware	3934/T.C./M.C.2
Netherlands ..	Tinfoil, tinplate	461
" ..	Paper	462
" ..	Tinplate	463
" ..	Pig-iron, steel	483
New Zealand ..	China, earthenware, glassware ..	469
Norway ..	Chemicals	486
Philippines ..	Glass, glassware, pottery ..	225/9/F.G./M.C.
Rumania ..	Tinplate, insecticides	487
South Africa ..	China, earthenware	453
" ..	Tinplate	454
Yugoslavia ..	Earthenware, china	488

* High Commissioner for Australia, Australia House, Strand, W.C. 2

† Director-General, India Store Dept., Branch No. 10, Lambeth, S.E. 1.

GOVERNMENT ORDERS AND NOTICES

Safeguarding of Industries Act. *Part I.*—The Board of Trade has received a complaint that "Sodium phosphate, mono-, R. Sodium phosphate, di-, and R. Sodium phosphate, tri-," have been improperly included in the lists of articles dutiable under the Act. (The prefix R was added to the item "Sodium phosphate, tri-" on April 6, 1922.) A further complaint has been received in respect of "sodium phosphate," and the complainants have notified their intention to object to the inclusion of other listed items, such as sodium pyrophosphate. As this complaint goes outside the precise terms of the list, the Board will contend that the only valid complaints received by it are those relating to mono-, di- and tri-sodium phosphate. The complaint will be submitted to the Referee, and interested persons should communicate immediately with the Assistant Secretary, Board of Trade, Great George Street, London, S.W. 1.

REVIEWS

Les Progrès de la Métallurgie du Cuivre. *By* Auguste Conduché, *Professor in the Faculty of Science at Rennes. Encyclopédie Léauté. Pp. xii+271. Paris: Masson et Cie., and Gauthier Villars et Cie., 1922. Price 14 francs.*

This little book attempts to give not only a scientific description of the metallurgy of copper, and of the chemical reactions which come into play, but also a summary of recent progress, and of the appliances and installations employed. Its scope may be judged by the fact that no less than 76 pages, nearly one-third of the whole book, are devoted to a description of the properties of copper, its compounds and alloys, 15 to roasting copper ores, 27 to blast-furnace smelting, including pyritic smelting, 10 to reverberatory smelting, 49 to matte-treatment (including converting), 30 to the treatment of complex ores and wet processes, 12 to fire-refining, and 27 to electrolytic refining.

The standpoint of the author throughout is theoretical, reactions are as a rule very well described and equations correctly given, but the descriptions of the appliances and of the operations followed are alike weak; such details, for instance, as the fuel consumption in various operations, the percentages of copper in mattes and slags, and the relative weights of each material produced are usually lacking, whilst data of cost are conspicuously absent.

It is a fact often lost sight of that there are two Metallurgies, the one a science, the other an art. The Science of Metallurgy is only a specialised branch of applied chemistry, concerned with the properties of metals and their alloys, their preparation by various methods, and the way in which the properties of both are modified by the presence of impurities, by heat treatment, etc. Investigation of these points often leads to commercial results of the highest importance, yet in its essence the science of metallurgy is a branch of pure science. Contrasting with this, the Art of Metallurgy may be defined as the "art of extracting metals from their ores and utilising them in such a manner as to yield the maximum of profit." The science of metallurgy is well dealt with by the academic professor, who in the investigation and recording of facts finds himself upon surer ground. With the art of metallurgy, the professor is too often not only out of touch, on account of his purely superficial knowledge and his ignorance of the essential details of operation and of manipulation, which can only be acquired by long experience, but frequently also out of sympathy, because these details, being dependent upon many variable factors, cannot be reduced to exact figures or tabulated, as can chemical or physical data. The present work exemplifies in characteristic fashion the limitations of the theoretical man in describing processes with which he is familiar only through his study of current literature. The chapter on blast-furnace, pyritic, and reverberatory smelting are all weak from the point of view of practical detail, and contain many statements which are either very incomplete or actually incorrect.

The author revives, for instance (p. 102), the old fallacy and bugbear of the theoretical man that "slags too rich in iron may give rise to the production of iron bears"; whereas experience proves that iron bears are never formed where there is plenty of iron to give a fusible slag and fast running; their formation is due to deficiency of iron and excess of silica, alumina, or lime, which gives rise to a high temperature of formation and slow running.

In order to ascertain the depth of matte in a settler, it is hardly necessary (as stated on p. 111) to "plunge into it a bar of *red-hot* iron," (!) and then note that after withdrawal "thanks to the greater conductivity of the matte, the part of the bar plunged therein takes a tint visibly darker than that which was exposed to the layer of slag." The ordinary well-known method of plunging in a slightly warmed bar and withdrawing after a few seconds shows clearly the level of the matte bath by a crust of congealed slag adhering to the bar above that level and a nearly clean red-hot bar below, corresponding to the depth of the bath of matte. The author describes (p. 112) the discharge of molten slag from a settler as taking place "periodically," by which is meant "intermittently." Such practice must be altogether unusual in copper smelting, if not unique, although intermittent tapping of lead slags from large reverberatory settlers is frequently adopted. In describing the practice at Anaconda the author states, on p.116, that the slags at the Washoe smelter formerly contained lime and ferrous oxide in the molecular ratio of 2:1. This was never the case, and the statement gives a misleading impression; the highest average percentage of lime in the slag was about 26 per cent., as against 22—23 per cent. FeO, which, in molecules, is only as 1·5:1.

The chapter on converting is perhaps the best in the book and presents fewest blemishes. At the top of p. 151, however, with reference to casting the converter copper in moulds, the author says "care being *often* (sic) taken to leave in the converter the rich slag which will serve during the following operation"; it may be remarked that, provided the slagging after blowing to white metal has been properly done, there will be very little slag left at the end of the blow, and what little there is generally accumulates near the mouth of the converter, from which it has to be chipped off after the operation of casting is completed.

Perhaps the weakest chapter of the book is that dealing with wet methods. No mention is made of the leaching of sulphates at Chuquicamata or of the ammonia leaching process, which, after having been discarded several times on account of operating details, has scored a marked success in Arizona, and is now to be adopted on a large scale in Central Africa. The description of the Huelva cementation process is by no means good. In explaining the oxidation of pyrites, for instance, the author says that in presence of air and of water, ferric sulphate and sulphuric acid are formed, whereas it is well-known that in the presence of a moderate amount of moisture ferrous sulphate is formed directly, and ferric sulphate only forms through a further absorption of oxygen in dilute solution.

The chapter on electrolytic refining is quite a good outline from the theoretical point of view, although, as usual, lacking in detail as regards the appliances employed and the operations carried out.

To sum up, it may be said that although too sketchy to be of use to practitioners of the art of copper metallurgy, the book will form a useful outline of modern practice from the point of view of the comparatively elementary student of the subject, for whom it is obviously intended; and it may even be of some use to those practically engaged in other branches of metallurgy, as throwing some sidelights upon their own work.

H. F. Collins.

Practical Tanning. *A handbook of modern practice and processes as applied in the manufacture of leather and allied products.* By Dr. Allen Rogers. *Pp. xxv.+699. London: Crosby Lockwood and Son,* 1922. *Price* 45s. *net.*

This work is based upon earlier editions bearing the same title, written by Louis A. Flemming. It has been modernised by the contributions of Dr. Rogers and his associates, and by the inclusion of a considerable amount of matter from other sources. The various processes of leather manufacture are ably dealt with in a style that will commend the volume to most practical men. The articles upon Unusual Tanning Processes by the author, Pigment Finishes by C. B. Kinney, and Patent Leather by G. W. Priest contain much interesting information, and as each has special knowledge of his particular subject, the contributions are of distinct value. The book contains many original illustrations, the subject matter is well arranged, is reasonably free from typographical errors, and the detailed table of contents affords a ready means of access to any desired information. The British reader should remember that the American gallon is roughly 17 per cent. smaller than the English gallon.

Dr. Rogers is aware of possible differences of opinion on some of the topics with which he deals, but it is not appropriate to discuss them here. At the same time, certain erroneous statements are made which call for comment. The assertion (page 496) that whilst sulphuric acid plumps hide, hydrochloric acid in certain dilutions has a depleting action, is contrary to fact. Various investigators have shown that under similar conditions the latter has even a greater swelling effect than the former. Dealing with the depickling of sheepskins, two working methods are suggested: (a) treatment with sodium bicarbonate—salt solution, and (b) a sour drench of bran and salt. The former is quite rational, but it is not apparent why a sour (*i.e.*, acid) drench is suggested as an alternative to the alkaline solution, and a simple brine solution would appear to be more effective for the purpose intended.

The Glossary of Terms used in the industry contains many errors and some superfluous definitions. Thus "depleting action" is referred to as "any action which tends to loosen the hair and epidermis," whereas in tannery usage it has no different meaning from that suggested by an ordinary dictionary definition. Similarly "tan" is wrongly defined as "any material which will prevent the putrefaction of hide substance." Common salt and all raw-hide preservatives would be classed as tanning agents according to the glossary. It is surely unnecessary to inform the reader that a lamb is a young sheep, and a kid a small goat! In its present form the glossary might have been omitted with advantage.

As a whole, the book is of distinct value to the practical tanner, as it contains much helpful information, but some assertions must be accepted with a certain amount of reserve.

Douglas McCandlish.

Die Methoden zur Herstellung kolloider Lösungen anorganischer Stoffe. *By* **Dr. The Svedberg.** *Third edition. Pp. xii.+507. Dresden and Leipzig: Theodor Steinkopff, 1922. Price 14s., bound.*

The issue of this new edition, an unaltered reprint of the second edition, of Svedberg's well-known work, testifies to its continued usefulness and value. From the comparatively small dimensions of the first edition the work has now grown into quite a large volume, in harmony with the general expansion which has taken place in the study of the colloidal state. In this volume, the author brings together most usefully the different methods which have been employed for the production of the colloidal form of different substances, and has thereby rendered a great service to other workers in this department of study and investigation. The methods for producing the colloidal state fall naturally into two groups, condensation methods and dispersion methods. In the former group one has, for example, methods depending on reduction, oxidation, and hydrolysis; whilst in the second group peptisation and electrical-dispersion methods find their place. The book is well written, the descriptions of preparations are clear, and full references to the original literature are given. The work is one which every worker in the domain of colloid chemistry will find indispensable.

Alex. Findlay.

Laboratory Manual of Colloid Chemistry. *By* H. N. Holmes, *Professor of Chemistry in Oberlin College. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd., 1922. Price 10s. net.*

The book before us is one which will be welcomed by every university teacher of chemistry who desires to introduce his students to the study of the colloidal state of matter. The rapid extension of chemistry in various directions has made it necessary to supplement the old courses in practical chemistry, consisting of inorganic analysis and organic preparations, with experiments in physical chemistry, electrochemistry, etc. And so the importance, from the practical point of view at least, of the study of the colloidal state is making it necessary to supplement the lectures on colloid chemistry, which must form a part of every honours course, by work in the laboratory. The work of organising and carrying through such a course will be greatly helped by the book which Prof. Holmes has written at the request of the Colloid Committee of the National Research Council of the United States. The experiments described by the author cover a very wide range and give scope for selection on the part of the teacher. In this selection, the teacher is helped by the author, who has suggested courses for medical students, students of agriculture or ceramics, students of geology, and students of industrial chemistry, as well as a general course to meet the needs of the student of pure chemistry. The value of the book is greatly increased by references to the literature and suggestions for collateral reading. The work is excellent and will, it is hoped, facilitate the introduction into our university courses of practical instruction in colloid chemistry.

Alex. Findlay.

OBITUARY

ALEXANDER CRUM BROWN

By the death of Emeritus Professor Alexander Crum Brown, at his residence in Edinburgh on October 28, at the ripe age of eighty-four, chemistry in Britain loses one of the most noteworthy figures of a passing generation, and a wide circle of scientists and others privileged to know him loses one of the most warmly esteemed of friends. Born in Edinburgh in 1838, he received his school education at the Royal High School there, and at Mill Hill. He then became a student at Edinburgh University, where, at the age of twenty, he graduated as M.A., and three years later, in 1861, as M.D. In the following year he obtained the degree of D.Sc. from the University of London. At an early age he seems to have been specially attracted to chemistry, most probably having had his attention turned in that direction through the circumstance of his maternal uncle, Walter Crum, himself a noted chemist, being engaged in chemical industry in the west of Scotland. At any rate, his M.D. thesis was a purely chemical one. After obtaining his medical and science degrees in Britain, he spent a year in Germany, where he made many life-long chemical friends, and where the work for his first published chemical paper, on the conversion of mucic acid into adipic acid, was carried out. A speculative vein with respect to theoretical chemical conceptions, which more or less distinctly characterised most of his subsequent contributions to chemistry, was evidenced in his M.D. thesis "On the Theory of Chemical Combination." At the date of its presentation, this thesis contained much that was in advance of the time, and, moreover, it foreshadowed a feature which became markedly noticeable in his later writings and in his dealings with affairs; that is, a far-seeing anticipation of the direction in which further investigation was likely to lead, and of the eventual consequences which would result from some line of action.

The speculative aspect of Crum Brown's mind and his strong liking for theoretical matters are well illustrated by a consideration of the diverse chemical subjects which engaged his particular attention, and by an examination of his treatment of these subjects in his original memoirs. In these connexions his papers or addresses on the theory of isomeric compounds, on the phlogiston theory, on chemical constitution and graphic formulæ, on the basicity of acids, on solution and osmotic pressure, on the ions of electrolysis, on the Le Bel—van't Hoff hypothesis, and (in conjunction with the late Sir Thomas R. Fraser) on the connexion between chemical constitution and physiological action may be recalled, and there are none of these subjects to which he did not contribute something of real and permanent value, either by experiment or by suggestion. The Crum Brown—Gibson rule concerning the position taken by replacing groups entering mono-substituted benzene derivatives also deserves mention here. In addition to the subjects just mentioned, Crum Brown, either alone, while occupying the chair of chemistry in Edinburgh University, to which he was elected in 1869, or in collaboration with pupils or assistants (Letts, Walker, and others) carried out investigations on the rusting of iron, on trimethylsulphine and thetine compounds, on the electrolytic synthesis of dibasic organic acids, and on a variety of minor subjects, all the time maintaining a remarkable flow of new and ingenious devices for attacking unsolved chemical problems.

Besides his pre-eminent position as a chemist, Crum Brown was a versatile philosopher, widely-read in other scientific subjects, including mineralogy, crystallography, and physiology, as well as in general literature; he was, also, a linguist of unusual attainments. Of the charm of his alert, vivacious personality as a host, as a *raconteur*, as a man, much might be written by one who held a sufficiently gifted pen. Failing the latter, it must suffice to quote one illustration of the man speaking for himself, as he did in the concluding words of his opening address to the Royal Medical Society in 1896:—

"Gentlemen, there are some things you need which cannot be got in lecture-rooms or laboratories, in dissecting rooms or in museums. I do not now refer to the priceless treasures, Honesty, Truth, Courage, Modesty, Kindliness, all that we include in our idea of a noble and good man; we should all covet earnestly these gifts and seek to increase more and more in them. I speak now of attainments of a more special sort—the power of easy and accurate expression, the power of quickly and correctly grasping ideas expressed—perhaps not very well expressed—by others. . . . These things can be had here. 'Iron sharpeneth iron; so a man sharpeneth the countenance of his friend.' And friends here learn to sharpen each other's wits without ceasing to be friends. We learn here to give and to take pretty outspoken criticism without any fear of taking or giving offence. I am speaking in the presence of many who know all this as well as I do, of many who could speak the praises of the Society far more forcibly and far more effectively than I; but I do not think there is anywhere any one who could do it more heartily."

LEONARD DOBBIN.

PUBLICATIONS RECEIVED

THE THEORY OF ALLOTROPY. *By* DR. A. SMITS. *Translated from the German by* DR. J. SMEATH. *Text-books of Physical Chemistry, edited by Sir W. Ramsay and Prof. F. G. Donnan. Pp.* 397. *London: Longmans, Green and Co.,* 1922. *Price* 21*s*.

RAPPORT SUR LE COMMERCE ET L'INDUSTRIE DE LA SUISSE EN 1921. *Pp.* 438. *Zürich: Secrétariat de l'Union Suisse du Commerce et de l'Industrie. Price* 9 *francs.*

THE NITROGEN INDUSTRY. *By* PROF. J. R. PARTINGTON *and* DR. L. H. PARKER. *Pp.* 336. *London: Constable and Co., Ltd.,* 1922. *Price* 21*s*.

CHEMICAL REACTIONS AND THEIR EQUATIONS. *By* PROF. I. W. D. HACKH. *Pp.* 138. *London: Chapman and Hall, Ltd.,* 1922. *Price* 6*s*.

SENSITOMETRY OF PHOTOGRAPHIC EMULSIONS AND A SURVEY OF THE CHARACTERISTICS OF PLATES AND FILMS OF AMERICAN MANUFACTURE. *By* R. DAVIS *and* F. W. WALTERS, JR. *United States Bureau of Standards. No.* 439. *Washington: Government Printing Office,* 1922. *Price* 35 *cents.*

LEIM UND GELATINE. *By* DR. L. THIELE. *Second edition, revised. Pp.* 189. *Leipzig: Max Jänecke,* 1922. *Price, paper.* 4*s*.

HEAT TRANSMISSION. TECHNICAL RECORDS OF EXPLOSIVES SUPPLY, 1915—1918. *Ministry of Munitions and Department of Scientific and Industrial Research. No.* 9. *Pp.* 48. *H.M. Stationery Office,* 1922. *Price* 5*s*.

COAL: A SERIES OF LECTURES ON COAL AND ITS UTILISATION. *Delivered in the Department of Fuel Technology, Sheffield University, by* H. CHAMBERLAIN, J. W. COBB, R. LESSING, F. S. SINNATT, *and* M. C. STOPES. *Pp.* 41. *London: Colliery Guardian Co., Ltd.,* 1922. *Price* 5*s*.

IRON ORE. PART VI.—EUROPE AND AFRICA (FOREIGN). SUMMARY OF INFORMATION AS TO THE RECENT AND PROSPECTIVE IRON-ORE SUPPLIES OF THE WORLD. *Imperial Mineral Resources Bureau. Pp.* 275. *H.M. Stationery Office,* 1922. *Price* 6*s*.

STANDARD SPECIFICATIONS FOR LABORATORY APPARATUS ADOPTED BY THE MANUFACTURING CHEMISTS' ASSOCIATION OF THE UNITED STATES. PART I.—GRADUATES AND THERMOMETERS. *Pp.* 49. *Published by the Association, Washington, D.C.,* 1922.

PROCEEDINGS OF THE TECHNICHAL SECTION OF THE PAPERMAKERS' ASSOCIATION OF GREAT BRITAIN AND IRELAND. *Vol. III. Part* 1. *October,* 1922. *Published by the Association,* 26, *Farringdon Street, E.C.* 4. *Price* 10*s*. 6*d*.

(1) DEFINITION OF RELATIVITY. *Pp.* 16. (2) DEFINITION OF THE AETHER. *Pp.* 16. (3) DEFINITION OF EQUIVALENCE. *Pp.* 16. (4) DEFINITION OF ISOTOPES. *Pp.* 20. *By* F. H. LORING. *Science by Definition Series. London: H. O. Lloyd and Co., Ltd.,* 1922. *Price* 1*s*. *each.*

MINERALS AND MINING INDUSTRIES ON THE CANADIAN NATIONAL RAILWAYS. *By* C. PRICE-GREEN. *Pp.* 63. *Toronto: Industrial and Resources Department, Canadian National Railways,* 1922.

BULLETINS OF INDIAN INDUSTRIES AND LABOUR. *Calcutta: Superintendent, Government Printing, India,* 1922:—

PROCEEDINGS OF THE FOURTH CONFERENCE OF DEPARTMENTS OF INDUSTRIES. *No.* 27. *Price* 1 *rupee.*

NOTES ON SULPHURIC ACID, SULPHUR, AND IRON PYRITES. *By* C. S. FOX. *No* 28. *Price* 6 *annas.*

PUBLICATIONS OF THE UNITED STATES' BUREAU OF MINES. *Department of the Interior. Washington: Government Printing Office,* 1922:—

FACTORS IN THE SPONTANEOUS COMBUSTION OF COAL. *By* O. P. HOOD. *Tech. Paper* 311. *Price* 5 *cents.*

SAFE MECHANICAL EQUIPMENT FOR USE IN SHAFT SINKING. *By* R. H. KUDLICH. *Tech. Paper* 276. *Price* 5 *cents.*

APPLICATION OF THE GEOPHONE TO MINING OPERATIONS. *By* A. LEIGHTON. *Tech. Paper* 277. *Price* 10 *cents.*

PERMISSIBLE EXPLOSIVES, MINING EQUIPMENT, AND APPARATUS, APPROVED PRIOR TO MARCH 15, 1922. *By* S. P. HOWELL, L. C. ILSLEY, D. J. PARKER, *and* A. C. FIELDNER. *Tech. Paper* 307. *Price* 5 *cents.*

REVIEW

Vol. XLI] NOVEMBER 30, 1922 [No. 22

UNVEILING OF THE WAR MEMORIAL TO LT.-COL. HARRISON AND OTHER FELLOWS OF THE CHEMICAL SOCIETY

ON November 16, in Burlington House, London, a large number of Fellows of the Chemical Society and many representatives of other scientific societies attended the unveiling of the War Memorial to Lieutenant-Colonel E. F. Harrison and other Fellows by the Rt. Hon. the Earl of Crawford and Balcarres. The memorial, executed by Mr. E. Gillick, consists of a large bronze medallion depicting a trench scene at the moment of the approach of a gas cloud; the medallion is mounted on a slab of Italian (Lamartine) marble and below it are inscribed the names of thirty other Fellows who gave their lives for their country during the Great War. The memorial is erected on the south wall of the landing on the first floor in the Chemical Society's rooms.

Sir James Walker, president of the Chemical Society, presided, and Sir George Beilby, chairman of the Harrison Memorial Committee, made a statement concerning the origin and destination of the memorial fund. To that fund, he said, £1640 had been subscribed, and the committee had decided to use a portion of it for the erection of a permanent memorial, and to devote the remainder to the provision of a prize of approximately £150, to be awarded every three years to the chemist, man or woman, not above thirty years of age, who had made the most meritorious original contributions to chemical science during the preceding five years. The prize would be awarded upon the recommendation of a committee comprising the presidents of the Chemical Society, the Society of Chemical Industry, the Institute of Chemistry, and the Pharmaceutical Society. He asked Sir James Walker to accept, on behalf of the Chemical Society, the custody of the memorial and of the trust deeds of the fund.

In accepting the trust, Sir J. Walker remarked that the institution of the prize would commend itself to all as a most wise election. A capable investigator at the outset of his career was adequately provided for by scholarships, etc., and late in life he generally had received, indirectly for the most part, some reward for his work, but there was a period when the substantial encouragement of such a prize would prove a determining factor in his development.

The Earl of Crawford and Balcarres then delivered an address in which he referred to the sadness of such occasions, when the closed book was reopened, and to the compensation and comfort brought to those who mourned by the acknowledgment of heroism and public service, and the recognition of exceptional skill and distinction. He congratulated the committee and the Society on having chosen a sculptor of note, on having placed at his disposal an admirable site, and on having given him full freedom to develop his idea. In eloquent phrases he recalled Colonel Harrison's great achievement in combating "the most terrible assaults ever directed by science against an army in the field," and then passed to an appreciation of his character. Harrison had the power of concentrating the accidents of knowledge and intelligence and of directing them into a consistent and specific channel. He had the power of interrogation, combined with intuition, which enabled him to anticipate developments and thus meet in good time the progress of enemy attack. Honour was also due to the other Fellows of the Society whose names were recorded on the memorial: men of conspicuous ability in their own departments of research, men of character and promise, whose precious lives were ended prematurely. Among these was Andrea Angel, who died in January, 1917, in the disaster at Silvertown, where he returned into a blazing building, knowing it to contain people in danger of their lives, and so perished.

Lord Crawford then unveiled the memorial; "The Last Post" was sounded; there was one minute of silence; and "The Reveille" announced the completion of the ceremony.

In a few words Sir James Walker thanked Lord Crawford for performing the ceremony and for his address, and reminded those present that he (Lord Crawford) was an artist and writer on sculpture, well fitted to judge the artistic merit of the memorial; and that he had enlisted as a private in the Royal Army Medical Corps, and so had witnessed the ravages of poison gas and the success of the protective measures employed against it.

A photograph of the memorial is reproduced on the art inset; opposite to it is a similar reproduction of the Ramsay Memorial, which was described in our last issue.

ANTICORROSIVE AND ANTIFOULING COMPOSITIONS

P. E. BOWLES

THE advent of the iron ship, with all the great improvements it made in shipping conditions, brought in its wake to a very serious degree the troubles of corrosion and fouling. By "fouling" is meant the accumulation of marine growth, which often assumes incredible proportions. The writer has seen weed-growths two feet in length on a vessel, coated with inferior compositions, which had been riding at anchor in home waters for six months. One can imagine, then, what the appearance of an unprotected ship's bottom would be like after a twelve-months' voyage in tropical seas!

The problems of corrosion and fouling soon demanded the urgent attention of the entire shipping industry, and so serious was the subject that Admiralty experts were at one time quite prepared to condemn the use of iron ships as men-of-war because of their weakness in these respects. In a report dated 1863 the Controller of the Navy gave as one of the reasons why he preferred wooden ships: "The rapidity with which the bottom of an iron ship gets foul, and the immense loss of all the ship's qualities that follows from the adhesion of marine zoophytes. No practical remedy has been found for this serious disadvantage; repeated docking and cleaning is the only palliative."

It is unnecessary to argue at this present period the case of Wood v. Iron for shipbuilding, but it is interesting to note that the Admiralty aimed very high when it considered a composition to have failed which did not keep a ship's bottom clean during the whole time of her commission, say from three to five years! This ideal has never been approached, and if one dared to play the rôle of prophet it might be stated that such immunity never will be realised. Modern metallurgy may succeed in rendering ships free from corrosion, but it is almost inconceivable that a permanent force ready to do battle against the myriads of marine organisms, fighting in their native element, and itself suffering no wastage, should ever be discovered. At the same time modern ships' compositions have played an enormous part in keeping the iron fleets of the world at sea and the units of those fleets in an efficient condition.

The modern accepted practice, which experience has proved to be right, is that the ship must primarily be protected from corrosion. All of the antifouling compositions in general use contain constituents which, in the presence of sea water, induce corrosion, so, in addition to the corrosive action of the sea water on iron itself, one has to protect the ship from the corrosive effect of the antifouling composition.

The ideals to be sought after, then, in making an anticorrosive paint are that:—

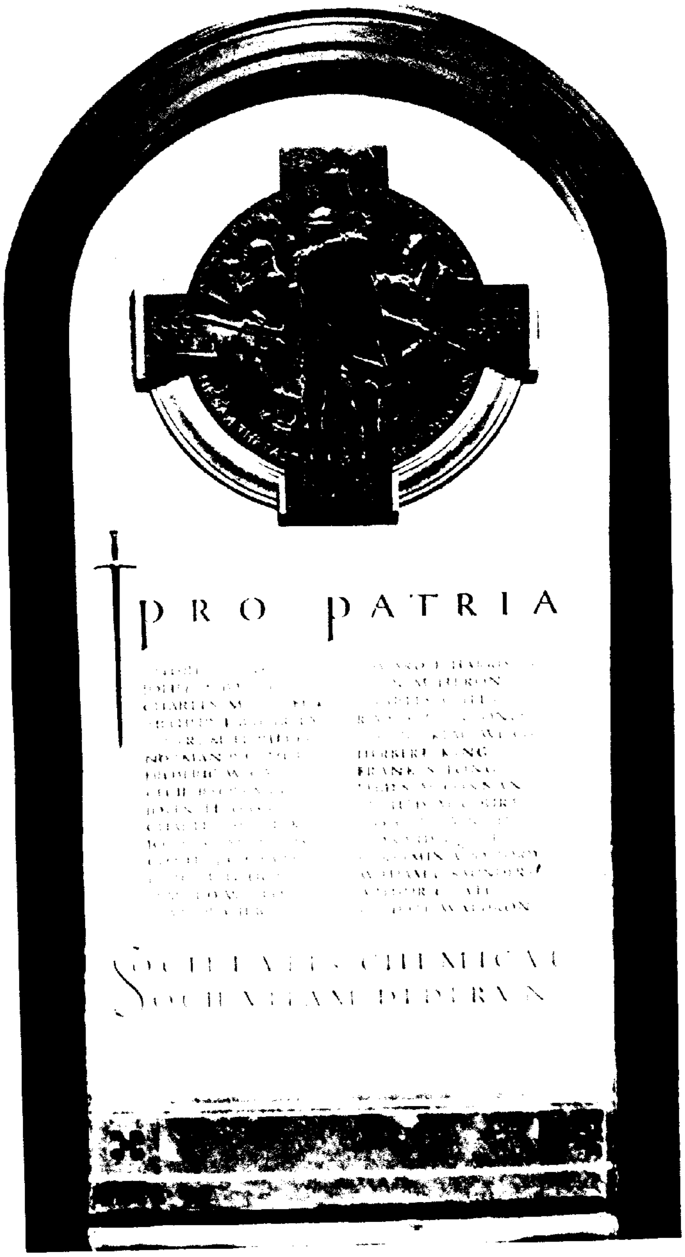
(*a*) It should be waterproof, as only by excluding the water from iron can corrosion be prevented.

(b) It should remain entirely undisturbed on the application of the coat of antifouling composition; failure in this respect is referred to in the dockyards as "lifting" or "breaking through."

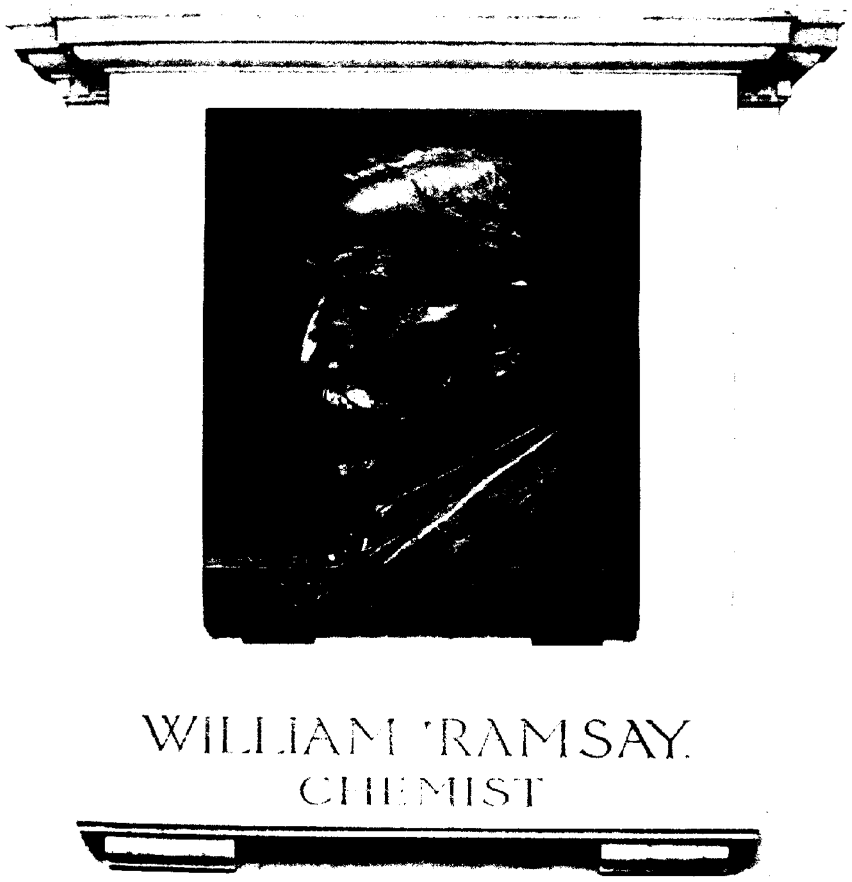
These conditions would be comparatively simple to fulfil if it were not for the fact that modern dry-dock practice demands compositions which dry very rapidly. The most waterproof varnishes are those made from linseed oil and linseed oil containing gums, resins, etc. Oil-varnishes dry by oxidation, and their use is absolutely barred on account of the time taken in drying. "Dry dock" is a courtesy title, as most dry docks are dripping wet, the air laden with moisture and the ship's sides "sweating." Under these circumstances many days would probably be required before a linseed-oil varnish would dry. Ships' compositions must, therefore, dry, not by oxidation, but merely by loss of solvent. Since this remark applies also to the antifouling coat, which also contains solvents, the difficulty of making a priming coat that will dry rapidly and be unaffected by the solvents of the second coat will be readily appreciated. As already stated, the finishing coat is invariably one which induces corrosion, consequently one must condemn unhesitatingly any compositions which show signs of breaking through, and, moreover, view them with grave suspicion if the priming and second coats are of approximately the same colour, thus tending to mask the breaking through.

The difficulty can be overcome by using dissimilar solvents for the two compositions and employing as the base of the priming coat materials that are not brought into solution again by the solvents in the antifouling compositions.

Certain gums, gum mixtures, resins—sometimes in simple solutions, sometimes hardened



Memorial to Lt-Col. E. F. Harrison and other Fellows of the Chemical Society, erected in the Society's rooms, and unveiled by the Rt. Hon. the Earl of Crawford and Balcarres, on November 16, 1922.



Elliott and Fry

Memorial to Sir William Ramsay, unveiled by H.R.H. the Duke of York in Westminster Abbey, on November 2, 1922.

by partial neutralisation with lime—are commonly used as a vehicle, and iron oxide as a pigment, together with, in low-grade anticorrosive paints, some cheap inert filler. This would be thinned down with naphtha or some similar solvent that evaporates rapidly. Shellac solutions are excellent for forming hard waterproof films, but the high price of the material, together with the fact that methylated spirit is used as a solvent, has driven them out of the market.

By far the most satisfactory products, however—those which meet the requirements very well from all points of view—are certain pitches and asphalt solutions. By blending asphalts with pitches a mixture can be obtained which satisfies the conditions required. Moreover, since such solutions dry very rapidly, a small quantity of linseed oil can be incorporated, ending a desirable toughness to the film without unduly hindering the drying. Much patient research was required before the right blend could be found, and the composition, as well as the method of manufacture, is a secret ealously guarded by the manufacturers. The pigment used in these asphalt primings, like the others, is iron oxide, and the solvent is tar oil. The colour is naturally very dark, and would show very readily through the coat of antifouling composition should any lifting occur.

Having now protected the vessel against corrosion, the equally important question of preventing the accumulation of marine life comes up for consideration. The reduction in knots of a high speed ship, even when only slightly foul, is very great, and to counteract it entails an enormous extra expense in coal.

A glance at the photograph (Fig. 1) makes this easily realisable. This shows a sheet of iron which, after being coated over all with an anticorrosive paint, was then coated on different sections with six experimental patches of antifouling compositions. The top left-hand strip was given only the priming and no antifouling coat. The plate was immersed in Genoa harbour for two or three months, and shows the capability of compositions to resist fouling. The second patch has entirely failed, being as foul as the strip at the top left half, which has no antifouling composition at all. Had a ship been coated with this composition its speed would have decreased very rapidly.

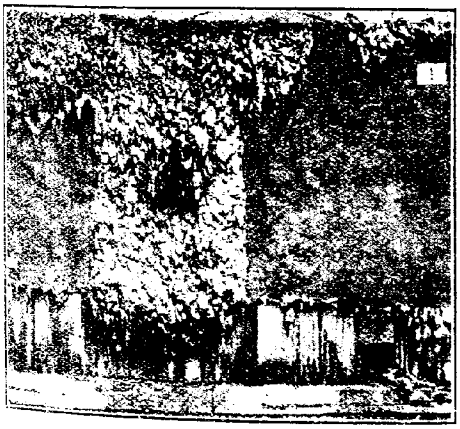


Fig. 1

The object of the antifouling composition is to surround the ship with a solution which is toxic to both animal and vegetable marine organisms, so that these are destroyed whilst still of microscopic size. There was at one time a theory that ships might be kept free from fouling matter by the gradual disintegration of the composition, so that the organism could only obtain a very insecure foothold, which would be even less secure the larger it became. This " exfoliation " theory had at one time many adherents, but the fact remains that, so far as the writer is aware, no successful antifouling composition has been prepared which is free from poisonous substances.

Bearing in mind the remarks already made with regard to quick drying and " non-lifting " of the priming coat, the problem resolves itself into one of designing a composition containing toxic materials which will dissolve slowly in sea water, and thus maintain a strongly antiseptic film surrounding the ship. Obviously, then, the choice of a suitable vehicle or varnish is of outstanding importance. If it is too impervious to moisture the sea water cannot dissolve the poisonous substances, which then for all practical purposes might as well be absent; if, on the other hand, the varnish does not hinder the solvent action of the sea water, the composition loses its toxicity too rapidly, and although the composition may be good in other respects, as an antifouling medium it has ceased to function. One can consider the varnish of a composition when painted out to be in the nature of a honeycomb, the tiny hollows of which are filled with pigments and poisons. If the poisons are of such a character that they are only very slightly soluble, then a large-mesh honeycomb is desirable so as to allow free access of the sea water; if the poisons are readily soluble, then the honeycomb should be made as small as possible. With this purely pictorial idea in the mind it is easy to see that the temperature, *i.e.*, the latitude in which a ship is steaming, plays an enormous part. A composition which might prove highly successful in the North Atlantic would be almost worthless in tropical waters. Since the majority of steamers trade in all quarters of the globe, the paint manufacturer must perforce content himself with attempting to meet average conditions.

Ordinary antifouling compositions nearly always have iron oxide for a pigment, which in the better class is always of a high quality, imparting to the paint the brilliant red so beloved by dock officials, to whom, of course, the artistic effect should be a matter of supreme indifference, since the primary function of the composition is to prevent fouling.

The question of settling of the paint presented some difficulty to the earlier manufacturers, but has been largely overcome by the use of better ground pigments made possible by the superior machinery which the modern manufacturer has at his disposal.

Almost every conceivable type of gum and resin is used by different makers in their efforts to arrive at an ideal varnish. Amongst others may be mentioned resin, copal, dammar gum, Borneo gum, and artificial resins of the type of coumarone resin; but this short list might be considerably extended.

Of the bodies used to render the compositions toxic, salts or compounds of copper and mercury are of first importance; arsenic compounds come next.

The copper in red compositions is usually in the form of cuprous oxide, which, by being carefully precipitated, can be obtained as a permanent, brilliant dark-red powder; this, when used in conjunction with iron oxide, imparts to the composition an attractive appearance. It is the gradual solution of this material which is responsible for keeping the vessel surrounded with a skin of antiseptic sea water, and is inhibitive to the growth of marine organisms, more particularly those belonging to the vegetable kingdom. Cuprous oxide is also made electrolytically, but experience has shown that this is somewhat inferior in antifouling properties to that prepared by the precipitation method, and at the same time more likely to induce corrosion, probably owing to the small quantity of metallic copper which it invariably contains. Where a red composition is undesirable, *e.g.*, for submarines, other salts of copper are used; but, of course, only those which have a low degree of solubility, such as emerald green, $Cu(C_2H_3O_2)_2.3Cu(AsO_2)_2$, copper carbonate, copper thiocyanate and, rarely copper cyanide. These are usually employed with zinc oxide, as a base or pigment, which itself is mildly antifouling. Yellow hydrated cuprous oxide is also used to a small extent. Copper has been introduced in many other forms in organic combination, of which copper resinate, oleate, stearate may be quoted as typical examples. In practice the free acidity is neutralised, entirely or partly, with some suitable copper compound and the resultant product incorporated in the vehicle of the antifouling composition.

Mercury is usually added to the composition in the form of oxide or sulphide. Sometimes also mercurous chloride is used, but superior results have been consistently obtained from the use of organic compounds. By this means a given quantity of mercury can be spread over a larger area, owing to the small percentage of mercury in the organic compound. For instance, mercuric dinaphthyl, with a molecular weight of 454, will enable, other things being equal, a given weight of mercury to be spread over a far larger area than if the same weight of mercury were in the form of, say, the oxide. The high cost of mercury prevents its being used lavishly on a commercial scale; and this makes the preparation of organic compounds advisable. It is an unfortunate fact that no cheap and efficient substitute for mercury has been found. From the shipowner's point of view, however, in the long run it is still more costly to use compositions which do not contain mercury.

Unfortunately, arsenic, although used by some manufacturers, appears to be of very little use unless in combination with copper, as in emerald green. One would anticipate from a knowledge of the properties of arsenic oxide and arsenious oxide that either one or the other, or a judicious mixture of both, would be a suitable poison for antifouling compositions; but anyone who has experimented with these materials would soon part with any preconceived optimism. In the writer's opinion, they are practically useless.

In this short article it is neither desirable nor possible to deal with the great variety of materials which has been pressed into the service. Nor can the problem of keeping ships' bottoms free from corrosion and fouling be considered settled; at the same time, however, good-quality compositions have achieved much, and shipowners can feel that under normal trading their vessels' bottoms will be kept in a reasonably good condition for periods of from nine to twelve months.

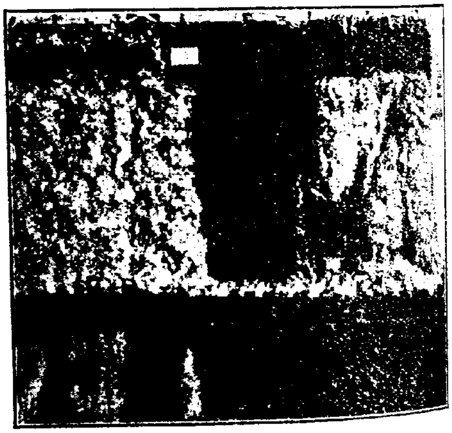


Fig. 2.

The annexed photographs show more experimental plates and demonstrate how cautious one must be in predicting the effect of materials when in the form of compositions. All these experiments were designed as improvements on a well-known standard brand, which was painted right across the top in Fig. 2 and the top right-hand strip in Fig. 3. Actual trial, which is the only reliable test, has shown the modifications to be wrong. Only by this process of elimination can the best results be achieved. As in actual practice most vessels are in dry dock on the average at least once in twelve months for purposes other than painting, the manufacturer of modern compositions can claim to have kept pace with the naval architect, for whilst in dry dock it would be folly to float a vessel again without seizing the opportunity to give her fresh coats of composition.

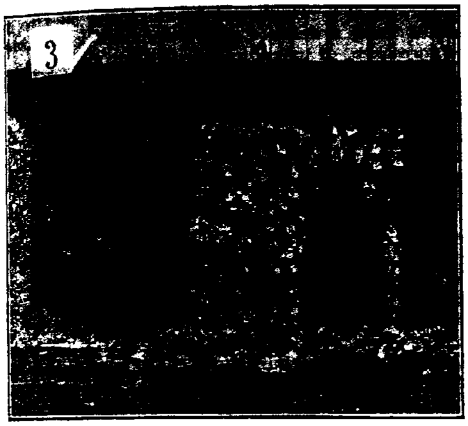


Fig. 3.

EMIL FISCHER'S RECOLLECTIONS

SIR WILLIAM J. POPE

At the time of his death, on July 14, 1919, in his 67th year, Emil Fischer was the most universally respected figure in chemical science. He exercised a great personal influence over his students, he had written his name large on many chapters in pure and applied chemistry, and he was recognised by all as an honest, straightforward man who had done much to enhance the status of his science.

Whilst excellent biographical notices of Fischer's life and work have been published, such as those by M. O. Forster (Trans. Chem. Soc., 1920, 117, 1157) and Kurt Hoesch (Berichte, Sonderheft, 1921), the knowledge that an autobiography was in existence still aroused keen interest. This autobiography has been published recently as "Aus meinem Leben,*" and a few copies have reached this country. Recognising the intense scientific and academic interest of the period covered by Fischer's active life, most chemists had anticipated that this work would appeal to them in the same way that Hofmann's "Zur Erinnerung an vorangegangene Freunde" appealed to a former generation of chemists; in this expectation they will be disappointed. Fischer's personal narrative is so entirely unworthy of the position which he occupied in science that its publication will bring a sad disillusionment to many.

Most chemists have probably pictured Fischer to themselves as a man of uncommon intellectual gifts—which he certainly was—and of the wide general interests which we ordinarily associate with the possession of such gifts. One would have anticipated that so undisputed a leader in chemistry as Emil Fischer would have been keenly interested not only in all scientific subjects but also in the humanities and in the great world-movements of which he was a witness. "Aus meinem Leben" shows clearly that, apart from his interest as a specialist in organic chemistry, Fischer was oblivious to everything save the most casual happenings connected with those with whom he came into daily contact.

This little volume of 200 pages was written whilst its author was in convalescence at Carlsbad and Locarno. It opens with the enumeration of countless relatives concerning the majority of whom only trivial details are recorded; it is difficult to believe that any person with a well-stored mind could pass two periods of repose away from home at the age of 66 extracting this vast amount of casual knowledge from the recesses of his mind and rigidly suppressing all his greater experiences. Fischer refers frequently to his indulgences in beer-drinking and tobacco-smoking, and suggests in a veiled kind of way that immoderation in these pursuits may possibly have been responsible for his later bodily infirmities. One joyous evening convinced him, he tells us, that nothing in the world compares with beer as a solvent for official and social distinctions and for establishing equality among human beings. Amongst his other simple pleasures he mentions music, but says nothing to indicate that he regarded this art as other than a distraction of the same order as his card-playing. Fischer was at the impressionable age of eighteen when the Franco-Prussian war of 1870 broke out. He mentions the war and records a few minor details concerning the way it affected his relatives. He refers several times to the war of 1914-18 as this "accursed war," but, apart from this and the loss of two of his sons, he expresses no views on a subject so remote from organic chemistry; he does indeed hope that a young relative, married in Australia, has been spared the intolerance extended towards his countrymen in the English colonies.

For Fischer politics apparently did not exist. True, he often experienced difficulty in securing financial aid for chemistry from governments, but he treats untoward occurrences of this kind with amused resignation and uses political party names merely as a nomenclature. He was in the lap of the gods and unaccustomed to question their decrees.

---

* "Aus meinem Leben," von Emil Fischer. Emil Fischer Gesammelte Werke, herausgegeben von M. Bergmann. Pp. 201. Berlin: Julius Springer, 1922. Price (at date of issue), 38 marks.

In 1885 Fischer visited Corsica. Passing through Paris, he dropped his gold watch on the boulevard, but returned after a few steps and picked it up. At Marseilles he demanded a few thousand francs on a letter of credit and had to wait because the bank was short. He informs us that the " vendetta " was still practised in Corsica and that a charming account of this barbarous custom is given in an excellent novel by Prosper Mérimée, entitled " Colomba.' He omits to tell us, in connexion with his earlier visit to Denmark, that Shakespeare wrote " Hamlet."

Hundreds of great names flit through the pages of these recollections. With each one is associated some petty and often sordid detail. We are told that Graebe's horse-laugh attracted the attention of all the guests in the dining-room of the Grand Hotel in Territet and that Pechmann lost most of his fortune at Monte Carlo, but the master says no word in praise or appreciation of the services rendered by these two celebrated chemists in the development of their science.

It seems to be possible in Germany for an individual of great intellectual endowments to achieve eminence in some narrowly confined branch of science and still to remain ignorant of all those weighty matters which lie outside the limited domain in which he is supreme ; this is perhaps responsible for much that has happened during late years. One of my friends recently visited a German scientific man of high standing and was informed by him that England must be in a desperate state ; that we have so many unemployed living at the Government charge, that the State has boarded out great numbers of them in Austria because they can be maintained there at a less cost than in England. The statement must be true, because it has appeared in all the German newspapers ! A similar detachment from human concerns led Fischer to sign the notorious manifesto of the 93 in September, 1914, justifying the violation of Belgian neutrality ; a few years later he expressed regret at this ill-considered action.

The unfortunate impression made by Fischer's recollections was evidently foreseen in Germany, and the earlier part of Kurt Hoesch's life, published by the German Chemical Society, consists in a journalistic paraphrase of the recollections in which the trivialities are submerged under a flood of Teutonic sentimentality. Hoesch is astonished to find so little mention of the war of 1870, and explains it somewhat naïvely by saying that Fischer's character was an international one, and that he was a good European or, indeed, a super-European. " Aus meinem Leben " affords no support for this ingenious proposition.

NOTES ON THE DETERMINATION OF "MIXED ACID"

W. H. PATTERSON

Various methods have been employed for the analysis of " mixed acid," *i.e.*, mixtures of nitric and sulphuric acids, such as are used in nitration, or the spent acid left after nitration. The present notes are based on experience in comparing known methods of analysis or modifications of them.

Total acid is easily determined by titration with standard caustic soda. The alkali is added from a burette to a weighed amount of the acid to be tested until a definite pink coloration is obtained in presence of phenolpthalein (the alkali being standardised under similar conditions). In another method the acid is added to a definite volume of the alkali in presence of methyl orange until a red colour is obtained, and the excess acid is titrated with caustic soda until the colour becomes pale yellow and finally turns pink after adding phenolphthalein.

Nitrous Acid.—For the separate determination of nitrous acid the well-known permanganate method is best, and it is satisfactory for fresh acid. With spent acids, in which the nitrous-acid content is high and organic matter is always present, titration with permanganate needs careful control. The method may be employed in analysing waste acid from TNT manufacture, containing matter not readily oxidised by permanganate. The influence of organic matter is shown by its effect on the end-point when the titration is performed at different temperatures up to 100° C. The method, however, is inapplicable to waste acids from the manufacture of picric acid, as oxalic acid is invariably present. Therefore some other method of estimating nitrous acid in presence of organic matter must be used, or other methods must be adopted which distinguish between the total nitrogen and the nitrogen in nitric acid. A useful method of estimating nitrous acid alone is to add the sample to be tested to a strong solution of potassium citrate, free from carbonate, in a Lunge nitrometer. The sample is washed in with more citrate solution, and a concentrated solution of potassium ferrocyanide added; the amount of nitric oxide evolved corresponds with the nitrous-acid content of the sample. This method tends to give low results.

The analysis of mixed acid also involves the determination of the total nitrogen acids, and the nitric or the sulphuric acid. Methods which are generally applicable, and which may also be used for nitrates or nitrites in most cases, can be tabulated as follows : —

Total Nitrogen Acids.—(1) Nitrometer method. (2) Reduction to nitric oxide by ferrous chloride in acid solution. (3) Reduction to ammonia by the Arndt method, the use of Devarda alloy, electrolytic reduction, etc. *Nitric acid:* (4) Direct titration with ferrous sulphate. (5) Nitron method [after elimination of nitrous acid]. *Sulphuric acid:* (6) By evaporating off the nitrogen-containing acids and titrating the sulphuric acid directly. *Nitric acid and sulphuric acid:* (7) By double titration with barium hydroxide and sodium carbonate.

Methods (3) and (5) are not discussed in this paper; most of the other methods have been so long in use that it is difficult to quote references to the original literature.

Determination of Total Nitrogen-Acids

(1) *The Nitrometer Method.*—The use of a calibrated nitrometer is usually held to give correct results, but large errors may occur if the apparatus is not manipulated correctly, and especially if a large number of tests has to be made. Emphasis is laid on this point because the author has experience of two large works where serious discrepancies were found in the results of routine estimations. Two nitrometers which nearly always showed large differences were examined and the divergence was found to be due to a difference in the tap-connexion which had led to different ways of using the nitrometers. An experiment which accentuates the error can be carried out as follows:—The nitric-oxide gas is expelled through the cup after an estimation has been made, and some of the acid lying on the mercury is allowed to enter the cup, thereby becoming exposed to the air. If this acid is drawn back into the nitrometer, or the walls of the cup are washed with pure sulphuric acid, and this is again shaken with the mercury, without adding any more nitrate, a further quantity of nitric oxide will be evolved which may amount to one-half the volume originally obtained. This production of gas can be repeated indefinitely and appears to be due to oxidation of the gas in contact with air to peroxide, which dissolves in the acid on the walls of the cup. A similar phenomenon may occur to some extent in the bore of the tap. Nitrometers should, therefore, always be constructed with a side-tube and cup connected by a two-way stopcock with two parallel diagonal bores (Greiner-Friedrichs cock). The gas can then always be expelled through the side tube, never through the cup, and each bore of the tap is used for one purpose only. About 5 c.c. of 90 per cent. sulphuric acid should be used with the sample in the nitrometer. Acid of greater strength must, according to Lunge, be avoided, and weaker acid gives a low result. A sample treated with sulphuric acid diluted to 50 per cent. gave as result 26·1 per cent. nitric acid, but when treated with the same amount of acid of 90 per cent. strength, 26·3 per cent. Also, with the more dilute acid, the action is slow at first and the mercury blackens and loses mobility.

(2) *Reduction to Nitric Oxide.*—The method of reducing to nitric oxide by ferrous chloride in acid solution, known as the Schlösing-Grandeau or Tiemann-Schulze method, has been modified by De Koninck and others (*cf.* Lunge-Berl., "Chemisch-technische Untersuchungsmethoden," 7te Auf. I., p. 783 *et seq.*). To compare this with other methods the following modification was used:—The ferrous chloride solution and the hydrochloric acid were boiled in a flask until free from air, and the flask was connected through a mercury seal with the gas-measuring tube, the drop of the delivery tube to the mercury being greater than the barometric height. The sample of acid to be tested was added to the flask by a tap-funnel. The volume of gas evolved may either be reduced to N.T.P. and calculated as nitric acid, or it may be compared with a standard volume of nitric oxide obtained from a known amount of pure nitrate or nitric acid. The two methods give slightly different results. Using spent acid and the nitrometer method, the results agreed within 0·05 per cent.; with fresh acid a result within 0·12 per cent. could be obtained by careful measurement and correction of volume, but when an old standard volume is used the result may be too high by 0·2 per cent. or more. The liability to error is greatest in making a first estimation with a fresh charge of ferrous salt. It has been proposed to extend the method to the determination of nitrous acid (*cf.*, Meisenheimer and Heim, Ber., **38**, 1905, p. 3834) by reduction to nitric oxide with potassium iodide; Raschig, Ber., **38**, 1905, p. 3911), separate determination by titrating the free iodine in an atmosphere of carbon dioxide; (Strecker, Ber., **51**, 1918, p. 997) estimating the nitrite in neutral solution as nitrogen, after decomposition with a very large excess of ammonium chloride. No attempt has been made to compare these methods with others mentioned.

Determination of Nitric Acid

(4) *Direct Titration with Ferrous Sulphate.*—It has often been doubted whether even approximate results can be obtained by this method, which dates at least from 1847. Bowman and Scott (Chemical News, **114**, 1916, p. 39) showed that if properly carried out, it could safely be used for estimating nitric acid alone in presence of other acids (with some exceptions) or of nitrites. Since then a modification of the method has been shown to be capable of giving results agreeing within 0·1 per cent, with those obtained for nitric acid determined by the nitrometer, or for pure nitric acid estimated by direct titration.

The ferrous sulphate solution, made by dissolving the pure crystals in 30 per cent. sulphuric acid, is added directly from a burette, and the end-point is marked by the formation of the brown colour due to interaction between ferrous sulphate and nitric oxide. The conditions necessary to obtain results accurate within 0·1 per cent. are as follows:—(*a*) An excess of sulphuric acid must be used; hence the sample to be titrated, about 0·5 g., is mixed with about 100 c.c. of concentrated sulphuric acid. (*b*) The flask is kept at a temperature of under 30° C. in water and agitated during titration. (*c*) The factor of the ferrous sulphate solution is determined just before use by standardisation against a known amount of pure nitrate or nitric acid. This procedure eliminates most of the error due to change in volume of the ferrous sulphate solution (which has a large temperature-coefficient), error by different observers in judging the end-point, and also the error due to the small amount of solution necessary to give the end-point colour, *i.e.*, to effect reduction to nitric oxide. A sharper end-point might be obtained if most of the colour due to formation of ferric salts were eliminated by titrating with stannous sulphate, containing some ferrous sulphate, in a neutral atmosphere.

Determination of Sulphuric Acid

(6) *By Titration after Evaporation of the Nitrogen Acids.*—This method, which is used on the ground of convenience, was carried out for purposes of comparison as follows:—About 1 g. of the sample was run into a porcelain evaporating-basin (diam. 7 cm.). After evaporating for at least 30 minutes on a water-bath, 1 c.c. of water was added, the liquid stirred with a small glass rod kept in the basin, and then heated for 15 minutes more. The sulphuric acid was then titrated, using methyl orange as indicator. Experiments showed that this

method could give almost correct results, but it was not always reliable, the sulphuric acid content being in some cases more than 0·5 per cent. too high.

DETERMINATION OF NITRIC AND SULPHURIC ACIDS

(7) *By Double Titration.*—This titration described by Langbein (Z. angew. Chem., 13, 1920, p. 1227) may be slightly modified as follows:—Total acid is determined by titrating the hot or boiling solution with barium hydroxide, using phenolphthalein as indicator. A known amount of standard sodium carbonate is then added in excess, the precipitated barium sulphate and carbonate are filtered off, and the excess of sodium carbonate titrated with standard hydrochloric acid, using methyl orange to show the final end-point. This method gives low results for nitric acid, but it is speedy, and there is no error due to the precipitate passing through the filter paper. It is accurate enough for corrections in bomb calorimetry, for which purpose it was used by Langbein, or even for the determination of the sulphur content of a fuel, since under the conditions of combustion or explosion in compressed oxygen, sulphur is oxidised completely to sulphuric acid, and is found, together with nitric acid, in the liquid in the bomb.

ELECTROCHEMICAL DEVELOPMENTS IN ITALY

Industrial conditions in Italy are very different from those to which we are accustomed in Great Britain. The main problem which confronts the Italian technologist is the high price of fuel, due to the fact that home supplies are negligible; on the other hand he has abundant water power. These circumstances tend to promote chemical development along electrochemical lines, and as one consequence much attention has been devoted since the war to the production of electrolytic alkali. The development of this industry was hampered at first by the usual difficulty of finding an outlet for the chlorine, which is produced simultaneously, but this problem appears to have been solved successfully and on somewhat original lines, with the result that an interesting group of industries has been established. Some of these developments are described briefly in the following notes.

The imports of caustic soda into Italy are considerable, but have dropped from 19,844 metric tons in 1916 to 13,921 t. in 1921. The total internal consumption is about 22,000 t. per annum, of which only 5,943 t. was produced in the country in 1913. To-day the potential internal production, if all the works were working at full capacity, would approximately cover the demand.

At the Pomilio Electrochemical Works (L'Elettrochimica Pomilio) near Naples, caustic soda is produced in Pomilio-Giordani electrolytic cells in which the yield per unit of current is about 93—95 per cent. of the theoretical. There are three batteries of 100 cells each, and each cell takes 3000 ampères. The output per 24 hours is 10 tons of 100 per cent. NaOH, obtained as a solution of 120 to 140 g. per litre, which is worked up in the evaporators and fusion pots to soda lye of the commercial strengths 38—40° Bé. and 48—50° Bé. and to fused caustic of 72—74° English degrees. Under Italian conditions it is, of course, necessary to reduce to a minimum the fuel charges for evaporation; by using electrically-driven heat-pump evaporators and so utilising the thermal energy of the fuel to the utmost the company has succeeded in reducing the coal required to evaporate each cubic metre of water in the production of 48 Bé. caustic lye to 16 kg., as compared with 48 kg. with multiple-effect vacuum pans, 210 kg. by heating with indirect steam, and 260 kg. by direct firing. Naturally this extreme economy of coal is only effected by the auxiliary use of electric current to the amount of approximately 230 kw. per cb.m. The caustic fusion pots are also of special type, coupled in parallel or in series, with tangential heating and recovery of the heat of the chimney gases which are said to reduce the fuel charges to 75 per cent. of those incurred by using pots of less recent type. The chlorine is used for the manufacture of bleaching powder, synthetic hydrochloric acid (for which purpose the hydrogen from the batteries is also utilised), sodium hypochlorite and zinc chloride; in future it is to be used for the production of potassium and aluminium chlorides, alumina and silica from the leucite of the volcanic rocks in the neighbourhood. The chlorine is also utilised in producing pure cellulose from hemp fibre and other raw materials. Three thousand tons of bleaching powder is produced yearly in leaden chambers; the hydrochloric acid plant has a capacity of 2000 t. per annum, and 160 t. per month has been actually obtained. The annual production of sodium hypochlorite is 2000 t., which is absorbed by local textile and other industries; and the output of 50 tons per month of zinc chloride is supplied to the State railways for the impregnation of sleepers.

The Pomilio company is now producing pure cellulose by the Cataldi process in a recently erected works, the output being 7 to 8 tons per day. In this manner an outlet has been found for the surplus chlorine, and the development is expected to have a very good future. The main raw material is hemp fibre, which is the dry residue from the beaten and macerated hemp plant. The annual production of this material in the Province of Naples is 25,000 tons. Hitherto this product has been used only on a small scale for fuel. The method of treatment is essentially Cross and Bevan's analytical method of estimating cellulose, adapted for industrial purposes, and consists in treating the fibre successively with dilute caustic alkali solution, moist chlorine, and again with dilute caustic alkali. The main precaution necessary on the manufacturing scale is careful regulation of the access of chlorine, as otherwise excessive heating takes place and the fibre is destroyed, or even charred. Large quantities of hydrochloric acid are evolved. Other raw materials are used instead of hemp, namely poplar wood, esparto and straw. The quantities required for the production of 100 kg. of poplar cellulose are: moist chlorine gas, about 28 kg.; coal about 15 kg.; bleaching powder (for subsequent bleaching) about 6 kg.; and sodium hydroxide, in dilute solution, 5 kg. To produce 10 tons of cellulose per day by this method only 50 workpeople are required and about 80 kw. of electric power. The amount of water required is not greater than in other processes. A plant of the above-mentioned output requires about 1500 sq. metres of covered floor-space. The above figures represent a maximum of chlorine and minimum of caustic soda, the object being to balance the ultimate demand for these two materials, but the quantity of chlorine can be considerably reduced if the consumption of alkali is increased. The alkali is used in a very dilute condition.

A further possible outlet for the surplus chlorine on a very considerable scale has been found in the production of synthetic hydrochloric acid and its use for decomposing the volcanic rocks which abound in Italy, and which represent the richest and largest source of potassium compounds known. It is calculated that the leucitic rocks of the active and extinct Italian volcanoes, of which six are included in the computation, contain in round figures nearly 8800 million tons of potassium oxide, or rather more than is present in the Stassfurt deposits, and about 25 times as much as in Alsace. It appears to be comparatively easy to separate from these rocks, by ordinary magnetic and other mineral separation methods, leucite, $K_2O.Al_2O_3.4SiO_2$, of a purity of about 90 per cent., and containing therefore about 19·5 per cent. of potassium oxide. It has been found that finely-divided leucite is readily attacked in the cold by hydrochloric acid, forming a solution of potassium and aluminium chlorides on the one hand and a residue of silica, which can be washed, sieved, and sold at a low figure, on the other. The solution of the mixed chlorides also contains small amounts of iron salts and silica in solution. Processes have been patented by Giordani, Pomilio, Blanc and Jourdan, and are being worked out on a semi-industrial scale, for the treatment of the acid solution of the mixed chlorides by several methods. By the first of these, a large part of the potassium chloride is recovered by cooling; the solution is then neutralised and the remaining silica thus precipitated is filtered off. The solution is freed from iron electrolytically, and electrolysis is also employed to precipitate the alumina, the production of aluminates being avoided by the use of a neutral catholyte. The chlorine and hydrogen produced during electrolysis are recovered and re-utilised. Alternatively, the solution of the mixed chlorides is successively subjected to such temperatures and pressures as to dissociate or otherwise separate each ingredient in turn. The solution of the chlorides is heated to 300°—600° C., and the chlorides of iron and aluminium, and even those of calcium and magnesium, are successively decomposed with recovery of hydrochloric acid. The aluminium chloride can also be separated by utilising its diminished solubility in presence of excess of hydrochloric acid in the cold.

By the methods indicated, products of the following degrees of purity have been obtained:—Potassium chloride crystals, KCl 99·7%, water 0·25%: free from silica, iron oxide or alumina; aluminium chloride crystals, Al_2O_3 17·5—19·7%, K_2O 0·91%, Fe_2O_3 trace: free from silica and lime; alumina, Al_2O_3 99·8%; SiO_2 0·19%: free from iron oxide and lime. It is important to note, bearing Italian conditions in mind, that by certain of these processes the leucitic rocks can be treated successfully without the use of any fuel whatsoever. As instancing the enormous amount of raw material available for this outlet for electrolytic hydrochloric acid, it may be noted that during the last eruption of Vesuvius in 1906 about 200 million tons of volcanic ash was ejected.

NEWS FROM THE SECTIONS

AMERICA

At a meeting of the American Section, held on October 20 in the Rumford Hall of the Chemists' Club, New York, the Grasselli Medal was presented by the chairman, Dr. Harlan S. Miner, to Mr. W. H. Fulweiler, of Philadelphia. In making the presentation Mr. Miner spoke as follows:—

The American Section of the Society of Chemical Industry is highly favoured in being able to give some tangible recognition to the meritorious papers presented at its meetings. The Grasselli Medal and the conditions controlling its award are distinctly American in character. The fact that it is awarded for the paper which, in the opinion of the Medal Committee, offers the most useful suggestions in applied chemistry, makes it peculiarly appropriate to an industrial society. This is only one of many ways in which the donors are advancing the profession of chemistry in the United States. The Committee of Awards has this year unanimously chosen as the recipient of this honour Walter Herbert Fulweiler, of Philadelphia, in recognition of the paper which he presented at the March meeting of the Section, entitled "Chemical Problems in the Gas Industry."

Born in Philadelphia on January 3, 1880, the medallist graduated from the University of Pennsylvania in 1901, with the degree of B.S. in chemistry. Having decided to devote his attention to the gas industry, he first accepted a position as chemist in one of the stations of the Philadelphia Gas Works. We next find him as cadet engineer and later as superintendent of manufacture of the Kansas City Gas Co. Returning to Philadelphia in 1907, he entered the Department of Tests of the United Gas Improvement Co., becoming chief chemist in 1913 and chemical engineer to the company in 1920.

As might be expected, Mr. Fulweiler's work in connexion with the gas industry has been of a very practical nature, and has had a decided economic application, although he has by no means ignored the purely scientific side of his subject. With an intimate personal knowledge of the industry, both from an American and a European point of view, he constructed one of the first waste-heat boilers on a water-gas set. Then he assisted in the design and erection of the first American type of vertical retort at Manchester, N.H.

The utilisation of some of the ill-smelling by-products of the gas industry is worthy of note in this connexion. Our medallist developed and introduced the successful road-binder known as "Ugite"; also the first cold patching-material made from tar which is now extensively used in road maintenance. He invented the "cut-back" method of manufacturing tar products used in the surface treatment of roads, and also devised an apparatus for determining the binding value of pure bitumens in road construction.

The refining of benzol products recovered from illuminating gas was thoroughly investigated, particularly with reference to the production of toluene. Like other loyal chemists connected with our "key" industries, he collaborated with the Ordnance Department during the war, studying particularly the manufacture of toluene. In addition to reporting on several methods for producing this material, so urgently needed at that time, he developed and perfected a process for its manufacture by a heat treatment of Californian distillates, and assisted in the construction and operation of two plants to work this process, one at Los Angeles and the other at San Francisco, the former having a production of 3 million galls. a year at the time of the armistice.

Another subject upon which Mr. Fulweiler worked during the war period was the development of a motor fuel for our air service, finally producing one, as a by-product from the operation of the toluene process, which, under tests at the flying fields, enabled the training plane to climb about 5 per cent. faster and with an economy in fuel consumption of about 8 per cent. This fuel consisted essentially of 60 per cent. unsaturated hydrocarbons, 30 per cent. benzol, and 10 per cent. paraffin hydrocarbons. Refined by a special process, it was found possible to eliminate gumming and corrosion.

In more recent years our medallist has made a very extensive study of the petroleum oils used in the gas industry, with special attention to the development of methods for their identification. These researches, which are still in progress, involve the preparation of a large number of hydrocarbons from different series and the determination of their physical constants, among which are several unusual ones, such as magnetic rotation, electrostatic double refraction, and absorption spectra, particularly in the ultra-violet.

An examination of the many published articles from Mr. Fulweiler's pen indicates still further the great diversity of his researches and developments. A paper on "Physical Theory of Coal Carbonisation," as early as 1908, was awarded the Beale Medal by the American Gas Institute. This was followed by "Theory of Flame and Mantle Illuminosity," "Physical Characteristics of Ferric Oxide," "Purification of Water for Gas-making Purposes," "A Source of Light, giving a Continuous Spectrum in the Ultra-Violet," "The Development of Modern Road Surfaces," "Destructive Action of Motor Traffic on Road Surfaces," and "Refractory Problems in the Gas Industry."

The subjects of wood-preserving and of refractories, both vital to the economic success of a gas plant, have received very careful study, as have also the many intricate problems involved in gas purification. In this field researches have been conducted to determine the nature of the sulphur compounds in illuminating gas, and also the chemical reactions involved in the purification by iron oxide and its subsequent revivification.

These and other papers, in addition to the one for which this medal is awarded, demonstrate conclusively that the industry, which had its inception over a century and a quarter ago in a relatively crude way, now maintains its important position as a result of systematic scientific research and control. Notwithstanding the volumes that have already been written describing the work of the scientists in this and earlier generations, our medallist has found new fields to investigate and has achieved results that have materially advanced the industry in which he has chosen to labour.

We are glad to find a man who will freely impart the information obtained through his researches and experience, and is willing to publish papers which, as our donors suggest, "offer useful suggestions" to his colleagues.

On behalf of the American Section of the Society of Chemical Industry, I am honoured in presenting to you, Mr. Fulweiler, this beautiful medal, no so much as an incentive to spur you on to other and increasing activities, for you do not seem to require such a stimulus, but as a token of appreciation from your many friends in the chemical profession. May you ever see in it an expression of our good-wil and may it bring you much happiness throughout a long and useful life.

Following the presentation, Mr. F. E. Hartman read a paper on "Ozone Generation, and the Industrial Application of Ozone," which contained, *inter alia*, the results of some original work on the action of ozone in accelerating the drying of paints and varnishes, and in bleaching linseed oil. A further paper, by Mr. E. Feikel, on "The Effect of Ozone on Organic Compounds," discussed the general properties of ozonides and the action of ozone on each of the more important groups of organic compounds.

LONDON

The first meeting of the new session was held on November 6 in the Engineers' Club, London. The chairman, Mr. E. V. Evans, presided, and announced that a joint meeting had been arranged with the Biochemical Society on January 8, 1923 to discuss the subject of micro-organisms and thei application to industry.

Further, Mr. Evans stated that the Committe had been fortunate in obtaining the consent of Dr E. F. Armstrong, the President of the Society, t address them on this occasion. He did not propos to introduce Dr. Armstrong or to talk of hi achievements: he was known to all of them, an his merits were everywhere recognised. The Counci of the Society was really to be congratulated o having obtained Dr. Armstrong's consent to b President of the Society at the present moment because he (Mr. Evans) could assure them that th responsibilities being undertaken at the presen time really necessitated a man of Dr. Armstrong' calibre. He (Mr. Evans) was one of those who wer perfectly confident of success in the new venture that they were to undertake with Dr. Armstrong a their leader.

Mr. Evans then called upon Dr. Armstrong t give his address on "Some Problems in Chemica Industry."

Dr. E. F. Armstrong, in the course of his address said:—Some few weeks ago your secretary did m the honour of insisting that I should come her to-night, and I understood I was to address you i Burlington House. I, therefore, prepared a elaborate scientific address suitable for the fou walls of that august establishment, but when heard suddenly, a day or two ago, that the meeting was to be here, the only thing to do was to bur that address and to make remarks more appropriat to the occasion. I am not at all certain whethe one ought not to say that the move is perhaps a wis one.

The subject which concerns all members of th Society of Chemical Industry, members of th chemical fraternity, more than anything else at th moment, is the means of our livelihood. Th Chemical Society has entrusted to it the safeguard ing and advancement of chemical science. We i this Society have rather different functions to fulfi functions which I would like to suggest to you call for other qualities than those of being, I will not say a mere chemist, but merely a chemist. "The Society of Chemical Industry" was the title given to us by our founders, 41 years ago, but to-day I think we ought to call ourselves the Society for the Promotion of Chemistry in Industry. It is very difficult to define chemical industry; those who formed the Association of British Chemical Manufacturers had very much wider ideas as to what was a chemical manufacturer than has proved to be the case. Those engaged in many branches of manufacture, who, it was thought, were chemical manufacturers, have chosen to regard themselves, not as chemical manufacturers, but as manufacturers of a particular article, and, in consequence, have not allied themselves to the chemical industry. I fear that the tendency at the present time is to restrict more and more the term "chemical industry" to the very definitely chemical industries. If we take as our title "the promotion of chemistry in industry," then nearly all industries become chemical industries, because chemistry is at the foundation of all.

The Status of the Chemist

Our Society, more than any other, represents the chemists of the country. Our efforts are supplemented to-day by the Institute of Chemistry, a body which is worthy of all praise. There was, in the past, a tendency to confine the Fellowship of the Institute to the restricted, although eminent, classes of chemists known as consultants and analysts, but that tendency has gone, and to-day the Institute is enrolling within its ranks, either as Fellows or Associates, everybody who is worthy of being called a chemist. In addition to the Institute we have the British Association of Chemists, of which I have a very high opinion. I regard it as the left wing of the party, and a party without a left wing is almost no party at all; we must have stimulus from within. I think both the Institute and the British Association of Chemists, and certainly ourselves—the non-political mother society—have all the same mission. We want to see the status of the chemist placed on a high plane, and I shall regard it as my duty, whenever you give me the opportunity to speak publicly, to state the fact as clearly as I can for the benefit of the outside world, that we chemists do claim to be a body of very highly trained, highly skilled professional men. Our training has been that of method, scientific method. We are gifted with certain knowledge which enables us, so to speak, to take things to pieces, and with an ability to predict events, because of our knowledge of chemical properties. Still more, some of us are in the position of exercising constructive thought, and I want to put very definitely that the nation has in its chemists a body of men in whose hands a great deal of the future of civilisation rests. If we are to take up this honourable position that we claim for ourselves, we must, like the doctors and the lawyers, have a very high standard of professional conduct. Remember, the British public is our judge. We must not despise the British public, because, although slow, it is sure, and its judgment is, in the long run, correct. And here I want to enter a strong protest against the action of certain chemists in misleading the public. I do not think any chemist has any right to set his name, much less its qualifications, to documents which are published in company prospectuses and elsewhere with intent to mislead. Of course, I am making these remarks without reference to any individual. I wish to emphasise the necessity of no chemist setting his name to documents that may mislead the public. The public is essentially gullible, but it has a long memory, and if Mr. X——, F.I.C., F.C.S., deceives the public once, the public will in future regard all F.I.C's. and F.C.S's. as of the same stamp. It is also time publicly to enter a protest, not against the use of the term "chemist"—because that has long since passed beyond our control—but against the qualified chemist in any way doing anything to perpetuate the existence of the unqualified chemist. During the war the mistaken policy of the Government in sending chemists into the trenches caused a shortage at home, and all sorts of unqualified men had to be brought into the factories. They did fine work, and it is to their credit, but during the recent trade slump the employer has parted with these men wholesale, unfortunately, thinking they were representative chemists, and I fear that it will take a considerable time to live down some of the mistakes made at that time.

The Rusting of Iron

Another matter for our consideration is whether chemists, as a class, contribute as much as they might to the general good of the community. Sir Robert Hadfield has calculated that there is an annual loss to the world of 40 million tons of iron and steel as the result of atmospheric corrosion, and that the monetary value of this loss is about £500,000,000 per annum. Sir Robert Hadfield has put some of these facts together in a recent number of the Royal Society's *Transactions*, and he calls attention to the fact that this is the first paper dealing with the subject that has appeared in those *Transactions* for 100 years. Now, think of it; a chemical factor which causes the loss of £500,000,000 per annum dealt with once in a hundred years by our leading scientific society! I am, of course, aware that the Institution of Civil Engineers and similar societies have considered this subject; and that there are many firms who specialise in anti-corrosive preparations; and one is very glad to note that these firms have recently come together and formed an association; but is not this state of things rather a reflection on the chemist? At a certain college in Kensington the students were not taught chemistry in the conventional way, but they had put to them the problem of what happens when iron rusts; many of these students have since become engineers. Teachers of chemistry have not favoured the Kensington method, and if any chemist mentions iron rust in public it probably causes more ridicule than attention.

Smoke Abatement

Our attention has recently been directed to the Smoke Abatement Bill, which, I believe, was fathered by Lord Newton and introduced into the House of Lords. That Bill is, presumably, based on the report of a commission, reports of committees, and investigations undertaken by a great number of active men who have long made a hobby of this particular question. The researches of these people, however, prove that four-fifths of the smoke nuisance in our industrial centres and great towns is due to the domestic fire; but the Bill does not mention the domestic fire; all it does is to select the manufacturer and threaten him with increased penalties. Of course, there are manufacturers to-day, and always will be, who let a great deal more smoke into the air than they would like to, but I am rather doubtful if it is the business of the manufacturer to prevent smoke. If a person sets out to produce a particular substance, he becomes an expert in its manufacture, often to the exclusion of everything else; he spends his capital, and puts his energy and brains into the business. There are certain standard pieces of plant which he has to buy from those who specialise in that plant, and he expects to find it of the highest and most up-to-date quality. One would not, of course, expect the soap-maker to experiment with boilers. Why should he? Nor the biscuit-maker to experiment in smokeless fuels or some new type of powdered fuel. That kind of work ought to be done by the chemical fraternity generally, acting with the engineers and the particular people who specialise in these types of plant. I believe that one of the greatest advances that we, as a Society, have made during the past five years will be found to be our Chemical Engineering Group, because that Group is very earnestly and sincerely trying to bring chemists and engineers together to solve these common problems.

WATER-SOFTENING

There are many satisfactory methods of softening water, and one of the most interesting and novel is that based on the extraordinary power of zeolites, both natural and artificial, to exchange bases. When a hard water containing lime and calcium and magnesium salts is passed over a zeolite, the sodium of the zeolite is exchanged for calcium and magnesium; the artificial zeolite—Permutit—is used extensively for this purpose. A material of this kind is really a very remarkable one, of which, as chemists, it is perhaps well worth our while trying to form a mental picture. In this problem structure—surface activity—plays a very important part. The preparation of Permutit, formerly made as the result of a fusion process, and later by precipitation, involves processes which have an adverse effect on structure. We know little of how natural zeolites (two of which are quarried in the United States and sold under the fancy names of "Boronite" and "Refinite") are formed, but, judging by their activity, it appears certain that their structure must have been adversely affected—from our point of view—in the process of formation. It struck us that it ought to be possible to prepare a much more satisfactory material by milder means. Zeolites are complex alumina silicates of unknown constitution, and we, therefore, took solutions of sodium silicate and sodium aluminate and mixed them in concentrations and under conditions of temperature which were found to be the most suitable. A few minutes after mixing, the whole mass sets to a jelly. When exposed, the jelly gradually dries to a solid material, a dried "gel," which in the apparently dry state contains about 50 per cent. of water. This material is very active in exchanging its sodium for calcium and magnesium, in fact, we guarantee it to exchange 5 per cent. of its dried weight, and we have obtained an exchange of 7—8 per cent. So far as our experience goes, the exchange in the natural materials is only 0·25 per cent., and for Permutit 1·6 per cent.; so that we have produced a substance which is at least four times as active as similar materials, either produced naturally or artificially by rougher methods. This is an example of the inter-relationship of chemical action and preservation of surface. When the material, prepared as indicated above, is placed in a suitable cylinder and water run through, the substance that is left after the soluble by-products of the initial reaction have been washed away is of constant activity and can extract definite amounts of calcium and magnesium from water passing over it at a very high rate of flow. The process can be reversed almost instantaneously by passing through the filter a relatively concentrated solution of common salt, the calcium and magnesium being washed away and replaced by sodium. The material has been named "Doucil," and is believed to be represented by the formula $Al_2O_3.Na_2O.5SiO_2$.

TECHNICAL JARGON AND PROFESSIONAL UNITY

The necessity for clear thinking and clear expression is as great as ever it was. To-day it is practically impossible for anyone to have a really good working knowledge of theoretical chemistry because so much of the literature is replete with jargon and complex technical terms. Plain language is also essential in dealing with workmen; and if we do not use it on public occasions we shall continue to assist the undesirable process of splitting up into small separate organisations. In that connexion I am of opinion that more harm is done to the cause of chemistry by the formation of new societies than good is done to any particular branch. Surely the scope of this Society, or, if you prefer it, that of the Chemical Society, is sufficiently large to satisfy the needs of all. Without a closer union than exists at present, the voice of the profession and industry will never be heard to its full effect.

DISCUSSION

The chairman said that Dr. Armstrong had dealt with a number of subjects which should form an admirable ground for discussion. He himself had taken some interest in the question of smoke abatement, and was of the opinion that Lord Newton's Bill was a little premature. As a chemist retained by a gas company, he naturally knew of a very valuable smokeless fuel. At the same time he knew that distillers of coal were beginning to realise that there would always exist a demand for solid fuel in every house, at least during the present century, and although he was very appreciative of what coal gas could do, yet he realised that solid fuels were also required. There was no reason why, in the future, there should not be—and he believed there would be—an admirable solid fuel which would not be as expensive as coal. At the same time he felt that, although smoke abatement was required, it was useless for a committee to make recommendations which might very largely influence the progress of industry when four-fifths of the trouble arose from the domestic grate.

Mr. W. J. U. Woolcock said that Dr. Armstrong had done very good service to chemistry and chemical industry in making the chemist feel that he could not be a chemist alone; that if he was going to do the real kind of thing which he was capable of doing in the world, he had not only to be a first-class chemist in his own subject, but he had also to take a rather wider view of his responsibilities with regard to the public. It was essential that every member of the Society should be a little point of propaganda in order that the general community might realise what the chemists really meant by calling themselves chemists. Dr. Armstrong did not say, but he might have done, that the Smoke Abatement Bill was dead, just as every other Bill was. It was, he supposed, one of the most stupid Bills having some bearing on chemical industry which had ever been brought to light.

Mr. Walter F. Reid, in referring to the Smoke Abatement Bill, said that chemists had no reason whatever to fear the new Bill, which would be introduced into Parliament as soon as it was possible to do so. The old one had defects that were due to the fact that the officials who drafted the Bill would not put into it what they had been asked to. When an influential deputation went to the authorities who were entrusted with this matter, the best spokesman and the most convincing advocate in favour of the Bill was a distinguished chemical manufacturer. If they asked too much, they would get nothing at all. It was quite impracticable to prohibit the use of coal in the grates already in existence, but it was well known that the closed stoves used on the Continent utilised three or four times the heat that our open fires did and that all the necessary household operations could be performed with them; and the atmosphere was not polluted. When the new Bill was introduced he believed they would find that some of the chief difficulties would have been surmounted. The great difficulty hitherto had been to prove the emission of what was erroneously called "black" smoke. As soon as the material in the smoke became black it was soot, but legally it was smoke, and the case had been stretched and many convictions obtained in respect of a large volume of a dark material. That would be altered, and there would be some tests which might possibly be useful and fair to the public and fair to the manufacturer. Reference had been made to the want of union among chemists and the starting of new societies. They had tried the Group system so as to include other industries in their Society, as in the case of the Chemical Engineering Group, but when the effort was made to have another one in connexion with the important paint and varnish industries, the Council of the Society did not see its way to offer the facilities that had been given to the Engineering Group. The consequence was that an Institute of Paint and Varnish Technologists had been successfully formed, and that body would in future deal with the enormous industry connected with paints, varnishes and oils, to the exclusion of the Society of Chemical Industry. In that connexion, he felt that one or two words of Dr. Armstrong rather hinted that the paint and varnish trade might object to anything that was done to prevent corrosion of metal, but that was not so. One of the chief objects of the Institute was the promotion of means for preventing corrosion and oxidation of metals. The figures given by Sir Robert Hadfield were most convincing, and it really was a disgrace to chemists that they had never been able to find anything that would cover iron or steel in a simple way and prevent the enormous waste of money that was going on. Finally, he would like to make a suggestion with regard to new words in chemistry. If the Publication Committees of the chemical societies were to keep a list of those new words which appeared and were put forward as being necessary, and if they compared that list from time to time, an authoritative statement might be made as to the adoption of each of them.

Dr. Ormandy congratulated the Committee of the London Section on the move it had made in leaving Burlington House. The President's address was an excellent augury for the future of the Society. It pointed to the probability of that closer co-operation between the Council and the members which was so eminently desirable, and which, in the opinion of many, had hitherto been lacking. He was also gratified to hear the President and the chairman speak so highly of the services rendered by the Chemical Engineering Group. The President was hardly fair to the chemists in his strictures regarding their work in relation to the rusting of iron and steel. Much had been done; there was a vast literature; and probably through the work of the metallurgical chemist in the production of non-rusting iron and steel the problem would find solution. Having been connected with the "Permutit" process, he was interested in the President's remarks regarding the more active zeolites, but he was under the impression that the Permutit Company was making the zeolites along the lines outlined that evening. For the production of water practically free from dissolved substances, the lime-soda process, combined with an electrical process, was making great headway on the Continent.

Dr. Stephen Miall said he had not been mixed up with chemistry for many years, but he had noticed a very great difference in the attitude of the public towards lawyers and the attitude of the public towards chemists, and he believed that this was due to the fact, as Dr. Armstrong, Mr. Reid, and others had said, that chemists did not make themselves intelligible to the public, and also to the fact that chemists looked at things too much from their own individual point of view. The result was the tendency to split up into small societies which had also been referred to. Whether it was right or wise that that state of affairs should exist was another matter, but he noticed in the chemical profession a large number of journals each dealing with one particular branch of chemical industry or of pure chemistry, and appealing to a limited audience. That was not so in the law at all. He supposed there were far more lawyers than chemists—and it might be monstrous that there should be—but the law did not have a number of journals each with a circulation of a few hundreds or a few thousands; lawyers had combined together to a much greater extent than chemists. They ought to be grateful to Dr. Armstrong for advising chemists to have a better conceit of themselves and show the public that they deserved not only the prominence that they had now, but the increasing prominence which they were going to have in all matters of civilisation in the future.

Mr. W. Cullen said he had had a great deal to do with lawyers recently, and his experience had not given him a very great admiration of the manner in which they made themselves intelligible to the ordinary public. With the general tone of the President's address and Dr. Miall's speech he was in entire agreement. He himself belonged to the old type of chemist, and he sometimes felt hopelessly discouraged when he tried to keep himself up to date with the terrible technical jargon of to-day. He hoped this aspect of Dr. Armstrong's address would be taken up very seriously.

Dr. E. Fyleman said he was amused at the extraordinary awe which the bulk of the speakers had of the atmosphere of Burlington House. It seemed to him that Burlington House was similar to most other places, but it certainly lacked the facilities for carrying out experiments. It might be right for the lawyers to have one journal and one society, but one was liable to overlook the comprehensiveness of chemistry and chemical industry. Was it seriously suggested that there should be one comprehensive journal to include such topics as the more abstruse sides of biochemistry, metallurgy, the paint and varnish industry, and so on? It would be quite impossible: it would be necessary to have a bi-weekly journal of the size of the present fortnightly one in order to cope seriously with all the many phases of thought and activity with which chemists were concerned. They might widen the scope of their abstracts, but he thought they would agree with him that the man who contented himself with reading abstracts would not get very far. They were lifeless things and did not help one as much as one would like.

After some remarks by Messrs. Barker and Booth Harris, the chairman proposed a vote of thanks to the President and said that the experience gained that evening would induce the Committee of the London Section always to invite the new President to address the opening meeting of the session. He had been present at a number of such meetings and he had not left one happier or more contented regarding the future welfare of the Society than he would do that evening. Dr. Armstrong, acknowledging the vote of thanks, said that we wanted a close time for chemists just as much as we wanted a close time for the country. We should stop awhile and consolidate the ground; that was the doctrine he had been preaching to them.

GLASGOW

The second meeting of the session was held on November 17 in the Institute of Engineers and Shipbuilders. The chairman, Mr. W. E. Moodie, announced that arrangements had been made for members to visit the works of Messrs. J. G. Jackson, Ltd., of Pollokshaws, on December 9, and inspect various types of "filling" machines. Mr. A. B. Steven then read a paper on "Artificial Silk," in which he summarised the history of this important textile. The first suggestion for producing artificial silk was made by Réaumur in 1734, viz., by drawing out varnish into a fine thread; but no progress was made until 1855, when Audemars nitrated cellulose, dissolved it in a mixture of alcohol and ether and drew out fine threads from the solution. The first workable nitrocellulose process was patented by Chardonnet in 1884; the threads, however, were very inflammable and subsequently the material had to be de-nitrated. In 1897 Pauly patented the use of Schweitzer's reagent, and "viscose" silk was introduced by Cross and Bevan in 1891. The most recent development is that of "acetyl" silk, which is made by treating cellulose with acetic anhydride or acetyl chloride in presence of a catalyst. The product, triacetylcellulose, is practically waterproof. Mr. Steven referred to the many attempts that have been made to produce artificial silk with a non-cellulose basis, and explained several tests to distinguish natural from artificial silks.

SOUTH WALES

A meeting of this Section was held in Cardiff on November 3, at which Prof. W. J. Jones presided and Mr. J. H. Duncan gave a paper on "The Physical Testing of Coal." The paper set out the importance of the scientific control of coal to be used for commercial purposes and emphasised the advantages of simple physical tests over the more tedious academic method of ultimate analysis. South Wales coals are so variable in composition and properties that it is most desirable that they should be blended and the mixture sold on a guarantee, which should state not only the analytical constants, such as ash, calorific power, and volatile matter, but should prescribe how such tests are to be performed. Mr. Duncan gave an account of the manner in which a cube of coal "cauliflowers" when placed in front of a muffle. The character of the "cauliflowering," taken in conjunction with the careful examination of the button of coke left after the determination of the volatile matter, affords to the practised eye most valuable indication of the way such coal will behave in a furnace. By such tests more information is afforded as to the rate of combustion and opening-out of a coal than by most elaborate ultimate analysis and chemical tests which are not desirable for commercial purposes.

In the discussion, Dr. S. Roy Illingworth specially pleaded for the more exact methods of chemical examination of coal, advocating that such tests not only afforded much more reliable information of the value and properties of a coal, but also furthered exact knowledge of its composition.

The first meeting in Swansea of this newly-constituted Section was held on November 10 in the Technical College. Capt. H. Vivian, the vice-chairman of the Section, presided, and Mr. A. Grounds read a paper on "Chemistry in Relation to Boiler-plant Efficiency."

Although the subject is one which has often been discussed before, the lecturer succeeded in putting some new points of view before the audience. Mr. Grounds emphasised that efficiency depended on (1) efficient combustion, (2) efficient transmission of the heat, and (3) retention of the heat, and he showed how different types of fuel have influenced the design of boilers. A very useful device for testing boiler-settings for air leakage was described: it consists of a lath frame one yard square covered with glazed linen, and provided with a small hole in the centre, opposite to which a lighted candle is fixed, supported on a cross-lath. When the frame is held flat against tho brickwork any leaks are at once shown up by the movement of the candle-flame. A large area may be rapidly tested by this means.

In the discussion which followed, Capt. Vivian, Messrs. F. J. Bloomer, G. A. Phillips, and E. K. Regan took part. It was emphasised that records (carbon dioxide, draught, etc.) to be of any value must be as continuous as possible, and that it is the works-chemist's duty to interpret the results obtained; the Chemical Engineering Group might well pay attention to this matter. Some American figures quoted by the lecturer were questioned by Messrs. Phillips and Regan, who agreed that such figures (showing high overload tests) are often misleading when compared with British figures, as American boilers are usually much under-rated.

YORKSHIRE

An address on " Oxidation of Oils " was delivered r Dr. L. L. Lloyd, the chairman, at the meeting ld in the Queen's Hotel, Leeds, on October 30. Oils are classified as non-drying, semi-drying and ying; but these are only relative terms, as all getable oils harden on exposure to the atmohere, the change being most probably caused by idation. The only true non-drying oils are ineral oils that have been subjected to special emical purification. The hardening of oils is not tirely due to oxidation since most oils become rder on exposure to sunlight—this change being robably due to polymerisation. It has been shown at free fatty acids in oils oxidise much more adily than the glycerides; and that when once idation has commenced, it proceeds more rapidly. he oxidation of oils may be partly prevented or duced by means of an antiseptic agent, such as tassium fluoride, such agents possibly preventing ydrolysis of the oils by bacteria or fungi, etc. In me cases oils become sticky on exposure to air, nd in this condition are very difficult to emulsify, nd consequently are deleterious in the textile ade. Many catalysts aid oxidation of oils, parcularly rust, iron, copper oxide, or copper. Oils r their fatty acids, when oxidised, are difficult to move from textile materials because their meltg-points are above the temperature at which ouring is usually carried out, and for the purpose f emulsification fluidity is an essential property.

On November 20 Mr. R. A. Mott and Mr. H. J. Iodsman read a paper on factors which influence e yield of ammonia in the carbonisation of coal, e work being a continuation of that published rlier this year (*cf.* J., 1922, 273 T). The previous aper had described the rôle of oxidation and the fluence of water vapour, but the scope of the vestigation was limited to temperatures below 00° C. This time the dissociation of ammonia in tmospheres of hydrogen, nitrogen, and coal gas as examined, especially the modification caused the presence of small proportions of oxygen and ater vapour. The latter has a very pronounced fect in restraining the decomposition of ammonia, d the remarkable observation was made that this fect was produced, though in a less degree, by ygen itself in the presence of hydrogen, possibly the water vapour formed. Even in the absence water vapour the rate of decomposition varied cording to the nature of the atmosphere. In udying the effect of contact materials it was und that well-used coke-oven brick impregnated th oxide of iron was much more active than new ebrick. This new brick was less active than the mples of coke tried. Fused silica and carbon posited from hydrocarbons were very inert.

Mr. P. Wedgwood and Mr. H. J. Hodsman read note on the determination of the volatile matter fuels. To obtain consistent results in the determation of the volatile matter in coal, it is imtant that the conditions shall be uniform. The tinum crucible is widely used in this determinan, but its cost is an obstacle to its general adopn. An effective substitute should be metallic in racter. Crucibles made from " monel " metal l iron treated with aluminium have been found sonably satisfactory. Results obtained are ally about 0·5 per cent. lower than those obned with platinum, and the crucibles are durable.

LIVERPOOL

On November 22 Mr. William Macnab delivered the Hurter Memorial Lecture in the Chemistry Lecture Theatre of the University. Dr. E. F. Armstrong presided over an audience of about one hundred, which included the Lord Mayor of Liverpool. On the motion of Dr. Armstrong it was resolved to send congratulatory letters to the chairman of the Section, Dr. G. C. Clayton, on his election to Parliament, and to Viscount Leverhulme and Sir Max Muspratt on having received " Dissolution " honours.

The late war produced a demand for enormous amounts of various explosives and chemicals, which led to the Government erecting many factories to supplement the output of private factories. The production of explosives in this country during the war period was:—Picric acid, 68,500 tons; TNT, 238,000 t.; ammonium nitrate, 378,000 t.; and cordite, 139,000 t. Toluene was in great demand for making TNT. A large distillery for handling the Borneo petroleum, which contains toluene and other aromatic hydrocarbons, was transferred from Holland to England, thus providing a valuable source of supply. Large works were erected at Oldbury and Queen's Ferry, the latter being able to produce 100 tons of TNT per day. Considerable quantities of synthetic phenol were produced from benzene, thus increasing the amount of picric acid which could be made. Great improvements were ultimately effected in the manufacture of picric acid. The output of sulphuric acid, as oleum, was increased enormously, the largest amount coming from Grillo plants. Cordite was also produced in large quantities, Gretna alone having a capacity of 1000 tons a week. The use of ammonium nitrate, mixed with TNT, as a filling charge for shells, led to a great development of its production; the largest amount was made by double decomposition of sodium nitrate and ammonium sulphate; a fine instance of the successful application of the phase rule.

In France, working under difficult conditions, owing to so many factories being in the hands of the enemy, remarkable efforts were put forth and splendid results achieved. Picric acid being the explosive most prized for French shells, and the supply of coal-tar phenol being totally inadequate, recourse was had to the manufacture of synthetic phenol from benzene. This manufacture developed until 200 tons a day was produced. The sulphonation of benzene in the form of vapour was carried out on the largest scale and proved a great advance on the old process. The production of propellent powder reached 370 tons per day. About 100 tons a day of nitrogen peroxide was made and used as chief ingredient in the explosive " anilite " employed in aeroplane bombs. Large works were erected for producing nitric acid from atmospheric nitrogen by the arc process; also from cyanamide and by the Kulhmann-Ostwald process. When the submarine menace was at its worst arrangements were made for erecting additional plants to produce 500 tons of nitric acid and 150 tons of ammonium nitrate per day. At the time of the armistice some of these factories had begun to manufacture and the others were nearly completed. In this branch of chemical industry the French got much ahead of us, and still remain far in advance.

Both nations, France and England, may well be proud of their achievements in chemical industry.

In both countries, and also in America, this industry received a great stimulus during the war, and keener competition must now be expected from France and America, as well as from Germany.

We need more men like Hurter in our chemical industry. He may well serve as a splendid ideal for all of us. It is earnestly to be desired that professors and manufacturers who got to know one another better during the war—and others who are interested—will co-operate cordially in developing the best means of educating men who will be able to conduct our chemical industry in the most efficient and progressive manner, and thus enable all competition to be met successfully.

CHEMICAL ENGINEERING GROUP

The first of a series of papers to be given in London was read by Prof. J. W. Hinchley in the Chemical Industry Club on November 10, Mr. J. Arthur Reavell, chairman of the Group, presiding. Prof. Hinchley dealt with "The Dewatering of Peat by Pressure," and showed that much more water could be removed from peat by hot pressing than by applying nearly double the pressure in the cold. Views were shown of presses invented by the author for carrying out the hot pressing of peat, the heating being effected by blowing steam through the peat whilst in the press. By this means the author has found it possible to obtain a peat which on leaving the press contains from 57 to 45 per cent. of water, according to the nature of the peat treated. A further reduction of moisture is obtained by placing this pressed peat in a tunnel which is heated by waste gases from the furnace of the boiler required to generate the steam used in the press. A careful estimate of the cost of the process was submitted in which it was shown that the amount of dried peat consumed in the boiler furnace to generate the steam required for pressing was 25 per cent. of the peat pressed, and that the cost of this method of pressing varied from 17s. 6d. per ton in the case of a one-press plant to slightly less than 4s. 6d. per ton in a ten-press plant, and that it would be possible to sell dried peat at the factory at 15s. per ton.

The paper was followed by a discussion opened by Dr. R. Lessing, who asked what material was used as the filtering medium and if the chemical composition of the extruded water had been investigated. He also mentioned that some interesting work had recently been done in Norway on the composition of peat. Mr. P. Parrish inquired if the type of press described would be suitable for pressing the very friable peat found at Morwell in Australia. Mr. G. Radcliffe mentioned the preserving properties of peat and gave some interesting details of work which he had carried out on Irish peat. The possibility of using this type of press to de-water sewage sludge was raised by another speaker, and Mr. A. J. Broughall asked if vacuum drying was applicable, and if any consideration had been given to the presence of air bubbles on the edge of the cake, since these might retard the flow of water from the interior. The chairman mentioned the difficulty of obtaining equal pressure all over the cake and stated that a press had recently been invented to overcome this difficulty, and that some remarkable results had been obtained. In his reply Prof. Hinchley said that the question of securing a uniform pressure was worth consideration; he had found a pressure of 500 lb. per sq. in. to be the most economical. The sides of the press consisted of tinned steel-wire gauze, which constituted the filtering surface. Most of his experiments had been made with peat from a depth of 3—8 ft., and for several reasons it was not desirable to utilise the lowest layer. He had not experimented with Morwell peat; and he did not think that the application of the centrifuge would afford a solution of the problem.

MEETINGS OF OTHER SOCIETIES

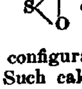
INSTITUTION OF RUBBER INDUSTRY

A meeting was held on November 6 in t Engineers' Club, London, at which Dr. H. Stevens read a paper on "Recent Developments the Plantation Industry." The author dealt wi the methods of tapping, collecting and standard ing the latex, preparing the rubber in sheet crêpe form, drying, milling, packing and transpo

The basic modes of preparing rubber are esse tially the same as those adopted by the pionee 20 years ago. It is now recognised that t severity of tapping affects the composition of t latex, and the intensive system is being replac by tapping on alternate days or even or at le frequent intervals, *e.g.*, every four months. Lat is now collected in glass, glazed earthenware, aluminium cups, instead of in tin cups and cocon shells, and sodium sulphite (1 part to 500 or 10 of latex) is added to prevent coagulation befo the latex is strained. Acetic acid is used coagulant, the latex having been previously bulk and diluted in large tanks (small pans, if crê is to be made) in order to secure a product unifor in appearance and properties; usually the latex diluted to a rubber content of 1·5 to 2 lb. p gallon. The rubber content of the latex is dete mined in the following way: the specific gravity ascertained by means of a special form of hydr meter, and the rubber-content is found by consul ing a graph showing the relation of the averag rubber-content of the latex to the specific gravit inaccurate results are obtained, however, if t latex shows any sign of pre-coagulation or thicke ing. Various improvements have been made in t houses used for smoking sheet rubber, mainly the direction of providing increased accessibilit continuous working, and reducing the time treatment. There has been no change in t method of preparing blanket crêpe, except that Ceylon, hot-air or vacuum driers are frequent employed, drying in ventilated sheds being used the Federated Malay States. For making thi crêpe, hot-air driers are now in use in the Mal States, as air-dried crêpe is hard and cannot milled readily into blanket crêpe. Great care taken to ensure that the rubber is dry befo packing, but sheet rubber often shows traces mould on arrival in Europe, owing to the presen in the rubber of water-soluble organic substance particularly *l*-methylinositol, which is hygroscopi Most of the impurities found in rubber by t manufacturer are due solely to contaminatio during unpacking, sampling and repacking, rubber usually does not contain grit or dirt wh packed.

THE PHYSICAL SOCIETY

At the meeting held on November 9, a paper on "The Structure of the Sulphur Dioxide Molecule" was submitted by Prof. A. O. Rankine and Mr. C. J. Smith. Viscosity data indicate that the actual mean collision area of the sulphur dioxide molecule is $0 \cdot 94 \times 10^{-15}$ sq. cm. Modern atomic theory leads to the conclusion that, in combination, oxygen atoms simulate neon atoms in size and shape, whilst sulphur atoms simulate argon atoms. The values of the mean collision areas of neon and argon are known from viscosity data, and the distances between the centres of atoms in combination are known from the crystal measurements of W. L. Bragg. It is thus possible to calculate the respective values of the mean collision area of the sulphur dioxide molecule, according as the molecular configuration is either



or O=S—O

the latter configuration being suggested by Langmuir. Such calculation decides definitely in favour of the first structural formula, the respective calculated values being $0 \cdot 99 \times 10^{-15}$ sq. cm. and approximately $1 \cdot 08 \times 10^{-15}$ sq. cm.

In a paper on "The Thermal Effect of Vapours on Rubber," Mr. A. S. Houghton described briefly the heating effect produced when rubber is suddenly plunged into the vapours of chloroform, benzene, toluene, ether, water, and gases such as ammonia and carbon dioxide. It is probable that only part of the heat evolved is due to condensation of vapour on the rubber, the remainder originating in the formation of a compound or solid solution of a loose nature between the vapour and rubber.

Mr. J. T. Robin described and demonstrated an apparatus for determining the tensile strength of gas mantles. The method adopted is an application of Archimedes' principle, whereby owing to the gradual fall of level of water in a cylindrical tube in which a float is immersed, a gradually and continuously increasing load is applied to the "burnt-off" fabric of the mantle under test, until fracture of the mantle results. The value of the applied load at the moment of fracture of the mantle is read on a scale approximately calibrated.

THE CHEMICAL SOCIETY

Prof. J. F. Thorpe presided at the ordinary scientific meeting held in Burlington House, W., on November 2. There was a very good attendance, and a large number of papers was scheduled to be read. These were:—

The solubility and volatility of the nitrobenzaldehydes: N. V. Sidgwick and W. M. Dash; Investigations on the dependence of rotatory power on chemical constitution. Part XIII. The spatial configuration of the unbranched aliphatic chain: R. H. Pickard, J. Kenyon, and H. Hunter; Investigations on the dependence of rotatory power on chemical constitution. Part XIV. The normal aliphatic ethers of *d*-*β*-octanol: J. Kenyon and R. A. McNicol; Investigations on the dependence of rotatory power on chemical constitution. Part XV. The normal aliphatic ethers of *d*-methylbenzylcarbinol. Part XVI. A new type of Walden inversion: H. Phillips; Investigations on the dependence of rotatory power on chemical constitution. Part XVII. The di-*d*-*β*-octyl esters of the acids of the general formula $(CH_2)_n(COOH)_2$: L. Hall; Orientation of the 1:4- and 1:5-dimethylglyoxalines. Mode of fission of 5-aminoglyoxalines: F. L. Pyman; Bromo-derivatives of 2-methylglyoxaline: L. Light and F. L. Pyman; 2:5 iminodihydro 1:2:3 triazole. Part I. Constitution of Dimroth's 5-anilidotriazole: P. K. Dutt.

The papers, each of which dealt with particular instances of more general investigations, were presented, respectively, by Dr. Sidgwick, Dr. Pickard, Mr. Phillips, Prof. Pyman, and Mr. P. K. Dutt. An informal meeting was held on Thursday, November 16.

BRITISH ASSOCIATION OF CHEMISTS

The fifth annual meeting was held on October 28, Mr. W. E. Kay presiding in the absence, through illness, of the president, Prof. J. W. Hinchley.

The annual report of the Council refers to a decrease in membership; there are now 1095 members, compared with a nominal roll of 1344 at the commencement of the year. The adverse balance of £43 on the year's working would have been larger but for the response to the Council's appeal for supplementary donations. Accordingly, after considerable discussion, a resolution was carried at the annual meeting to raise the subscription to 30s. The report refers to the effect of the continued depression in trade on the activities of the Association, and particularly on the work of the Appointments Bureau. Nevertheless, the Council has been able to institute an Unemployment Benefit Fund, subscription to which is obligatory on all members holding salaried appointments. The Legal Aid Fund continues to help members in regard to service agreements, etc., and in securing rebate from income-tax for professional expenses. Negotiations have been carried on with the National Union of Scientific Workers with a view to closer co-operation or amalgamation, and two joint council meetings have been held for the discussion of common policy and activities. The Council has also considered the question of terminating the "B" qualification for membership of the Association, legal re-definition of the term "chemist" and other matters affecting the status and professional efficiency of the chemist. The Association is registered under the Trade Union Acts and membership is open to both employers and employees.

Speaking at the annual dinner, Dr. H. Levinstein, the new president, said that, with adequate organisation, the Association could be made to include practically all the chemists in the country, as did the Institute of Chemistry, whose functions were complementary to those of the Association. The chief, but a very great, difference between an ordinary trade union and a trade union of chemists was that the employers of chemists were just as interested in raising the status of chemistry as the chemist himself. Collective bargaining to secure minimum fees or salaries was, he believed, a retrogression rather than an advance, but such questions as the stabilisation of remuneration and rewards for patents could readily be discussed with a body of employers like the Association of British Chemical Manufacturers, and educational matters with university authorities. Dr. E. F. Armstrong also spoke.

NEWS AND NOTES

BRITISH INDIA

Tata Oil Mills

The Times Trade Supplement for November 11, 1922, publishes an abstract from the report of the Tata Oil Co., which shows that for the fifteen months ended March 31, 1922, a loss of Rs. 14 lahks was incurred. A report issued by the company in 1921 disclosed a loss of Rs. 20 lahks. The directors put forward several reasons for these heavy losses, including the collapse of the overseas markets since the mill started work, making it impossible to operate either continuously or at full capacity; the heavy fall in the price of coconut oil from £121 in 1920 to £37 in August, 1922; and particularly, the heavy duties which America has imposed against all foreign oils in favour of similar oils from "its own colonies"—presumably the Philippines—for it was hoped to dispose of much of the output of the mills in America.

The position in which this company finds itself, after less than two years of actual operation, stands out in vivid contrast to the situation in India during the amazing boom period of 1919-1920. In Bombay particularly, the name "Tata" at the head of a new company-prospectus was sufficient in the eyes of the Indian speculator to render ordinary shares—perhaps not unjustifiably—equivalent to gilt-edged securities. In the spring of 1920, before the oil mills had produced a single ounce of coconut oil, the original Rs. 100 shares of the company stood at Rs. 600, and probably no other newly-founded Indian industrial concern attracted so much interest or was launched with greater confidence in its future.

The policy underlying the formation of the Tata Oil Mills Company is characteristic of the Tata group of capitalists, namely, to develop manufactures as far as possible in India itself instead of acting merely as trading concerns engaged in the collection and export of raw material. The Malabar Coast region, which is one of the finest coconut-producing areas in the world, offered a particularly attractive field for new enterprise. Before the war the whole output of copra, apart from the relatively small proportion consumed locally, was exported, chiefly to Europe. In 1914 about 38,000 tons was shipped, and of this amount 75 per cent. was taken by Germany. The only crushing plant in the Malabar country consisted of the primitive native chuck-mills and a few small steam-driven mills constructed on the same principle.

The Tata Mill was erected at Enakulam, on the Cochin Creek, a particularly advantageous site, since it lies in direct communication with the sea and with the long line of backwaters which stretch north and south throughout the coconut area and afford very cheap means of transport for copra and other coconut products. The Government intends to construct a harbour at Cochin which will allow the products of the Mill to be loaded directly on to the ship; at present the Malabar coast possesses no harbour, and the cost of intermediate transport is a considerable disadvantage for traders in that region. Enakulam is also connected by rail with all parts of India.

The mill was equipped entirely with American plant and was erected under the supervision of American engineers who had had experience in the Philippines, where the copra-crushing industry has been developed with marked success. The capacity of the factory is about 100 tons of copra per day. The present writer, in the course of a visit to the Malabar coast during 1920, was particularly struck by the interest shown in the new enterprise on the part of the native population, which certainly looked forward to an era of prosperity as a result of this development of an industry on which it depends almost entirely for a livelihood.

In view of the resources of Malabar in respect of coconut products, the unique combination of advantages which the situation of the mill affords, and the fact that the company is controlled by a group of men who have shown remarkable business acumen and foresight hitherto, it is difficult to believe that the present unfavourable position of the company can be other than temporary.

Crop Forecasts.

Groundnuts and Sesamum.—Reports received from provinces comprising 99 per cent. of the area under groundnuts in British India indicate that the acreage under the crop has increased by 24 per cent. to 1,846,000 acres (first forecast). The second forecast of the sesamum crop sown in provinces containing 99·6 per cent. of the total area under th crop (including Burma, but excluding the "mixed" crop in the United Provinces and the late crop i Bengal and Madras) gives the area sown as 3,432,00 acres; excluding Burma, the estimated area i 2,595,000 acres, or 4 per cent. below the corresponding estimate of last year. The present conditio and prospects of the sesamum crop are reported t be good.

Sugar-cane.—The second forecast of the are under sugar-cane estimates the acreage under th crop at 2,460,000, a decrease of 1 per cent. compared with the estimate at the same time last yea and an increase of 3 per cent. over the final estimat of last year. In general the condition of the cro is good. The forecast relates to provinces contai ing 99 per cent. of the total area under sugar-ca in British India.—(*Ind. Tr. J., Nov.* 2, 1922.)

AUSTRALIA

Beet-Sugar in Victoria

During 1921-22 the State beet-sugar factory Maffra, Gippsland, treated 16,578 tons of sugar-be from 1500 acres, and produced 1872 t. of sugar. T average sugar content was 11·3 per cent., and 8·55 of beet yielded 1 ton of sugar, as compared wi 9·745 t. in 1918-19 and 12·348 t. in 1910-11. F each ton of clean beet 45s. was paid, and after allo ing for interest and depreciation the year's worki showed a profit of £9920. New machinery is to installed in the factory which will more than dou its capacity and ensure more economical worki It is anticipated that the beet crop will also doubled, especially as the Glenmaggie system irrigation renders the growers independent of rainfall to a large extent. Compared with the c sumption of sugar in Victoria—approximat 75,000 t.—the output of the factory is small, but industry offers prospects of extension, as the c of production is about the same as that of ca and the sugar content is gradually improving (*Ind. Austr., Aug.* 31, 1922.)

FRANCE

Industrial Notes

Chemical Industry.—In the *Revue Scientifique* for October 28, Professors Béhal, Haller and Moureu review the present position of the French chemical industry, and especially the organic-chemical industry, in relation to the general economic crisis. Chemical manufacture in France, particularly that of organic products, is declining gradually to the pre-war level owing to the severe German competition made possible by the depre-ciation in value of the mark. For this reason the difference between German and French cost prices is so great that many French factories are con-emplating closure unless assistance is obtained. Apart from the advantage due to depreciated cur-ency, production costs are lower in Germany because almost all the raw materials of chemical -dustry are produced locally, and the factories tside the war-zone are of recent date and magnifi-ntly equipped. In France, however, labour and w materials cost ten times as much; in certain eas the plant has been destroyed or damaged, d the remainder has to be brought up to date. e French industry is protected by a heavy tariff all, but this can be evaded either by false clarations of origin or by having the material ansformed in a foreign country before it is im-orted into France. This state of affairs appears l the more deplorable in view of the great strides ade by France during the war to become self-upporting in respect of supplies of organic hemicals. At present France can not only meet he home demand for pharmaceutical and photo-raphic chemicals, and synthetic perfumes, but is roducing 85 per cent. of the requirements in dyes nd intermediates. In addition, well-equipped search laboratories have been established, and the ourses in the various schools of chemistry have en attended by large numbers of students, but, nhappily, these cannot find employment, and eir distress does not encourage others to follow e profession. The authors appeal to the Govern-ent to act before it is too late by initiating a rict control over imports of organic chemicals. hey emphasise the commanding position held by emical industry in the life of every nation, and oint out the grave error committed in certain arters of seeking a temporary advantage by ading with Germany, instead of supporting the tional industry.

A proposal has been made to establish a Cellulose search Institute, comprising an intelligence partment, provided with all the relevant litera-re, and five research laboratories for investi-ting the preparation of cellulose, bleaching and eing cellulose and artificial silk, production of ificial silk for preparing nitrocellulose, cellulose tates and formates, aeroplane "dope," and the t for research on the manufacture of celluloid. ch an institute would be of value to the French nies, as great interest is now being taken in lising "alfa" from North Africa and similar nial products.

etallurgy.—Production remains good in the ious mining areas, except near the Pyrenees. Normandy and Anjou, manufacturers are find-new markets in England and Germany, and ortant contracts are being considered. Home sumption is progressing, and if supplies of man coke were steadier, more blast furnaces could be blown in. Generally, the metallurgical situation remains unaltered, but with a slight tendency to diminished consumption.

An important meeting has been held by the *Conseil Supérieur* recently formed to co-ordinate all railway transport, and the question of revising railway rates was discussed. A reduction of these rates is held to be long overdue. At present most of the metallurgical firms near the eastern frontier find it cheaper to export their products *viâ* Holland and Belgium. Recently a railway company had a consignment of rails made in Belgium shipped to an Atlantic port, rather than transport it by land over the French Eastern Railway.

UNITED STATES

"Journal of Physical Chemistry"

As previously announced, the above-named journal is to be published under the joint auspices of the American Chemical Society, the Chemical Society of London, and the Faraday Society, and the following chemists have now been appointed to the editorial board:—Professors T. M. Lowry, J. W. McBain, and J. C. Philip (Chemical Society of London); Prof. F. G. Donnan (Faraday Society); Dr. A. L. Day, Prof. G. A. Hulett, Dr. Irving Langmuir, and Prof. W. Lash Miller (American Chemical Society). The board will shortly elect an editor-in-chief.

The Perkin Medal, 1923

Dr. M. C. Whitaker, the next recipient of the Perkin Medal (*cf.* p. 512 R of this issue) was chairman of the New York Section of this Society in 1922, and president of the American Institute of Chemical Engineers from 1914 to 1916. In 1914 he organised the Department of Chemical Engineering at Columbia University and became its head. During his management of the Welsbach Company's factory, from 1903 to 1910, the output of the plant was more than doubled and the cost reduced by more than one-half. In 1916 Dr. Whitaker became manager, and in 1917 president, of the Curtis Bay Chemical Co., now the U.S. Industrial Chemical Co., which at that time made only acetone; now it is the largest producer in the United States of alcohol motor fuel, absolute alcohol, normal and iso-propyl alcohols, isobutyl alcohol, diethyl phthalate and many other fine chemicals. Eight of this company's products are made by new processes which have been worked out and put into operation under Dr. Whitaker's direction.

Chemists in American Public Life

A survey was recently made of the part that chemists play in the public life of their communities in America. On the whole it showed a general tendency among chemists to take interest only in such affairs as concern their personal welfare, and that few chemists are office holders. In one western city, Tacoma, Wash., a chemical club formed a committee to co-operate in civic affairs; but there is one city in Michigan, the seat of a large chemical industry, that is a truly chemical city. Only fifty-five out of its population of 5500, or 1 per cent. are chemists, but in spite of this proportion the chemists have this record: For six years, the mayor and three out of eight aldermen have been chemists; one chemist is on the school board; ten are in the Chamber of Commerce; and sixteen in the Kiwanis

Club, a "better community" organisation. There is one real chemist in the United States Senate, viz., Dr. Edwin F. Ladd, the junior senator from North Dakota. He has been active in the chemical laboratory for thirty-six years and as chief chemist of North Dakota for twenty years he waged a winning fight for pure foods and materials. During this work of law enforcement he learned the ways of legislation and legislatures. He is particularly interested in urging in the Senate such measures as those providing for the adoption of the metric system, the compulsory working of patents, and the setting up of purity standards for paints.

Storage of Portland Cement

The U.S. Bureau of Mines, in studying the storage and transportation of Portland cement, has found that, owing to the smaller area exposed, the cement stored in bulk deteriorates less than when stored in bags, hydration taking place only on the exposed surface. Cement transported in bulk must be shipped in a tightly closed car, and must be protected from moisture during loading, shipping, and unloading. This method of transport dispenses with the use of the costly bags and permits a saving in freight rates in the United States.

Gasoline Consumption by Motor Cars

In the October issue of the *Journal of Industrial and Engineering Chemistry*, Prof. G. G. Brown, of the University of Michigan, asks: "Can we afford the Ford?" He declares that his researches have shown that the Ford automobile touring car, driven under average conditions, runs not more than 17·5 miles per gallon of gasoline and that it should give 24 miles per gallon. One cause for this inefficiency is the present carburetting system, which can be so improved that the average Ford car will give 25 miles per gallon and operate as economically as more expensive cars. Of the 11 million motor vehicles in the United States about 5 million are Fords, which, it is estimated, consume one-fourth of the total gasoline production of the country. If a chemically controlled carburettor, such as that designed by Prof. Brown, were used, 400 million galls. of gasoline, worth $100,000,000, would be saved annually. Mr. Ford could buy a Muscle Shoals every 18 days with the savings made by improving the carburetting system on his cars.

CANADA

Pulp and Paper

President Dodge, of the International Paper Co. of America, stated recently that many of the company's mills in the United States would eventually be converted into power plants. This statement may be regarded as a forecast of the possible disappearance of the U.S. newsprint manufacturing industry in the face of Canadian competition, assisted by the continued rapid depletion of pulpwood supplies in the Eastern United States. The total production of newsprint in the States during 1920 was 1,511,000 tons, whilst 15 mills in Canada have a present capacity of over one million tons. The development of the pulp and paper industry in Canada is exceedingly interesting. In 1891 the exports were valued at $120, and in 1921 at $163,655,344. During the last decade the increase in value of exports has been very marked: in 1912, $8,980,184; 1915, $27,107,697; 1920, $104,[illegible]5,388.

Petroleum

The tar sands of Alberta are occupying much attention, but it is quite clear that many of the proposed methods of utilisation are not economic. The latest method is one developed by the research department of the University of Alberta. The press account of the process, which is all the information available at present, is not sufficiently explicit to justify the expression of any opinion regarding its practicability.

The chief interest in petroleum development in Canada is now concentrated in the Sweetgrass District of Southern Alberta, where, owing to the strikes across the line in Montana, many wells are being drilled. Coutts, a small town south of Lethbridge, is the centre. Many prospectors from Texas, Wyoming, Louisiana, California and other parts of the States are operating in this district, but the latest arrivals include representatives of British financial interests. Many wells are being sunk; the deepest is down 2100 ft., but oil is not expected above 2500 ft. The Imperial Oil Co., Ltd., is drilling six wells in Alberta, but, so far, no useful discovery has been made. The well at Pouce Coupe is down 2612 ft., and there is a flow of 10 million cb. ft. of gas a day. The Fabyan well, at 2600 ft., has also a strong flow of gas. The others are barren of results. Drilling is being continued in the Fort Norman district, on the Mackenzie River.

RUSSIA

Pharmaceutical Chemicals

In June, 1922, eight factories were producing pharmaceutical chemicals, and the intended output was realised. The output included 826 cwt. of medicinal preparations, 514 cwt. of disinfectants, 185 cwt. of soap, and 391 cwt. of various preparations. Production, especially that of ether, is much hindered by the duty levied on alcohol.

Metalliferous Mining in 1922

Ore-mining in Russia is in a bad condition. Even in the Krivoy-Rog, formerly the greatest ore-producing region, only three mines are working, with a monthly output of 11,700 long tons, which is a poor figure compared with pre-war production. Stocks in hand amount to 1,354,000 tons, largely remaining from pre-Bolshevist days. Although production was continued during the first years of Soviet rule in the Tula and Kaluga district, it was stopped last winter and only just recently have steps been taken with a view to resumption. The production achieved has not been large, as this district, like that of Krivoy and also Lipetsk, is in a state of "technical conservation," probably a Bolshevist euphemism for a state of decay. In the Oka district only the Tischinsk mines are at work, the May production being 161 tons.

Production is better in the Ural region, where the Tinchinsk mines have a monthly output of 3609 tons, which is 12 per cent. more than the estimate. The Bakalsk mines have the next largest output with 1873 tons, or 73 per cent. of that anticipated.

The Nikopol manganese mines produced in May 2323 tons of ore, *i.e.*, 57 per cent. of the estimated amount. Stocks of manganese ores amount to 137,000 tons. Copper-mining has been practically at a standstill since 1918, and only recently have fforts been made to revive it; during this year the roduction has been 2705 tons. The most important zinc and lead mines are at Alagir, in the Caucasus, where in 1920 and 1921 about 600 tons f lead and 200 tons of zinc were produced. The iberian zinc and lead works are not yet completed. The winning of asbestos has been carried n by the recently formed trust, "Ural Asbestos." This year's production amounts to 1496 tons, and tocks in hand to 16,000 tons.—(*Prawda* [*Moscow*], *No.* 184, 1922.)

GERMANY

"Reparation" Dyestuffs

The dyestuffs delivered by Germany under the Treaty of Versailles up to May 1, 1921, were valued at 32,476,000 gold marks and from that date to June 30, 1922, at 10,708,000 gold marks. Deliveries were distributed as follows:—

	To May 1, 1921	May 1, 1921—June 30, 1922	Per cent. of total
	1000's of gold marks		
Belgium	2,949	3,221	14·3
British Empire	8,499	1,696	23·6
France	9,251	2,006	26·0
Greece	—	196	0·5
Italy	9,124	3,589	24·9
Japan	2,630	—	6·1
Yugoslavia	23	—	0·1

In addition to the above deliveries, dyestuffs valued at 4 million gold marks were sold to the Textile Alliance of the United States through the Reparation Commission, which also re-sold dyestuffs valued at 3 million gold marks to German buyers.—(*U.S. Com. Rep.*, *Oct.* 23, 1922.)

Denatured Spirit for Medicinal Use

In reply to a petition, presented by representatives of the hospitals, for a reduction in the price of spirit, the Prussian Ministry of Welfare (*Volkswohlfahrt*) stated that the price for use in public hospitals would be reduced by means of a yearly grant not exceeding 40 million marks from the alcohol-monopoly tax, but that the mode of distributing the grant had not been decided. For many purposes, such as disinfecting and dressings, hospitals could economise by substituting a suitably denatured spirit for pure spirit. It was proposed to make available a cheap spirit denatured with diethyl phthalate, which possessed such a bitter taste that it could not be taken internally, although it could be used safely for disinfecting the skin and in preparing alcoholic medicaments for external application.—(*Chem. Ind.*, *Sept.* 25, 1922.)

Acetic Acid and Industrial Alcohol

Official statistics record that in 1920 acetic acid was manufactured in twenty factories, of which eleven utilised acetate of lime as raw material, five calcium carbide, one pyroligneous acid, and three various other raw materials. Industrial alcohol was made in only four factories, the output of 668 metric tons comparing with 8 t. from five factories in 1919 and 109·7 t. from eight factories in 1914. The great increase in 1920 was due to the renewal of demand from industries using alcohol whose production had been restricted during and after the war. The industrial use of undenatured acetic acid has also greatly increased; figures of production have not yet been issued. Prices of acetic acid rose from 90 to 105 marks per quintal for 80 per cent. acid in 1913 to 600—1800 mk. per quintal for 80 to 100 per cent. acid in 1920.—(*Chem. Ind.*, *Oct.* 2, 1922.)

The Production of Gas and Crude Tar from Lignite

In No. 243 of the "Forschungsarbeiten auf dem Gebiete des Ingenieurwesens," Hilliger and Wurm record the results of a number of tests carried out to discover an economical process for the production of gas and tar from lignite. The results show that in the present position of the distillation process and with the present price-ratio for lignite and lignite tar, direct distillation affords an economical method of utilising lignite.

Cement from Blast-furnace Slags

Unsuccessful attempts to convert acid blast-furnace slags into cement by fusing them with lime have been made for some time past. The increasing scarcity of building materials and the production of very large quantities of the slag have once again turned the attention of chemists to the problem of its utilisation, and two processes have been developed which have given promising results. Wennerstrom's method consists in heating by electrical means the slag with lime in a graphite-lined circular furnace, whereas R. Grün first converts the slag into a basic compound by adding alumina to the charge either before, or simultaneously with, the lime. The alumina reduces the melting point of the mixture and enables it to take up more lime. The resulting product when finely ground with clinker makes a good cement.

GENERAL

The British Empire Exhibition, 1924

Active preparations are being made for this Exhibition, which will be held in Wembley Park, London, from April to October, 1924. As the title implies, the function of the Exhibition will be to bring together all parts of the Empire: to bring markets to producers, and goods to buyers. The whole Empire will be represented at Wembley, and the space already booked by Greater Britain is nearly seven times that which it occupied at the exhibition held in the White City in 1908. Wembley Park, it may be remarked, is within 10 minutes ride by railway from Baker Street and Marylebone, and there are 126 railway stations within the London area from which the Exhibition may be reached in an average time of 18 minutes. Exhibits will be arranged in 10 sections, 45 groups, and 150 classes. All raw materials and manufactured goods to be shown must have been produced within the Empire, and applications for floor space must be in the hands of the General Manager (16, Hobart Place, London, S.W. 1) by December 30, 1922. The chemical exhibits will be displayed in Section E, Manufactures: Group XXVI, Chemical Industries, Dyestuffs and Perfumery; other materials of interest to chemists will be shown in the same section under Group XXIII, Metal Industries; Group XXIV, Textiles; Group XXIX, Miscellaneous Industries (including pottery and glass, oilseed products, and rubber). Plant and apparatus used in the chemical industry will be shown in Section D, Machinery and Implements, Group XX. The organisation of the sections covering chemistry, pure and applied, has been entrusted to the Association of British Chemical Manufacturers, with which the Society of Chemical Industry is cooperating actively. Members of the Society are invited to visit Wembley Park to inspect the grounds and the buildings in course of erection, but for this purpose they must first obtain tickets from the General Secretary at Central House.

PERSONALIA

Sir Robert Robertson has been elected president of the Faraday Society.

Mr. D. H. Peacock has been appointed professor of chemistry in the University of Rangoon.

Dr. F. Gianformaggio has been appointed professor of chemistry in the Technical Institute, Syracuse.

Dr. P. Fischer has succeeded Dr. Agde in the chair of chemical technology in the Polytechnic at Cöthen, Germany.

The Perkin Medal of the American Section of this Society has been awarded to Mr. Milton C. Whitaker, vice-president and manager of the U.S. Industrial Alcohol Co., and will be presented to him on January 12, 1923.

Prof. M. Bodenstein has been invited to accept the chair of physical chemistry in the University of Berlin, held formerly by Prof. W. Nernst, who is now president of the Physikalisch-Technisch Reichsanstalt and honorary professor in the University.

Mr. W. B. Wiegand, M.A., of Montreal, chairman of the Rubber Division of the American Chemical Society, has been appointed general manager of Ames-Holden-McCready, Ltd., large manufacturers of tyres and other rubber goods.

Prof. G. T. Morgan, professor of chemistry in the University of Birmingham, has been awarded the Research Medal of the Dyers' Company for his paper on "The Co-ordination Theory of Valency in relation to Adjective Dyeing," which was read last year before the Society of Dyers and Colourists.

The honours bestowed on the occasion of the resignation of the Ministry include a viscounty to Lord Leverhulme, for public services, and a baronetcy to Alderman Max Muspratt, chairman of the United Alkali Co., Lord Mayor of Liverpool, 1916–17, who rendered great service during war in trench warfare.

The following were among those elected members of the House of Commons at the General Election, held on November 15—16:—Major W. A. Bowdler, of Church, Accrington (Holderness, Yorks, East Riding); Dr. G. C. Clayton, a director of the United Alkali Co. (Widnes); Mr. C. S. Garland (South Islington); and Sir Alfred Mond (Swansea West). The unsuccessful candidates included:—Sir John Brunner, Bt.; Major A. G. Church (secretary, National Union of Scientific Workers); Sir William Pearce; and the Rt. Hon. J. W. Wilson. Mr. W. J. U. Woolcock, general manager of the Association of British Chemical Manufacturers, and Col. Sir Edward Brotherton did not seek re-election.

* * *

We regret to note the death, on November 26, of Mr. Harry J. Powell, late of the Whitefriars Glass Works, in his 70th. year.

Dr. H. Larouche, director of the Civic Laboratory and assistant professor of chemistry in the University of Montreal, died suddenly on August 16, aged 33 years.

The death is reported of L. Tschugaeff, professor of inorganic chemistry in the University of Petrograd, from typhus fever, at the age of 50 years. The deceased is, perhaps, best known for his discovery of the method of determining nickel with dimethylglyoxime.

REPORTS

Reports on Cinchona Bark [and Myrobalans]. *Reports of the Indian Trade Inquiry, Imperial Institute. Pp.* 59. *London: John Murray,* 1922. *Price 4s. net.*

Cinchona was introduced into tropical British possessions about 1860, and within twenty-five years Ceylon became the chief source of supply of the bark, yet at the present time Java produces annually about 23 million lb. of bark, or about 90 per cent. of the world's supply, whilst the production in India is only about 2 million lb. (4 million lb. in 1899—1900) and that of other countries about 400,000 lb. Although "druggists' bark" is exported from India, most of the Indian-grown bark is worked up for quinine factories; further, as all of the quinine produced is used in India and both bark and quinine are imported, India cannot be regarded as an immediate source of exports of cinchona bark for quinine manufacture. In fact, to quote the words of the report, "The most striking feature of the trade in cinchona bark is therefore the virtual monopoly held by Java; a monopoly which, moreover, has been secured at the expense of Ceylon and India, and which makes the British Empire ultimately dependent on a foreign country for the raw material from which the essential drug quinine is made."

This position is obviously serious, especially when the hazards of war are taken into account, and when it is realised that the Empire requires an annual supply of about 8 million oz. of quinine, equivalent to about 8¼ million lb. of bark of average Java quality.

The position is complicated further by various agreements made between Java planters and manufacturers of quinine; although full details of these arrangements have, apparently, never been made public, the present agreement—which remains in force until July, 1923—affects only quinine manufacturers in Java and Holland who have agreed to take bark equivalent to 575,000 kg. of quinine sulphate annually, which was the quantity allocated under an earlier agreement to quinine manufacturers throughout the world. Whether quinine manufacturers in other countries will be able to obtain supplies of bark is uncertain, though it is stated that the single quinine factory in this country "has been partially safeguarded by an arrangement made, it is understood, at the suggestion of H.M. Government," under which supplies will be obtained during the next ten years from British-owned plantations in Java which are not now parties to the contract, and which have an estimated output of about 9 per cent. of the total for Java. Certain Dutch plantations in Java are also said to be standing out of the contract and to have arranged to supply bark to Japan, where quinine manufacture was started after the commencement of the war. According to Lt.-Col. A. T. Gage, I.M.S. (*Rept. Extension Cinchona Cultiv. in India*), large extension of cinchona in the areas in India where it is already grown is not possible, but other areas are suitable, *e.g.*, in Northern Tavoy, Burma. In British Malaya also it seems that cinchona might be grown successfully, as the trees on 20 acres planted with *Cinchona succirubra* and *C. Ledgeriana* at Gunong Angsi, Negri Sembilan, in 1914 were making excellent growth three years later. The question of establishing plantations is being considered by the F.M.S. Government, and areas of suitable land have been reserved pending a decision.

Reports on a number of samples of bark from St. Helena, the Cameroons, and the Tanganyika Territory, examined at the Imperial Institute and submitted to brokers and to manufacturers of quinine, show that bark of good quality may be produced, but it is doubtful if these countries will yield commercial supplies of bark in the near future.

The Javan monopoly of cinchona bark is evidently very important to other nations, and it is said that quinine manufacturers in the Allied countries and the United States have formed an Association to watch the position and safeguard their interests, and that a special American mission has investigated the possibilities of Colombia as a source of supply. Experimental plantation of cinchona in Japan and the Philippines is said to have been undertaken and arrangements made for quinine manufacture in Brazil and Peru from locally grown bark.

Provided that supplies of bark can be assured, the manufacture of quinine does not appear to offer difficulties, as the Government factories in India seem to have been financially successful, and a second factory which existed formerly in the United Kingdom was so successful—especially in the quinine export trade—that it was taken over by German manufacturers and subsequently closed.

In 1916 the Bandoeng factory in Java treated about one-fifth of the output of bark and for many years has been most successful. The exports of quinine sulphate from Java rose from 2,556,887 oz., valued at £120,845, in 1913, to 4,572,128 oz., worth £546,621, in 1917.

Appended to the report are useful statistics of production of, and trade in, bark and quinine in the chief producing and consuming countries.

REPORT ON THE ECONOMIC AND COMMERCIAL SITUATION OF AUSTRIA, TO JULY, 1922. *By* O. S. PHILLPOTTS, *H.M. Commercial Secretary, Vienna. Department of Overseas Trade. Pp.* 57. *H.M. Stationery Office*, 1922. *Price* 1s. 6*d.*

The economic plight of Austria is too well known o need description. Failure to restore agricultural production has proved most serious; the country is nable to buy food from abroad, and fertilisers annot be imported because farmers have to sell heir products at less than world prices.

In 1921 production of iron ore improved by 51,036 tons to 679,536 t., and that of pig iron by 16,274 t. to 214,322; the figures for the first uarter of 1922 are 216,868 t. and 60,071 t., respecvely; supplies of coke were obtained from Czechoovakia and England, but lack of labour limited e output. The output of coal was 2,607,000 t. nd importations from Upper Silesia, Czechoovakia, and Poland amounted to 5,928,000 t. ightly more magnesite (120,000 t.) was mined, t the production of salt was only 78,100 t. 60,000 t. in 1913), owing to the cost of coal for aporating the brine. Development of the available water-power has been slow, but 24 works with total capacity of 99,400 h.-p. were under construcn in 1921 and other schemes have been started ce. Most industries working for exportation re very busy during the second half of 1921, but trade fell off greatly when the value of the krone ceased to fall and severe German competition became possible owing to the depreciation of the mark. Although the effect of this slump has been partly overcome, the outlook is unfavourable on account of the shortage of working capital, the fluctuating exchange, foreign (chiefly German) competition, prohibitive tariffs in adjacent countries, high wages, and labour troubles.

The total weight of exports in 1921 was 1,477,402 t. and of imports 8,175,736 t., leaving an unfavourable trade balance of 6,698,334 t., compared with 4,744,000 t. in 1920. The value of the foreign trade is not known exactly, but it is estimated that the exports and imports in 1921 were worth £35,000,000 and £62,800,000, respectively. The share of the United Kingdom in the import and export trade is still very small, under 1 per cent. of the total quantity; skins, fatty oils, coal, wolfram ore, china clay, rubber, tin, caustic soda, varnish and colours were imported from this country in greater quantity. Importations of copra, fats, photographic plates, pig iron, ferro-silicon, etc. and chemicals declined. Among the exports of chemical interest sent to the United Kingdom were magnesite, talc, wood pulp, cement, glassware, and calcium carbide.

REPORT ON THE ECONOMIC AND INDUSTRIAL CONDITIONS IN THE SERB-CROAT-SLOVENE KINGDOM, DATED MAY, 1922. *By* CAPT. E. M. HARVEY, *H.M. Commercial Secretary, Belgrade. Department of Overseas Trade. Pp.* 31. *H.M. Stationery Office*, 1922. *Price* 1*s.*

At the beginning of 1921 conditions in Yugoslavia were promising, but later in the year, when control over the exchange was removed, the currency depreciated rapidly; this, combined with the inadequacy of the railways, greatly hindered trade. Drought seriously affected agriculture, which finds employment for 80 per cent. of the inhabitants. Apart from staple agricultural products, commercial and industrial herbs, such as pyrethrum, rosemary, sage, sumac, belladonna, gentian, etc. are grown in Dalmatia, the opium poppy is grown in Serbian Macedonia, and tobacco in Bosnia, Herzegovina and Macedonia. Progress was made in textiles, but other industries did not prosper, the leather industry in particular suffering from severe competition from Austria and Czechoslovakia. Many new industrial undertakings, mostly on a small scale, are springing up, and development will be rapid when means of communication are improved. German capital is said to be interested in many of these new industries. Development in the mining industry awaits improved transport. A British company has acquired a valuable lead mine in Slovenia, and a coal mine in Croatia is being worked by British enterprise. Oil-boring operations are in progress in Croatia in the district between the rivers Save and Drave; and the Government has shipped to Germany a large quantity of iron ore from the Ljubija mines in Bosnia. In 1921 the production of coal was 63,940 tons, of soft coal 2,651,108 t. and of lignite 103,064 tons.

Imports during the first half of 1921 were valued at 2,093,525,548 dinars; they included chemical and pharmaceutical products, colours, varnish, ethers, alcohols, essential oils, artificial grease, and explosives worth 102,024,271 dinars, glass and glassware 43,141,660 dinars, wax and wax products 34,419,171 dinars, metals and metal products 236,546,955 dinars, and minerals and mineral oils 118,458,462 dinars (dinar=9·5d. at par; av. value during 1921, 0·8d.). The origin of the imports was (per cent.):—Austria 25·45, Italy 21·85, Czechoslovakia 19·75, Greece 7·16, and Great Britain 6·59. Probably a large proportion of the imports from Greece was of British or French origin. During the whole year Great Britain supplied goods valued at £1,045.705. Trading with Great Britain is hampered by the fluctuating exchange, but as German and Austrian firms are beginning to quote in sterling for certain products, *e.g.*, steel, the advantage derived from depreciated currency is apparently disappearing. Exports during the whole year were valued at 2460·7 million dinars, of which 35·86 per cent. went to Austria, 23·43 per cent. to Italy, and only 0·72 per cent. (£759,542) to Great Britain.

LEGAL INTELLIGENCE

THE PHOSPHORIC-ACID CONTENT OF UNGROUND BASIC SLAG. *Le Manufacture d'Engrais et de Produits Industriels v. T. W. Ransom, Ltd.*

In the King's Bench Division on November 9, Mr. Justice Greer heard an appeal by Le Manufacture d'Engrais et de Produits Industriels, Antwerp, against an umpire's decision in favour of T. W. Ransom, Ltd., Manchester. The latter company claimed that a contract to buy unground basic slag from the Belgian company stipulated that the slag should contain from 17 to 20 per cent. of phosphoric acid. Slag containing 11 to 17 per cent. of phosphoric acid was offered, but the English company refused it, contending that the slag should contain approximately 18 per cent.

For the Belgian company it was submitted that at least 11 per cent. of total phosphoric acid would have to be present in the bulk so that the solubility prescribed in the contract could be reached, and that the company was entitled to deliver unground slag containing any percentage of phosphoric acid, provided that the guaranteed solubility of 75 per cent. was not infringed. The umpire found that there was no necessary relation between the contents of total and of soluble phosphoric acid present in the bulk of the slag. In giving judgment Mr. Justice Greer said that the foregoing fact was known to the trade and the umpire was entitled to decide that "18 per cent. basic slag" meant that the content was 18 per cent. or thereabouts. He therefore decided in favour of T. W. Ransom, Ltd., with costs.

GOVERNMENT ORDERS AND NOTICES

"REPARATION" DYESTUFFS.—The Board of Trade announces that a list of the products comprised in the stocks of "reparation" dyestuffs is now available. The list, together with any further information relating to these stocks, may be obtained on application to the British Dyestuffs Corporation, Ltd., Reparation Department, 70, Spring Gardens, Manchester.

COMPANY NEWS

BRITISH SULPHATE OF AMMONIA FEDERATION, LTD.

At the second annual general meeting, held on November 16, Mr. D. Milne Watson, chairman, said that conditions had improved during the past year and that deliveries had not kept pace with the demand. The average price obtained was disappointing, on account of high costs, the price of sulphuric acid alone being more than twice that of pre-war times. There would have to be a great reduction in the price of acid if the cost of producing ammonium sulphate was to be reduced to the level of the selling price of nitrogen, and the Federation was determined to buy acid much more cheaply than at present. No effort was being spared to reduce the cost of production and administration, because, as the output of ammonium sulphate grew, the Chilean nitrate producers would attempt to reduce costs by improving the yield. Their present cost was, roughly, £8 10s. per ton, inclusive of the royalty of £2 10s. paid to the Chilean Government. On May 31 the productive capacity of the firms in the Federation represented over 90 per cent. of the British output, and it was significant that Synthetic Ammonia and Nitrates, Ltd., whose large plant at Bellingham would probably begin to produce within six months or so, had decided to become a member. The use of ammonium sulphate was extending in France, where 25,400 tons of nitrogen as ammonium sulphate was consumed in 1921 (19,400 t. in 1913), compared with 23,600 t. of nitrogen as nitrate of soda (48,700 t. in 1913), and the demand had grown even more in this country. Germany was consuming about 320,000 t. of nitrogen annually, *i.e.*, about 10·3 lb. per acre, as against 2·0 lb. in France and 4·5 lb. in England, and the total consumption of nitrogen in the three countries was 404,300 t. per annum. The prospects of the industry could be judged from the consideration that if these three countries were to consume 12 lb. of nitrogen per acre of arable land the total annual consumption would be 755,500 tons.

STANDARD CHEMICAL CO., LTD., CANADA

The eleventh annual statement, for the year ending March 31, 1921, of this company reflects the extreme depression that has existed in the Canadian chemical industries engaged in the production of acetate of lime, methyl alcohol, etc. from wood. The company has plants at Sault Ste. Marie, Longford, Donald, Parry Sound, South River, Thornbury in Ontario, and Montreal, Fassett, Cookshire, Mont Tremblay, Weedon in Quebec, and the total carbonising capacity is approximately 135,000 cords per annum. During the last financial year, 59,278 cords was retorted, or 44 per cent. of the capacity, which is a decline of 22 per cent. from the total carbonising capacity is approximately compared with $340,327 in 1919–20, and the net loss was $762,368, as against $166,967. The actual deficit shown in the accounts is $624,088. Current assets are estimated at $1,411,659 (1921, $1,942,065); liabilities, $631,185 ($606,223); and stocks, $1,121,622 ($1,616,814). Total assets are $6,733,670, against $6,880,485 last year. The demand for the company's products has increased since the close of the financial year and the company's plants are now working at 60 per cent. capacity.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for November 9 and 16)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence), 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina ..	Pottery	561
Australia ..	Fine and heavy chemicals ..	494
" ..	China, glassware, crockery ..	*
Canada ..	Dry zinc white, lithopone, white lead, umber, sienna	496
"	Drugs	497
"	Perfumes	521
" ..	Fire-extinguishing materials ..	†
Egypt	Drugs (tender for)	9409/F.E./C.P.
Egypt, Sudan, Palestine ..	Earthenware, semi-porcelain ..	509
Italy	Groundnuts, oilseeds, Chilean nitrate	503
Netherlands ..	Earthenware	504
Russia and Baltic States ..	Fertilisers, paint, colour, oils ..	508
Spain	Fine and pharmaceutical chemicals, heavy chemicals for bleaching, dyeing, etc. ..	538
"	Electrical porcelain	539
"	Dyes, colours, drugs	541
Switzerland ..	Chemicals, drugs	547
United States..	" Stainless " steel and iron ..	511
" ..	Fuller's earth, caustic soda ..	512

* Ref. No. 412/7/1/1/10A. Official Secretary, Commercial Bureau, Australia House, Strand, London, W.C. 2.

† Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C. 2.

TARIFF CUSTOMS EXCISE

Belgium.—A Bill to revise the customs tariff is to be presented to Parliament during November.

Germany.—A list of the monopoly taxes on imported spirits is given in the issue for November 16. The duty on imported acetic acid and vinegar has been increased to 135,555 marks per hectolitre of anhydrous acid.

Hungary.—A commercial agreement based on the principle of " the most favoured nation " has been made with Esthonia. Goods recently added to the list of free imports include dégras, coal tar, certain coal-tar oils, oil colours, opium, chemical paper (not photographic), minerals, materials for grinding, cleaning and polishing, firebricks, earthenware, metal sheets, bars and wire.

Italy.—By a recent decree, the duties on synthetic organic dyestuffs and intermediates are increased; the restrictions on the import of these chemicals is withdrawn; and mineral oil-fuel is admitted duty free. Export licences are no longer required for aluminium scrap, calcium cyanamide, ammonium nitrate, and pyrites.

Kenya.—Under the new customs tariff specific duties are levied on imports of butter substitutes, edible fats, cement, kinematograph films, matches, metal wire, methylated spirit, mineral oils, salt, soap, spirits, and sugar. *Ad valorem* duties of 30 per cent. are applied to proprietary medicines, essential and perfumed oils, and of 10 per cent. to asbestos packing, glass and earthenware bottles and jars, tinplate, carbon dioxide, certain metals, fireclay, various oils, colours, varnish, driers, and paper. The duty-free list includes preparations for treating latex, explosives, fuel, creosote, drugs, medicines, disinfectants, rectified spirit for pharmaceutical use, fertilisers and manures, salt, fungicides, insecticides, radium, and vaccines.

Mexico.—The importation of opium, cocaine, morphine, etc. is prohibited save by permission of the Health Department.

Palestine.—From November 1 excise duties are leviable on imported alcoholic liquors, in addition to the customs duties.

Poland.—A commercial convention with Austria has been signed.

Spain.—The full text of the commercial treaty with the United Kingdom is reprinted in the issue for November 9.

TRADE NOTES

BRITISH

Gambia in 1920 and 1921

The chief agricultural product of Gambia is the groundnut crop, and while this continues to be profitable other crops are unlikely to attain importance. The climate is unsuitable for cotton-growing, the production of palm kernels is diminishing, and the export of wild rubber has now ceased. Owing to the prime importance of agriculture to the Colony, the establishment of a Department of Agriculture is being considered. Rhum palms, mahogany and rosewood are utilised locally, but the quantity and quality are insufficient to warrant exportation. The year 1921 was a very bad one for the Colony, and the total foreign trade declined by £3,500,000 to £1,678,021; the export of groundnuts was 59,175 tons and of palm kernels 302 t., as compared with 85,190 t. and 468 t., respectively, in 1920.—(*Col. Rep.-Ann., Nos.* 1020, 1121, 1922.)

FOREIGN

Japanese Imports of Paraffin Wax and Stearin

The paraffin wax imported into Japan comes mainly from Burma and Sumatra, 28 per cent. being derived from the United States. Australia is the chief source of supply of stearin, the United States and Manchuria coming next with 30 and 10 per cent., respectively.

	Paraffin wax (m.p. under 45°C.		Paraffin wax (m.p. over 45°C.)		Stearin	
Year	Long tons	1000 $	Long tons	$	Long tons	1000$
1913 ..	3,715·5	383·6	4,340·3	518·9	324·2	67·2
1916 ..	6,139·7	671·8	8,413·2	1,168·9	234·3	54·5
1918 ..	4,324·4	956·5	10,949·1	2,434·5	110·9	42·0
1920 ..	3,372·5	708·0	12,879·1	3,077·5	328·4	158·5
1921 ..	3,800·9	555·6	11,601·3	2,798·5	120·8	43·5

Japanese Exports of Camphor, Menthol and Peppermint Oil

Exports of these commodities during the first six months of 1920, 1921, and 1922 were as follows:

	January–June 1920	1921 lb.	1922
Camphor	974,522 ..	423,625 ..	1,962,670
Menthol	354,961 ..	137,783 ..	96,976
Peppermint oil	275,713 ..	116,762 ..	107,957

The percentage distribution of the exports of camphor during the first half of 1922 was as follows:—United States 57, Great Britain 14, British India 10, France 9, and Australia 4. The value of the exports of menthol and peppermint oil during the same period of 1922 was 793,634 yen and 219,488 yen, respectively (yen=2s. 0½d. at par).—(*Oil, Paint and Drug Rep.*, *Oct.* 9, 1921.)

Trade Notes from Finland

The manufacture of mineral and other colours is to be undertaken at Nedertornea by a new company, the Kyläjoki Väritehdas O/Y (capital 100,000 Finnish marks). (Finnish mark=9·5d. at par, now about 1·25d.)

A new company, the O.Y. Star A.B. Tammerfors, has been formed with a capital of 2 million Finnish marks, and has taken over the drug factory of the Tammerfors Droghandels A.B. with a view to increasing greatly its operations.

During the first half of 1922 the export of matches from Finland was 1209 metric tons, valued at 18·03 mill. Finnish mk., as compared with 742 t., valued at 6·90 mill. Finnish mk., in the same period of 1921.—(*Chem. Ind.*, *Sept.* 18, 1922.)

Swiss Chemical Trade

The following official figures afford a comparison of the import and export trade of Switzerland in certain chemical products during the first four months of 1913, 1921, and 1922:—

	January—April 1913	 1921	 1922
		Metric tons	
Imports :—			
Turpentine oil	6·85	4·57	5·10
Caustic soda and potash	35·72	9·82	25·39
Chloride of lime	5·44	2·83	1·30
Tar-oil derivatives, etc.	6·21	24·94	4·63
Coal-tar intermediates	12·27	13·08	3·53
Benzine, benzol	58·68	110·09	153·59
Aniline	4·70	0·58	3·90
Aniline compounds	3·84	0·98	1·01
Benzyl chloride, nitrobenzene, etc.	4·79	1·72	1·20
Logwood extract	2·37	1·02	0·69
Coal-tar dyes	2·72	1·57	1·64
Linseed oil	19·72	10·01	17·46
Petroleum	254·75	56·82	70·23
Exports :—			
Soda ash	—	1·56	14·83
Coal-tar dyes	29·90	15·14	16·88
Indigo	7·75	0·45	11·68

Manchurian Trade in Dyes and Paints

During 1920 supplies of dyes in Manchuria were insufficient and prices high, but in 1921 the small demand and the reappearance of German dyes caused a fall in prices which enabled synthetic indigotin again to compete with natural indigo. Numerous brands of German and American dyes are sold in Manchuria, the latter being reputed of first-class quality and selling readily. Imports from Germany were double those of the previous year and many of the well-known German makes reappeared on the market, mostly in limited quantities. All coal-tar dyes are packed in 8 oz. and 20 oz. tins. In the paint market Japanese lead paints have almost a monopoly, but two brands of British red lead are still in fair demand. Only limited quantities of paint and varnish are imported from the United States. Statistics of the imports of dyes and paints during recent years are given below:—

	1913	1920	1921
		lb.	
Natural indigo, paste	4,257,599	2,118,930	1,369,000
Synthetic indigotin, paste	45,900	2,003,200	273,333
		Haikwan taels*	
Coal-tar dyes	288,270	176,348	371,550
Dyes, other	69,302	94,106	53,882
Paint, paint oil	116,135	275,609	248,000

* The average value of the Haikwan tael was 36·5d. in 1913, 73·8d. in 1920, and 41·8d. in 1921.

—(*U.S. Com. Rep.*, *Oct.* 9, 1922.)

REVIEWS

Researches on Cellulose, 1910—1921. *By* C. F. Cross *and* C. Dorée. *Vol. IV. of the "Cross and Bevan Series." Pp.* 253. *London: Longmans, Green and Co.*, 1922. *Price* 15*s. net.*

It is gratifying that Mr. Cross has been enabled, with the help of Dr. Dorée, to issue a fourth part of the collected "Researches on Cellulose," the preparation of which was originally undertaken in collaboration with the late Mr. E. J. Bevan. The series dates back to 1895, and the present volume is of special importance as it deals with a period marked by unusual activity in the scientific study of cellulose.

The authors have naturally been confronted with the difficulty of classifying under appropriate headings the researches they have selected for mention. This has been successfully overcome, one section being devoted to the physical properties and relationships of the cellulose complex, and another to the progress made in recent attempts to elucidate the constitution of the molecular unit of celluloses. Thereafter, the physical and chemical problems of modified celluloses are discussed and, in conclusion, a review is given of modern industrial developments.

Following the method adopted in earlier volumes, the authors provide useful summaries of selected researches and, from time to time, add critical notes which the reviewer, although holding somewhat different opinions, has read with genuine appreciation. The question raised in the introduction as to whether a volume of this nature is justified can at once be answered in the affirmative. Not only is it an immense benefit to the student of polysaccharides to have the unwieldy mass of publications on cellulose weeded out on his behalf, but the discussions on the papers themselves will be of service in preventing narrow views being taken by the specialist. The present book will do more than its predecessors to bring together the two different schools of research workers on cellulose. We have one type of inquirer, represented by Mr. Cross and his collaborators, who regards the complex as an organised colloidal structure and finds no help in the molecular constitutional views of the organic chemist. On the other side there is the constitutional chemist inclined to think exclusively in terms of groups and molecules. These schools have to be brought together, and the amalgamation cannot be effected by fair words and compliments.

Mr. Cross who, on his own confession, is an agnostic when it comes to questions of a molecular constitution for cellulose, has the courage of his convictions. There is much to be said for his policy of tilting (with all courtesy) at the academic chemist, or rather at chemists who adopt the lofty attitude implied in the statement that "cellulose is nothing more than a polymerised dextrose-glucoside of dextrose." Such statements seriously damage the position of the scholarly investigator who recognises that a structural formula for the molecular unit of cellulose is but one step in a long journey. To take a simple parallel, he is unlikely to forget that, although the composition of silica is known and the compound has been synthesised, the mechanism of building up the organised structure of a diatom is beyond the chemist's power.

With Dr. Dorée, Mr. Cross adheres to the view that the divergence which starch and cellulose show "from each other and from the anhydro-hexoses is not to be displayed in terms of polymerisation." The theoretical chemist, interested in the celluloses chiefly as aggregates of organic molecules, might reasonably refute some of the arguments used in the present volume and point out that current ideas regarding the constitution of the simple sugars are insufficiently expressed, but a discussion of this nature falls outside the scope of a review.

What has been said will show that the book is more than a reference volume. It is designed for the thinker, and will be appreciated by a wider circle of readers than the earlier issues. Disappointment may be felt in the brevity of the reference to the decomposition of cellulose by bacteria and the possible development of such processes to the production of power alcohol. Otherwise, the subject-matter is well-proportioned, and a fair balance has been maintained between different aspects of studies on cellulose. Special emphasis is laid on volume relationships, and the phenomena of fluorescence, as studied by S. J. Lewis, is accorded a prominent place. Papers published in the less accessible journals are well abstracted, and the essential features of the originals are reproduced with commendable accuracy.

J. C. IRVINE.

(1) COLOUR INDEX. PART I. *Edited by* DR. F. M. ROWE. *Pp.* 24. *Bradford: The Society of Dyers and Colourists,* 1922. *Subscription price of the whole work, in monthly parts,* 84*s.*

(2) THE MANUFACTURE OF DYES. *By* J. C. CAIN. *Pp.* 274. *London: Macmillan and Co., Ltd.,* 1922. *Price* 12*s.* 6*d. net.*

(1) The spirit of enterprise, which was stimulated by the war, pervades industrial chemistry throughout the British Empire, and its manifestation in the projection of a comprehensive Colour Index, of which Part I has just been issued, does credit to the Society of Dyers and Colourists, under whose auspices the work is being undertaken. The special committee of that Society, headed by Mr. Ernest Hickson and supported by very eminent experts, has enabled the editor, Dr. F. M. Rowe, to present an index which in form and arrangement compares favourably with similar publications.

Part I contains the names, constitution and literature references for over 100 dyestuffs, beginning with the nitroso-compounds. The names are so arranged that the firms who produce the colours can be given in alphabetical order, and references to the literature are arranged chronologically. It was obviously impossible to give all the commercial names of the dyes mentioned, because the manufacturing firms frequently change them for various reasons; therefore, it was an excellent idea to reserve a large portion of the Index for notes which the worker in this field is bound to make for himself. The dyes given in Part I are well known to the expert, and it will be interesting to see, as the work progresses, how the committee has solved the problem of the more obscure dyes, such as Benzo Fast Colours which are, without *any* exception, wrongly described in the text-books.

Although the Index is, speaking generally, very accurate, there are a few errors and omissions to be noted. Erio Azurine has not the constitution amidodimethylanilinedioxy-S-acid, but it is the dye mono-ethylamidoaniline chromotropic acid (Friedländer VII, p. 368, A.D.R.P. 8759, June, 1904, Richard), No. 59. Certain brands of the dye called Chrome Printing Yellow G. etc., No. 36, are, it is true, made with salicylic acid, but for wool-dyeing the combination m-nitraniline-*o*-cresotinic acid is much to be preferred, because it is at least 30 per cent. stronger. The treatment of different brands of Meta-Chrome Browns is, in the reviewer's opinion, somewhat inadequate; and many of the Meta-Chrome colours are not combinations with *m*-diamines; F-acid and others are also used, and the most important is the combination picramic acid-chloro-m-diamine.

It would be very unfair to expect absolute accuracy, because this is technically impossible, and it is well known that "Schultz" also makes a number of mistakes which are practically unavoidable. There are, however, two omissions of great importance. First "Friedländer" *must* be noted, because unless the class is given, it is impossible to find the German patents; and every dyeworks' chemist has "Friedländer" at hand. If the committee cannot give references to "Friedländer," it must at once prepare a complete collection of all the dyestuff patents.

The second point relates to absorption-spectra. The small errors mentioned above would not have been made if the absorption-spectra (after Formanec) had been consulted. As only Part I of the work has been issued, one cannot know if the committee intends to insert these missing data, but future parts will be awaited with great interest, not only for their intrinsic value but because they will doubtless bear witness to the great progress which the British dyestuffs industry is making.

(2) It was with a deep sense of loss that this book was opened, as Dr. Cain was very well known to the writer, who was aware of his intention to write a text-book on artificial dyestuffs. An unhappy fate appears to hover around the writers of large text-books on this beautiful subject, and the "torso" left by Cain in his desk shows that he was assembling the necessary material for a work which would probably have become a standard one. His ingenuity in seeking out all the accessible data recalls the memory of Dr. K. Heumann, who also died before his big work was finished.

The arrangement chosen by Dr. Cain does not differ from that of other authors, but it was his intention to give not only the constitution of the dyes but also extracts from the patents and other hints on manufacture. There is no doubt that even the short outlines which the author has left, show that he was a master of his subject, and we must be grateful to Prof. J. F. Thorpe for having published the manuscript, as he states, "practically as he received it."

H. E. FIERZ.

GRUNDLEGENDE OPERATIONEN DER FARBENCHEMIE. *By* H. E. FIERZ-DAVID. *Second edition, revised. Pp. xii+266. Berlin: Julius Springer,* 1922. *Price, bound,* 12*s.*

The second edition of this valuable work differs but slightly from the first edition, which was reviewed in these columns in 1919 (p. 486 R), but certain additions have been made which increase its utility. Thus two methods are given for preparing H-acid as well as for gamma- and J-acids. The amino-anthraquinones are described and the mode of preparing anisoles from the corresponding chloro-derivatives explained. Other changes effected relate only to minor details, but paper and binding have been brought up to peace-standard.

The Properties of Electrically Conducting Systems. *By* **Prof. C. A. Kraus.** *American Chemical Society, Monograph Series. Pp.* 415. *New York: The Chemical Catalog Co., Inc.,* 1922. *Price* $4.50.

Probably more experimental work has been carried out in the field of electrically conducting systems in recent years than in any other, and the literature on the subject has grown so large and is so scattered that it has become practically impossible for anyone who has not actively pursued the subject for some years to obtain a comprehensive view of it. Prof. Kraus has confined himself mainly to pure conductance phenomena and has dealt only briefly with other properties of electrolytes and with the more general problem of electrolytic dissociation. Within the restricted field he has chosen, the author has produced a work of the greatest value. He writes, naturally enough, from the standpoint of the American school of electrochemists, and in his brief treatment of the general theory he perhaps dismisses too lightly those recent theories which attempt to find a solution of the anomalous behaviour of strong electrolytes in the electrostatic attraction between the ions. Whatever may be the shortcomings of the theories of this kind which have been proposed up to the present, these forces do exist and must be taken into account before we can obtain a really comprehensive theory of electrolytes. A very valuable feature of the book is the great prominence given to non-aqueous systems; in fact, they are treated much more fully than are aqueous solutions. Unfortunately there has always been a tendency to neglect non-aqueous systems and to build up theories entirely on results derived from the study of aqueous solutions. The work under review brings the whole subject well into perspective.

The greater part of the book deals, naturally, with electrolytic solutions and the whole subject is treated very fully and in great detail from the standpoint of conductance phenomena. In a work of this kind, covering such a wide field, very careful selection of the available material is imperative, otherwise a false or one-sided impression may be conveyed to the reader. The author has done this very successfully and it would be difficult to find fault with his choice of material. In the same way no complete bibliography is given, but the selection of the more important references provided is sufficient to enable the reader to explore the whole field.

In addition to the main subject of electrolytes, there are three chapters dealing, respectively, with fused salts and solid electrolytes; the properties of metallic conductors; and systems intermediate between electrolytic and metallic conductors, the last being an account of Prof. Kraus's recent important work on solutions of metallic sodium in liquid ammonia. These three chapters, which are of the greatest interest, contain some very striking results which must inevitably lead sooner or later to a clearer understanding of the nature of the structure of metals and solid salts.

Throughout the text great use is made of the application of graphical methods in the interpretation of experimental results. The whole book is very clearly written and the examples and illustrative diagrams are numerous and well chosen. The book makes most interesting and easy reading and Prof. Kraus has rendered a very great service to chemists in writing it.

C. S. Salmon.

PUBLICATIONS RECEIVED

Handbook of Chemical Engineering. *Edited by* **D. M. Liddell** *and prepared by a staff of specialists. Vol. I. Pp.* 517. *Vol. II. Pp.* 519–1008. *New York and London: McGraw-Hill Book Co., Inc.,* 1922. *Price* 40*s*.

Synthetic Colouring Matters. Dyestuffs Derived from Pyridine, Quinoline, Acridine, and Xanthene. *By* **Prof. J. T. Hewitt.** *Monographs on Industrial Chemistry, edited by Sir E. Thorpe. Pp.* 405. *London: Longmans, Green and Co.,* 1922. *Price* 14*s*.

The Analysis of Rubber. *By* **J. B. Tuttle.** *American Chemical Society, Monograph Series. Pp.* 155. *New York: The Chemical Catalog Co., Inc.,* 1922. *Price* $2·50.

Modern Gasworks Chemistry. *By* **Dr. G. Weyman.** *Pp.* 184. *London: Benn Brothers, Ltd.,* 1922. *Price* 25*s*.

Gesammelte Abhandlungen. *By* **Prof. F. Kehrmann.** *Vol. I. Part I. Untersuchungen über Komplexe Anorganische Säuren. Part II. Untersuchungen uber Sterische Hinderung. Pp.* 203. *Leipzig: Georg Thieme,* 1922. *Price, paper,* 8*s*.

Warenkunde. *By* **Dr. K. Hassack.** *Vol. II. Organische Waren. Fourth edition, enlarged. Pp.* 150. *Berlin and Leipzig: Vereinigung Wissenschaftlicher Verleger,* 1922. *Price* 1*s*. 6*d*.

Ninth Annual Report of the Mellon Institute of Industrial Research, University of Pittsburg. *By* **E. R. Weidlein.** *Pp.* 23. *The Institute, Pittsburg, Pa.,* 1922.

Recent Progress in Smoke Abatement and Fuel Technology in England. *By* **R. J. McKay.** *Smoke Investigation. Bulletin No.* 10. *Pp.* 62. *Mellon Institute of Industrial Research, Pittsburg, Pa.,* 1922.

De Aetherische Oliën Leverende Planten van Nederlandsch Oost-Indië en de Bereiding van Haar Oliën. *By* **A. W. K. de Jong.** *Berichten van de Afdeeling Handelsmuseum van het Koloniaal Instituut. No.* 7. *Pp.* 183. *Amsterdam: Koloniaal Instituut,* 1922. *Price* 3·60 *florins*.

Vanille, Vanilline, Vanille-Extracten. *By* **Dr. W. L. Utermark.** *Koloniaal Instituut te Amsterdam. Mededeeling No. XVII. Afdeeling Handelsmuseum No.* 3. *Amsterdam: Koloniaal Instituut,* 1922. *Price* 2·50 *florins*.

Publications of the Dominion Bureau of Statistics, Canada. *Mining, Metallurgical and Chemical Branch, Ottawa: F. A. Acland,* 1922:—

Chemicals and Allied Products in 1919 and 1920. *Pp.* 150.

Coal Statistics for the Years 1919, 1920, 1921. *Pp.* 115.

REVIEW

Vol. XLI] DECEMBER 15, 1922 [No. 23

WHAT CHEMICAL INDUSTRY OWES TO PASTEUR

LOUIS A. FERNBACH

For the Centenary of Pasteur's Birth, December 27, 1922

OF the most eminent scientists who are universally held to be benefactors of mankind, no one bears a more honoured ne than Louis Pasteur. Public health has ived such immense benefit from his work, l ideas concerning contagious diseases and ir prevention have become so diffused ong the greater mass of the public, that the dical side of Pasteur's discoveries, and the olution which they promoted in medicine and gery, are appreciated almost universally.

But even among educated people who have airly good knowledge of Pasteur's life and coveries, very few realise that this immense gress was the natural outcome of Pasteur's liest researches, and that, before becoming eminent master in pathology, he acquired ne by his biochemical work and its numerous plications in the fermentation industries.

This great chapter of Pasteur's scientific life ll deserves a short re-statement in this *urnal,* exclusively devoted to chemical lustry, especially in view of the celebration the centenary of his birth.

One of the most curious features of Pasteur's liest work is that he first investigated a estion which is apparently very remote from subjects of his subsequent researches. der the guidance of his great master, the nous physicist Biot, he undertook a study crystallography—namely, the crystalline ms of the various tartaric acids and their s; and he was thus led to the discovery of ets which had escaped the notice of previous strious workers, the so-called hemihedric ets, a discovery which was the origin of the ous theory of molecular asymmetry. In a es of papers, Pasteur demonstrated the e relationship subsisting, on the one hand, ween crystalline form and rotatory power, , on the other, between molecular structure the action on polarised light, a subject ch has since been greatly developed and ch forms one of the foundations of modern nic chemistry.

he study of tartaric acid led to the conclusion it and many other optically active substances exist in four different forms :—(*a*) two optically active forms, having equal but opposite rotatory powers, the asymmetric crystals of each being the mirror-image of the other ; (*b*) an equimolecular mixture of the above forms which is optically inactive *by compensation*, and known as the *racemic* form ; (*c*) a form which is inactive *by nature*, its inactivity being due to its crystalline as well as to its molecular symmetry. Unlike the racemic form, this last form cannot be resolved into active compounds ; and this fact leads us to the next period of Pasteur's discoveries—namely, his studies on fermentation.

Among the various methods employed by Pasteur to resolve the racemic form of tartaric acid into its two active constituents, the most striking is certainly the biochemical method, because it represents a most important link in the harmonious sequence of his researches. Having found that a solution of ammonium tartrate ferments easily (through bacterial infection, as we are now able to say), Pasteur transferred some seed from a fermenting solution into a solution of ammonium paratartrate (the racemic form), which fermented equally well ; but the polarimetric observations, made in order to control the progress of fermentation, revealed an unexpected and most important fact—namely, that the dextrorotatory form disappears, and that the final residue of fermentation is the lævorotatory ammonium tartrate. The same effect was obtained with a fungus, which proved later to be *Penicillium glaucum*.

These experiments are of capital importance. Not only do they provide the first instance of the resolution of a racemic body into its active constituents by a biochemical method that has since been applied in many directions, but they also afford evidence of the sensitiveness of micro-organisms to the optical properties and molecular arrangement of organic compounds, of which the processes of *selective fermentation* have since furnished numerous examples. These experiments first brought our great master into contact with micro-organisms, and thus laid the origin of a new science whose importance cannot be overestimated.

The attention which Pasteur was thus led to pay to a particular form of life was considerably favoured by the fact that, at this early period of his career (he was then 32), he was called to act as Dean of the Faculty of Sciences in Lille, in the centre of one of the chief industrial districts of France, where the fermentation industries, especially the manufacture of alcohol and beer, are widespread, and at that time were conducted on purely empirical lines.

In this new field of investigation, Pasteur had to organise the fight against a stubborn prejudice, emanating from one of the greatest chemists of that time, Liebig, who for many years refused to admit the specific action of micro-organisms, holding the opinion that they were merely organic matter in a state of decomposition, which state was communicated to the compounds undergoing fermentation.

One of the most striking instances which appeared to support Liebig's views was lactic fermentation, and the transformation which it promotes of the sugar into lactic acid. To start such a fermentation, it is only necessary to add a small quantity of spoiled meat or old cheese to a solution of sugar, in presence of chalk. Pasteur demonstrated that above the deposit of chalk, which formed at the bottom of the flask, there appeared a thin grayish layer, which consisted of minute rods, and that some of these rods, when introduced into a fresh solution, promoted a new lactic fermentation. The lactic ferment, far from being in a state of decomposition, as claimed by Liebig, multiplied itself vigorously in the course of the fermentation. The existence of numerous varieties of the lactic bacillus was established by the experiments of Lord Lister, whose work on this subject corroborated the results of his great friend, Louis Pasteur.

The part played by yeast in alcoholic fermentation held Pasteur's attention for many years. Through his experiments we have learnt that yeast reproduces during the splitting-up of the sugar molecule, thus confirming the view expressed many years before by Cagniard-Latour, that yeast promotes fermentation by its vital activity. In addition to contributing to our knowledge of the influence of various factors on the development of the yeast cell and on its action as an alcoholic ferment, on its origin and diffusion in nature, on the production of new compounds, *e.g.*, glycerin and succinic acid, on the part played by oxygen in the maturation of wines, on the oxidising functions of the acetic ferments (a subject much developed subsequently by Adrian Brown), Pasteur's researches on alcoholic fermentation have had a most profound influence on industrial practice; above all, they have taught us the importance of pure fermentation, which is one of the fundamental conditions of success in all industrial fermentation processes.

The necessity for securing pure fermentation appeared clearly to Pasteur as a consequence of observations made in his researches on wine and beer, namely, that the alterations which these beverages frequently undergo are due to the presence and development of minute organisms, the so-called disease ferments (*ferments de maladie*). The action of heat, which has since been applied industrially under the name of "pasteurisation," is an effective protection against disease; but a much more rational practice is to obtain a product under conditions which will secure stability. One of the most important of these conditions is *pure fermentation*, a term which signifies that the fermentation is promoted by an organism belonging to a definite single strain, in a liquid which has been previously deprived of all its living germs and which remains protected against all extraneous organisms.

The application of this fundamental principle has been of the greatest service in all fermentation industries. It involves working under conditions of absolute cleanliness, and all thinking wine-producers, brewers, distillers, vinegar manufacturers etc., now realise that the word *cleanliness* means *aseptic conditions of work*, which are the only safeguard against subsequent trouble. It involves also the use of pure cultures, which may be easily obtained by the methods worked out by Pasteur and which have been changed but little since.

However widely Pasteur's marvellous methods and discoveries have been applied, their possibilities are far from being exhausted, and an immense field lies open for their application to new fermentation industries that will benefit mankind.

École de Brasserie,
Institut Pasteur, Paris.

FEDERAL COUNCIL FOR PURE AND APPLIED CHEMISTRY

For many months before his death Lord Moulton was occupied with the elaboration of a scheme for ensuring the closer co-operation of the various interests—academic and technical, pure and applied—which are embraced by our numerous chemical organisations. Lord Moulton was convinced that a serious defect in the organisation of public affairs in our country lies in the lack of solidarity of sentiment and of expression amongst chemists as a body. The culminating task of his life consisted in unifying the scattered chemical talent of the country and teaching it to work for the common cause in unison with the engineer and the manufacturer; as Director of the Department of Explosives Supplies he accomplished this task, but none realised better than he that the extravagant cost of the achievement was largely traceable to the absence of previous organisation among chemists. His insight orn of genius and sharpened by experience, ld Lord Moulton that the conditions of peace e much like those of war: co-operation saves bour and treasure, and leads to that efficiency hich is essential in a modern economic struggle. e saw the necessity of creating for chemistry corporate organisation in which all branches the science and practice should be embraced, hich could put forward its collective view ith the same force as had long been possible other learned professions, such as engineering, edicine, and the law.

With this outlook Lord Moulton threw himlf whole-heartedly into the scheme of the ederal Council for Pure and Applied Chemistry, nd drafted an appeal for funds in order to d British Chemistry of certain obvious disadantages under which it now suffers. He elieved that what is needed in this country is a entral organisation for chemistry, which should ring under one roof our several important hemical societies, an exhaustive library, ample ooms for administrative purposes and for cientific meetings, and, if possible, the social menities of a club. There was no thought of njuring the splendid traditions of the Chemical ociety and the Society of Chemical Industry; oth should retain their autonomy, but if these nd other smaller allied societies are to meet odern requirements there must be that closer o-operation which only comes from physical roximity.

The provision of the needs just above menioned calls for funds, and in the appeal which ord Moulton drew up at the end of 1920 he stimated that £250,000 was required for remises, equipment, etc., and a further £250,000 or literary purposes. This appeal was agreed y the Federal Council and was signed by the residents of the sixteen societies then enraced by the Federal Council; it was being laced before prominent personalities in the hemical and manufacturing world for several onths previous to the sudden death of Lord oulton in March of last year.

We have lost our leader; we realise that e cannot hope, in the present condition of the orld's financial affairs, to raise £250,000 for ur project of placing chemistry in a position imilar to that now enjoyed by engineering, edicine, and the law. Pending the better imes which we all believe are in store for British industry and British enterprise, we can, however, do much to advance our project. We lready have in existence a unifying body. The Federal Council for Chemistry was founded everal years ago with a view to meeting two generally recognised needs: first, the promotion of co-operation and economy of effort between our several large chemical societies, and, secondly, the representation of those interests of chemical science and technology which are too general in character to be the sole province of either of our existing organisations. Following the example set by the creation of our own Federal Council for Chemistry, many other countries have formed a national Council for Chemistry on very similar lines; all these national councils are now combined under the International Council for Chemistry which was inaugurated at the annual meeting of the Society of Chemical Industry in 1919 (J., 1919, 38, 208 T). The International Council now includes the national chemical councils of twenty-four States (J., 1922, 41, 328 R); it has held its three previous annual meetings in Brussels, Rome, and Lyons, and is to meet next year in Cambridge.

Hitherto, the International Union for Chemistry has been largely occupied with the organisation of its numerous international interests, such, for instance, as concern the production of international tables of fundamental constants of the elements and the introduction of a generally agreed system of chemical nomenclature; the "Tables annuelles de constantes et données numériques de chimie, de physique et de technologie," edited with such success by Dr. Charles Marie, are published under its auspices. Now that these and related matters of importance have been dealt with, and organisations created which will rapidly increase its productivity, it is intended to extend the scope of the Union and to include in its annual proceedings the presentation and discussion of reports on the progress and development of large scientific and technical questions. This branch of the Union's activities was indeed inaugurated at the recent meeting at Lyons, and the meeting at Cambridge next year will therefore be one of great interest and importance.

Our own Federal Council has taken an active part in the pioneer work of the International Union, although it should be stated that the bulk of the progress made has been due to the devotion of Professor Charles Moureu, its President for the last three years, and our other French colleagues. The Federal Council, in addition, has been able to do a good deal in securing joint action between our large organisations, such, for example, as promoting the arrangement for some measure of co-operation between the Chemical Society and the Society of Chemical Industry in the weekly publication of the *Journal* of the latter Society. A vast amount remains to be done in this direction, and especially in the establishment of a solid feeling that the chemist should have at heart the interests of his whole subject rather than that merely of the particular chemical society of which he is a member. The promotion of this feeling calls for the united effort of all chemists. It was with this purpose in view that the societies composing the Federal Council were asked to nominate to the Council men who would be active in initiating and carrying into operation measures for the strengthening of the whole chemical organisation of the country.

Hitherto, the principal expenses of the Federal Council have been the annual subscriptions to the International Union, and the revenue has consisted mainly of grants from the Chemical Society and the Society of Chemical Industry. These grants cannot be increased, because both societies have already large calls upon their limited resources for other indispensable purposes; yet money is required to enable the Federal Council to develop its work on an adequate scale. At the meetings of the International Council in Brussels, Rome, and Lyons the foreign organisations corresponding to our Federal Council entertained the delegates to the Union. We shall have to return the compliment at next year's meeting in Cambridge. Further, whilst the prevailing financial stringency makes it impossible to carry out the large scheme outlined by the late Lord Moulton, it is at least necessary that we should make a beginning. We therefore ask for contributions to be devoted towards the scheme, and so convert into a useful form the sympathy of our chemical colleagues with the objects of the Federal Council.

In the present article we have touched on many questions—and therefore, perhaps, in too scanty detail—and have left unmentioned many others which are also of vital importance to the chemical organism. The nudity of our chemical compendia, the paucity of our efforts to cultivate the social side of chemistry, and so develop the excellent work of the Chemical Industry Club—these and many other matters call for attention; they call for a few chemists to lead and for many to collaborate, and above all they call for financial support.

With the above considerations in view the Federal Council has appointed a Benefaction Committee, with the request that they will collect funds. The Committee now consists of Sir William Pope, Dr. E. F. Armstrong, Mr. H. E. Coley, Mr. E. V. Evans, Mr. Emile Mond, Mr. W. J. U. Woolcock, and Dr. S. Miall; other names may be added at a later date. It is intended to issue a preliminary list of subscriptions, and when this has been completed to make a widespread appeal in a more or less public manner. It is requested that contributions be sent to Dr. S. Miall, Society of Chemical Industry, Central House, Finsbury Square, London, E.C.

W. J. Pope.
E. F. Armstrong.
H. E. Coley.
E. V. Evans.
Emile Mond.
W. J. U. Woolcock.
Stephen Miall.

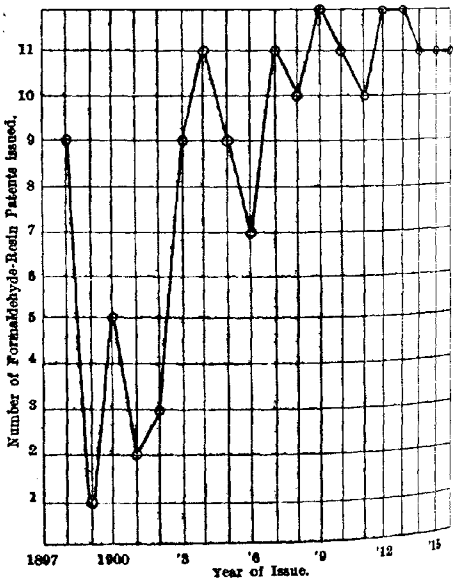
The First List of Contributors to the Fund will be found on page 534 of this issue.

RECENT RESEARCH ON FORMALDEHYDE-RESINS

ALAN A. DRUMMOND

SINCE 1872, when Baeyer first observed that phenol reacts with formaldehyde to give a resinous condensation product, much work has been done with a view to making synthetic resins of this type commercial materials, and as a result, primarily of research by Dr. Baekeland, the technical world has come to realise the possibilities of phenolic condensation products for use in many industries. The object of the earlier workers was merely to produce substitutes for shellac, and it was not until recently that the peculiar properties of these resins, notably their resistance to heat, electricity and chemical action, were appreciated fully. Varnish manufacturers are still actively investigating the possible applications of synthetic resins, but the lack of uniformity in behaviour of different batches, made under supposedly identical conditions, has so far precluded extensive use in this industry.

During the past thirty years many data, more or less empirical, concerning synthetic resins have accumulated, mainly in the patent files. The number of patents taken out year by year in Great Britain since about 1897 up to the beginning of the war, shows clearly that interest in synthetic resins has been increasing steadily.



The graph indicates a general upward tendency in the number of patents, reaching a maximum soon after the publication of Baekeland's lecture in America on Baekelite and its applications (*J. Ind. Eng. Chem.*, 1909, 149). Research in this subject was, naturally, retarded by the war, but it is now receiving renewed attention. The later patents relating to the subject still convey an impression of empiricism, but this may be due to the nature of the record, because systematic scientific method can rarely be deduced from a survey of patent specifications. The fact remains, however, that little or no fundamental work is being published on the exact course of the reaction involved in the production of phenol-formaldehyde resins. It is, perhaps, more along the lines of physico-chemical investigation that new knowledge will come. Up to the present, work has been concentrated mainly on the investigation of the chemical properties of the condensation product, on its behaviour towards various reagents, and on efforts to identify the individual constituents of the resins. As a result of this chemical study, attempts have been made to ascribe a definite constitution to the colloidal resin, but the results have been conflicting. Baekeland deduced an anhydride formula from the results of elementary analysis, starting with an assumption based on work done by Lederer (*J. prakt. Chem.*, 1894, **158,** 223), and Manasse (*Ber.*, 1894, **27,** 2409), who was the first to claim the synthesis of oxybenzyl alcohol by the condensation of phenol and formaldehyde in presence of basic catalysts. Raschig (*Zeit. angew. Chem.*, 1912, 1939) disputed Baekeland's conclusions, but without advancing very clear proof of his own deductions.

Recent work by Coster van Voorhout (*Chem. Weekblad*, 1920, **17,** 2) has supplied more definite information concerning the course of the reaction between phenol and formaldehyde. This worker has investigated the changes in viscosity that occur during condensation, and has successfully isolated chemical individuals from the reaction mixture. He has separated crystalline *o*- and *p*-oxybenzyl alcohols, when an alkaline catalyst was used, and he has shown the presence of dioxydiphenylmethane when the condensation was initiated by acids. His conclusion was that in all probability Bakelite consists of dioxydiphenylmethane (probably polymorphous) in colloidal solution, together with traces of phenol and formaldehyde.

It must appear from the foregoing that, valuable as a knowledge of the chemical constitution, based upon an investigation of the final condensation product, undoubtedly is, further practical advance can more readily be achieved by a synthetic study of the resin, *i.e.*, by investigating it before and during synthesis, rather than analytically after the synthesis has taken place. Such a study involves physical, as well as chemical examination: a study of the changes during condensation in such physical properties as viscosity and density. Coster van Voorhout's paper contains only a brief reference to viscosity determinations; more data of this kind are wanted, and particularly by the manufacturer of formaldehyde-resins.

Air-drying varnishes or lacquers, containing formaldehyde-resins, are readily obtained; they yield films of good elasticity, which can be improved by the addition of such substances as celluloid, collodion, and cellulose acetate, but their durability in use is poor unless they have been stoved. A non-stoving varnish of acid-resisting properties would be of great service even in the chemical industry alone, particularly if it were also highly resistant to heat.

Another difficulty has been the restricted solubility of the finished resins; alcohol has proved to be the best solvent, even for the resins in their more soluble condition, *i.e.*, before the final reaction has been effected by stoving. Spirit as a solvent is not altogether desirable; for one reason, varnishes containing alcohol are liable to leave a track of trapped air-bubbles on the surface that is being covered, and these bubbles or pin-holes are not easily removed. Linseed oil, turpentine and similar oils are more useful varnish media. A process for obtaining oil-soluble synthetic resins has been protected (Albert and Berend, E.P. 15,875, 1914). Such so-called "albertole" resins apparently contain, in addition to the formaldehyde-resins, at least 50 per cent. of natural rosin, and although the process claims to effect a specific reaction between the synthetic and the natural resins so that a durable oil-soluble varnish is obtained, it is difficult not to suspect the durability of a varnish film of such composition. A claim for the production of oil-soluble resins has also been made, whereby advantage is taken of the different reactivities of *m*- and *p*-cresol with formaldehyde; *p*-cresol, with an excess of formaldehyde and an acid catalyst, is stated to give a resin soluble in oils (Robinson-Bindley, Weller, and Dulcken, E.P. 134,563, 1918). The biggest field of application for synthetic resin varnishes, as now made, is as insulators in the electrical industry, where they are used as stoving varnishes, particularly for coating insulating fabrics and tapes, and for impregnating coils.

Following the amalgamation of three of the foremost American manufacturers of insulating materials under the ægis of the General Baekelite Company (*cf.* J., 1922, 320 R), the pooled resources of scientific and technical information should make possible very distinct advances in the methods of manufacture and application of formaldehyde-resins. In view of this strong competition, British manufacturers of electrical insulating material who are beginning to realise the specially advantageous properties of these resins, are likely to be seriously handicapped in their efforts to establish sound commercial processes, unless their methods have a firm scientific basis, founded on the results of systematic research.

THE EXTRACTION OF GASOLINE FROM NATURAL GAS

GEORGE A. BURRELL*

Part I.—Extraction by Compression and by Absorption in Oil

The natural-gas gasoline industry was started about the year 1904 in the oldest fields of the United States, viz., those of northern Pennsylvania, and its development to the commercial stage followed as a consequence of the impossibility of meeting the demand for gasoline by any other means. In 1904 the automobile was still in its infancy, but a demand had already been created for gasoline, hitherto a by-product of little commercial value. Although some gasoline was extracted from natural gas in 1904, the industry did not assume commercial proportions until the year 1910. Table I gives statistics of production in the United States for the years 1916—1920. The total amount of gasoline of all kinds produced in the States in 1920 was about 4·5 billion gallons.

TABLE I

Natural-Gas Gasoline Produced in the United States, 1916—1920

Year	No. of operators	No. of plants	Gasoline produced			Gas used	
			Gallons	Value $	Average price per gall. cents	Volume 1000 cubic feet	Value $
1916	460	596	103,492,689	14,331,148	13·8	208,705,023	14,609,300
1917	750	886	217,884,104	40,188,596	18·4	429,287,797	34,343,000
1918	503	1,004	282,535,550	50,363,535	17·8	449,108,661	40,419,700
1919	611	1,191	351,535,026	64,196,763	18·3	480,403,963	41,314,700
1920	576†	1,154	384,743,962	71,788,122	18·7	496,430,952	41,700,000

† Not comparable with other years because of new classification adopted. (*From statistics of U.S. Geological Survey.*)

At the present time the production of gasoline from natural gas amounts to about 8 per cent. of the total production. This figure appears small, but it is important, because the addition of natural-gas gasoline to refinery gasoline increases the volatility of the latter, and so makes available much larger quantities of less volatile crude-oil distillates for conversion into gasoline. In no other way could the refiner at the present time meet satisfactorily the almost insatiable public demand for motor gasoline. It is probable that if natural-gas gasoline had not been forthcoming for increasing the volatility of motor fuel, the internal-combustion engine for automobiles would have been developed so as to burn less volatile oils, for it is certain that the problem of supplying satisfactory motor-cars would have been solved in some way or other.

OCCURRENCE OF GASOLINE IN NATURAL GAS

Natural gas invariably accompanies petroleum in oil-sand. At times the quantity is almost negligible, usually it is considerable, and frequently it is sufficiently great to turn a well into a "gusher." In the oil-sand the natural gas becomes saturated with the low-boiling constituents of the petroleum and these escape with it from the well.

Natural gas is divided into two great classes: "dry" or "lean," and "wet" or "casing-head" natural gas. By "dry" natural gas is meant gas from natural gas wells, not containing oil, at least not in commercial quantities. In some fields in the United States it is not known until the drill strikes the formation, whether an oil well or a gas well will be found, so close together do the pockets of natural gas and oil lie in the stratum. In such fields it is not uncommon to find both gas and oil in paying quantities in the same well. The term "paying quantities" must be used with reservation, because what would be a paying gas-well in the Eastern States, near extensive pipe-line systems and good markets, would not be a paying proposition in some parts of the West, where the natural gas cannot be conveyed to market except at prohibitive expense. It is different, however, with the oil, which can be stored, and of which a large quantity can be conveyed a long distance by a relatively small pipeline; or it can be transported in tank cars.

"Wet" or "casing-head" gas is found in intimate contact with oil. It emerges from an oil well at the casing-head, finding its way thereto through the annular space in the well between the tubing and the casing.

"Dry" natural gas seldom contains more than 0·5 galls. of gasoline per 1000 cb. ft.; "casing-head" gas contains up to 10—15 galls. per 1000 cb. ft. However, there is no sharp line of demarcation between the two kinds. "Casing-head" natural gas is but rarely found with a lower gasoline-content than "dry" natural gas.

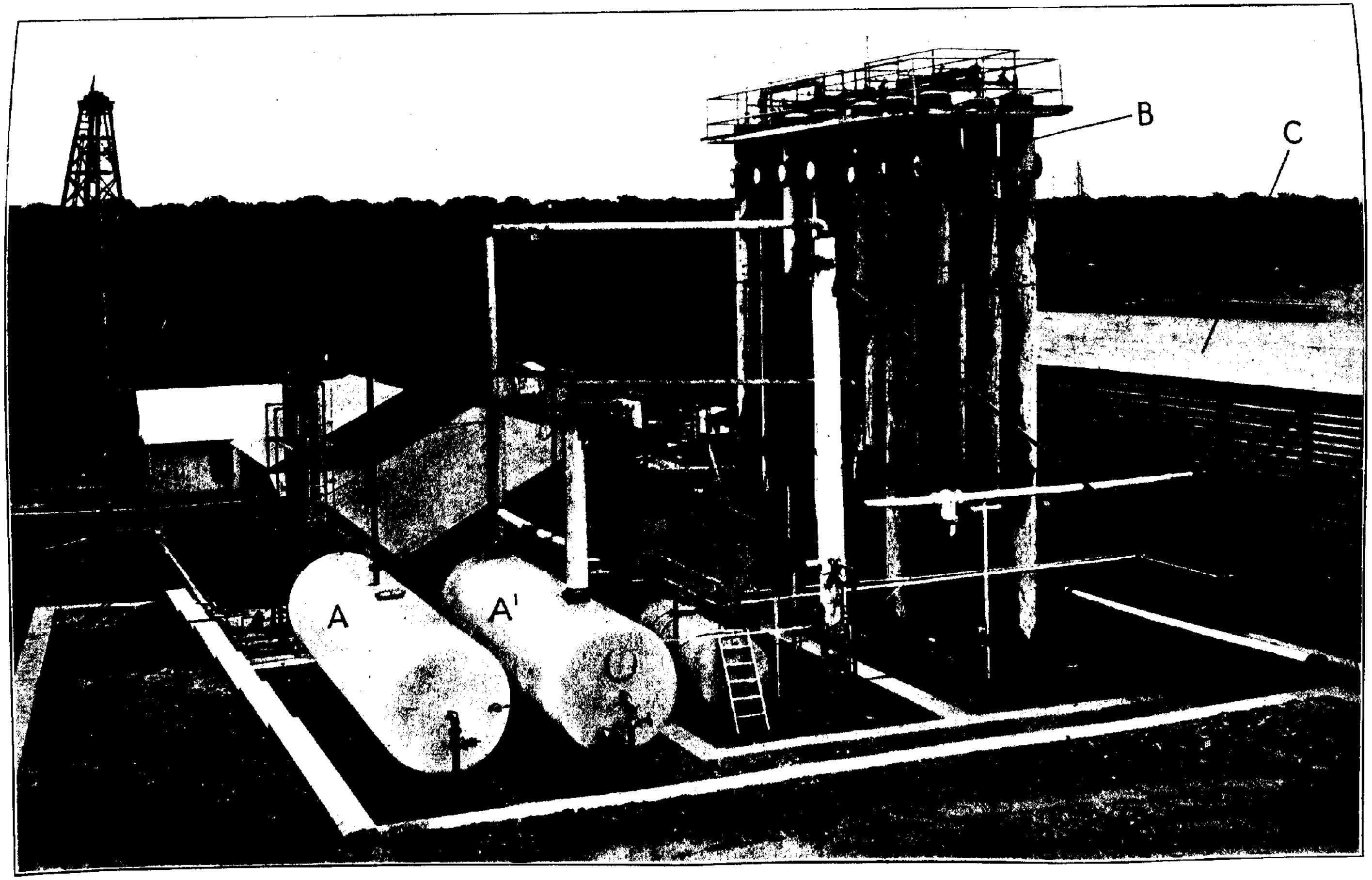
It seems fairly probable that the hydrocarbons of "dry" natural gas were formed by processes analogous to those by which the oil was formed. In some cases, if not many, the natural gas found its way from the main body of the natural hydrocarbons, and lodged finally in the stratum where it was discovered. In its migration it freed itself from most of those hydrocarbons which are liquid at ordinary temperatures, retaining only a relatively small quantity of very volatile gasoline. "Wet" gas, however, being found in contact with crude oil of very high gasoline content, is naturally very rich in this constituent.

COMPOSITION OF NATURAL GAS

The composition of typical samples of "dry" and "wet" gas, as determined by the writer, is given below. The methane was drawn off with a Töpler pump at the temperature of liquid air, and the other hydrocarbons at gradually rising temperatures. Many fractionations were made to extract the several hydrocarbons in a sufficiently pure state. Statements in text-books to the effect that natural gas contains appreciable quantities of oxygen, carbon monoxide, hydrogen, and unsaturated hydrocarbons, have not been confirmed.

---

* Petroleum Engineer, New York.



Oil-absorption plant for extracting gasoline from natural gas. Phillips Petroleum Co., Pershing, Oklahoma.

A, A'—steam stills ; B—absorbers ; C—cooling-coils under cover.

Analyses of Natural Gas

	A "Dry" gas	B "Wet" gas
Methane	84·7	36·8
Ethane	9·4	32·6
Propane	3·0	21·1
Butanes	1·3*	5·8
Pentanes, hexanes, heptanes, etc.		3·7
Carbon dioxide	Trace	Trace
Nitrogen	1·6	†
Total	100·0	100·0

* Principally butanes.

† Owing to unavoidable experimental error the nitrogen content es not appear; it is probably about 1·0 per cent.

EXTRACTION BY COMPRESSION

Gasoline was first extracted from natural gas by e compression method. The casing-head gas is bjected to pressures up to 300 lb. per sq. in., and oled with water in pipe coils, while under essure. The gasoline produced is condensed and apped in storage tanks. To secure the maximum eld of gasoline from oil wells, the gas is frequently thdrawn at the casing-head of the well under a cuum registering up to 25 in. of mercury. Under ese conditions the well simply becomes a still, and ing to the reduced pressure, it happens, not in-equently, that after the natural gas from an old ll has been exhausted, almost pure gasoline pour distils off from the oil-sand. When some oil lls are connected up with many others to a mmon gasoline plant, they remain profitable rces of gasoline long after they have become nost valueless as oil producers. In methods of -winning only from 20 to perhaps 60 per cent. the oil is recovered; hence the vast bulk of the oil mains underground. Although some gasoline mpression plants are connected to as many as 00 wells, the average number is from 100 to 300 lls. One of the largest compression plants in the ited States, producing a maximum of 9000 galls. gasoline per day, is connected to only 29 oil wells.

A natural-gasoline compression plant, in its usual m, is simplicity itself, and consists of a com-essor or compressors, either belt-driven or directly nected to a gas engine; cooling coils arranged in ders made of 2-in. pipe, on which water ps; and receiving tanks, built to withstand the ssure, where the gasoline is condensed, and out which it is automatically trapped into storage ks. Other machinery comprises water pumps, plying condensing water for cooling purposes; a oline pump to move the gasoline from tank to k and to a loading-rack for shipment; a small erator to supply electric current for lights; and sibly a little machinery, such as a drill press or e, for minor repairs. There is usually also a uum pump connected to several 4- or 6-in. n gathering lines leading to various oil leases. nected to these main gathering lines are 2-in. s leading to the casing-heads of the oil wells n which the gas is withdrawn. Some gasoline pression plants are much more elaborate than simple plant just described, because to many rators the industry has proved a very profitable , and this fact is reflected in the size and iency of their units.

ressures required to condense the gasoline from ng-head natural gas depend upon the gasoline ent. When the desirable condensable con-nents, principally pentane, hexane and heptane, present in large amounts, pressures up to 100 lb. sq. in. are sufficient, but usually pressures of to 250 lb. are employed.

In compressing casing-head natural gas to pressures above 100 lb. per sq. in., two-stage compressors are used. In the first stage the gas is compressed to about 35 to 50 lb.; it is then cooled and given its final compression. For natural gas which gives up practically all its gasoline at pressures up to 100 lb., only single-stage compressors are employed. In two-stage compression but little condensate is collected in the first-stage cooling coils. This condensate is of low gravity, usually of sp. gr. between 0·7368 and 0·7000, and is mixed finally with the bulk of the condensate precipitated by the high-stage compressor. Two-stage compression is economical, because the temperature of compression is reduced, and more gas can be compressed in a given installation.

The output of a natural-gas gasoline plant is largely limited by the handling and transportation of the product, and by the extent to which it can be used. Enough pressure could be applied to condense far more of the paraffin hydrocarbons than are liquefied, but these lighter fractions, principally propane and butane, raise the vapour pressure of the entire mixture to such an extent that railroad regulations forbid its transportation; it becomes dangerous to handle, and loss by evaporation (weathering) becomes serious.

Some of these lighter constituents can be saved and fixed for safe transportation and efficient use by the addition of naphtha, of sp. gr. 0·7778—0·7609 and 450° F. (232·2° C.) end-point, to the hot compressed gases in the condensing coils. By this method any grade of gasoline can be made, and the vapour pressure of the mixture can be lowered sufficiently to make transportation safe and use efficient. This particular method of blending is called "hot blending." Many other expedients are adopted to serve the same purpose, but "hot blending" is the best.

In the Eastern States, where oil products of all kinds command a higher price than in the west, gasoline plants producing as little as 200 galls. per day are profitable under some conditions. It is rare in the eastern fields to find a compression plant producing more than 2000 galls. daily, whilst in the western fields of gaseous oil wells, plants to produce 5000 galls. daily are not uncommon.

A complete compression plant to handle about one million cb. ft. of casing-head natural gas per day, with gathering lines, vacuum pumps, booster stations, compressors, gas engines, buildings, water supply, tanks, loading racks, etc., costs about $150,000. Production costs, including labour, overhead charges, depreciation, depletion, taxes, insurance, sales, supplies, repairs, etc., amount to from 7—13 cents per gall. Natural gasoline in the east now sells for about 18 cts. per gall. at the plant, and in the mid-Continent fields for about 15 cts. per gall.

ABSORPTION PLANTS

The oil-absorption method as applied to natural gas is essentially the same as that applied to shale gas by James Young of Clippens, England, in 1876. It was first applied to natural gas by the Standard Oil Co. of New Jersey in 1906, and a U.S. patent was issued to George M. Saybolt of that company in 1911. This patent has been the subject of litigation for about three years, but a decision is due shortly.

The oil-absorption method has a field of operation distinct from the compression method in that it is applied to natural gas which contains a relatively small amount of gasoline vapour. The compression method is usually applied to casing-head gas containing more than 1 gall. of gasoline per 1000 cb. ft., and the absorption method to so-called "lean" or "dry" natural gas containing less than this quantity. However, the oil method is steadily usurping the field long held by the compression method, as operators are learning by experience that oil plants will work efficiently on rich natural gas and at low pressures.

The great bulk of the natural gas used industrially in the United States is the "dry" gas, which comes from gas wells and supplies light and fuel to cities like Pittsburgh, Pa., Cleveland, Ohio, Cincinnati, Ohio, Louisville, Ky., Tulsa, Okla., Fort Worth, Texas, and thousands of other towns and cities. The compression method cannot be used to extract the gasoline from this gas because the partial pressures of the desirable condensable constituents are so small that a prohibitive pressure would be required to precipitate the gasoline-content. The oil-absorption process is used instead, and by it the gas is brought into contact with an oil of sp. gr. 0·8333—0·8140, and having the following general characteristics:—

Characteristics of Absorbent Oil

Specific gravity	0·8284
Pensky-Marten closed-cup flash-point ..	250°F. (121·1°C.)
Cold test	28°F. (—2·2°C.)
Viscosity (Saybolt)	1,300

Distillation Test

Fractions	Per cent.	Deg. F.	Sp. gr.
1	10	537 (262·2°C.)	0·8159
2	10	543 (261·1°C.)	0·8178
3	10	551 (270·6°C.)	0·8192
4	10	557 (273·9°C.)	0·8202
5	10	565 (278·3°C.)	0·8211
6	10	575 (283·9°C.)	0·8221
7	10	585 (289·4°C.)	0·8245
8	10	595 (295°C.)	0·8269
9	10	618 (307·8°C.)	0·8309
10	8·5	660 (331·1°C.)	0·8373
	1·5	above 660 (331·1°C.)	

The oil containing the absorbed gasoline is pumped to a still in which the gasoline is distilled off, usually by means of live steam. The oil is then pumped back to the absorbers for another charge of gasoline, and so the process is continued, the oil acting simply as a carrier of gasoline from the absorbers to the still.

A complete unit consists of absorbers, weathering or vent tank, heat-exchangers, oil-cooling coils, still and condensors, pumps, boilers, piping, gas engine and compressors.

The absorbers vary in size and number according to the pressure and quantity of the gas and its gasoline-content. From the absorbers the oil passes to a weathering tank where the pressure is released, and gases that are loosely held are withdrawn to the compressor. The oil next passes to a heat-exchanger where it is heated by means of hot oil coming from the still, thereby reducing the fuel requirements of the plant. From the heat-exchangers the oil passes into the still where it meets live steam and where the gasoline is distilled from the oil. A mixture of steam, gasoline vapour and some absorbent oil pass out of the still, first into a so-called "knockout" box, where most of the water vapour and absorbent oil is precipitated under thermostatic control at temperatures of 170°—180° F. (76·7°—82·2° C.), and thence to the gasoline-cooling coils where the gasoline is condensed. The oil, freed of its gasoline, passes out of the still through heat-exchangers into oil-cooling coils, where its temperature is further reduced by means of spraying water on the coils, and thence into the top of the absorbers for another charge of gasoline.

All sorts of apparatus to produce the above effects have been tried, such as horizontal and vertical absorbers, different kinds of filling material for the absorbers, such as wooden baffles, cobble stones, steel turnings, clay forms, etc., tubular and double-pipe heat-exchangers, open and closed types of steam stills, vertical stills, fire-heated stills, electrically and gas-engine operated pumps; and all this experimentation is resulting in standard types of apparatus of good design, to fit whatever conditions are encountered.

The type of plant just described is called an absorption plant, but, as a matter of fact, frequently more than half of the gasoline is produced by a compressor which is always included as part of the equipment. The absorbent oil extracts hydrocarbons from the natural gas which cannot be condensed in the gasoline-cooling coils of the steam-still. Therefore these vapours, along with other light vapours from the vent tank, are compressed up to pressures of 250 lb. per sq. in. and cooled in water-cooled coils while under these pressures. There results a deposit of gasoline lighter in weight and more volatile than the gasoline produced from the still, but which, when mixed with the latter, is transportable and usable. This combined product, known as "absorption gasoline," is more stable and of a lower gravity than ordinary compression gasoline. For this reason it is a preferred product and sells for one to two cents more per gallon. This is one reason why more and more casing-head gas is being treated each year by the absorption method than by the compression method. Another reason is that air enters the pipe-lines which draw natural gas from the wells under reduced pressure. The introduction of air decreases the capacity of the compressors, and, what is far more important, diminishes the partial pressure of the gasoline fractions in the gas so that higher and usually prohibitive pressures have to be employed to condense all the gasoline. The introduction of some air into pipe-lines leading to the absorbers of an absorption plant has but little effect on the efficiency of the plant. Rarely can the air-content of natural gas in compression installations be kept below 12 per cent.

It is also true that if the plant is efficient and if the operators have taken advantage of the best information available, all compression plants have small absorption plants to treat their residual gases, because these contain a certain amount of gasoline. No matter what pressure be used to precipitate it, the gasoline has an appreciable vapour pressure and inevitably finds its way into the outgoing gas; the amount will range up to 0·5 gall. per 1000 cb. ft. The best practice is to absorb this remaining gasoline in naphtha, in a tower, the naphtha remaining in contact with the gas long enough to raise its Beaumé gravity five or six degrees, after which it is diverted to a storage tank and a fresh supply added.

Thus we see that a compression plant is really a combination compression-and-absorption plant and an absorption plant is a combination absorption-and-compression plant. As the former combination is more selective in producing a gasoline free from latile constituents, it is coming into favour as an lround type of plant for treating both "wet" and dry" natural gas.

The colder the absorbent oil, the better does it sorb gasoline; hence in oilfields where water is arce, or hot in the summer time, artificial methods ve been adopted to cool the oil. These methods ually take the form of some kind of refrigeration stem, *e.g.*, ammonia coils. This plan has met ith some success although such installations are ry few.

In compression plants, expansion engines are used a limited extent to cool the hot compressed gas om the compressors. In these engines, compressed s is expanded from the power cylinder of an gine, and thus cooled it is passed through the ter tubes of double pipe coils, inside of which sses the gas to be cooled.

Most of the oil-absorption plants are installed on in lines of natural-gas companies supplying ies with gas for light and heat. Almost invariably the plants are located on the discharge le of compressor stations already installed for rcing natural gas to market These compressor tions are adopted by the gas companies when the essure of the gas from the wells has declined to a int that is insufficient to force the gas to market. is has occurred in all the natural-gas fields in e eastern part of the United States and in most the western fields. The natural-gas industry is declining one and already some gas companies ve had to mix artificial gas with their natural s to supply their customers. This is especially e in the winter time when consumption reaches peak.

The pressure of the natural gas at these stations ies between 25 and 300 lb. per sq. in., and as rule ranges from 100 to 200 lb. At higher ssures less oil is required for extraction than at er pressures, for the same quality of gas. The ntity of oil is the principal determining factor fixing the cost of an absorption plant, because more oil that is required, the larger must be absorbers, pumps, stills, boilers, lines, and er equipment. Therefore natural-gas companies e found in the gas delivered from their comssor stations, conditions almost ideal for the cient working of the oil-absorption process. In ition, they had a water supply already at hand, te, working force, shop equipment, houses, etc., of which only had to be enlarged in building absorption plants.

Depletion of Heating Value

xtensive tests have shown that the heating e of dry natural gas is lowered but little by racting the gasoline. Only 1 to 5 pints of line per million cb. ft. of gas are removed. s is equivalent to 10 to 20 cb. ft. of gas per sand, and corresponds on the average to a ease of 2 per cent. or less in the heating value inary dry natural gas has a calorific value of –1200 B.Th.U. per cb. ft., hence the slight ease still leaves a gas far higher in heating e than artificial gas supplied to consumers. depletion in volume due to the extraction of line from casing-head gas may, however, be er cent. or more, because of the higher gasoline ent of this gas. The heating value is, however, very high; as much as 1500—1800 B.Th.U. cb. ft., owing to the preponderance of the hydrocarbons ethane and propane, with heating values of 1800 and 2500 B.Th.U., respectively.

Natural gas is sold at prices ranging from 30 to 75 cts. per 1000 cb. ft.; but little artificial gas of 500 to 600 B.Th.U. per cb. ft. is sold for less than $1·00 per 1000 cub. ft. in the United States.

The extraction of gasoline from natural gas is a real conservation measure. Most of the casing-head gas thus treated formerly went to waste, after the relatively small requirements of the leases for drilling and pumping wells had been satisfied. The gasoline extracted from dry natural gas sells for much more in that form than in the form of vapour mixed with the gas and supplied for heating and lighting purposes.

Absorption plants remove much water vapour from the natural gas. This is an advantage because in cold weather this water deposits in low places in the mains and freezes, breaking or choking the pipe and thus diminishing the output. The removal of the gasoline vapour also lengthens the life of rubbers in the patent pipe-couplings used on all main gas-lines. Some of these mains are 20 in. in diameter and several hundred miles long, and are connected with hundreds of miles of other pipes with diameters down to 1 in.

CHEMICAL INDUSTRY CLUB

Mr. A. Gordon Craig, Chairman of the Executive Committee of the Chemical Industry Club, presided at the fourth annual dinner, which was held in the Connaught Rooms, London, on November 24. Lord Riddell was the principal guest, and there were also present Sir William Alexander, Sir Max Muspratt, Mr. Roscoe Brunner, Mr. T. R. Duggan, Sir William Pope, Dr. E. F. Armstrong, Mr. A. Chaston Chapman, Prof. F. G. Donnan, Mr. P. A. Ellis Richards, Mr. J. Arthur Reavell, Dr. Herbert Levinstein, Mr. E. V. Evans, Mr. W. J. U. Woolcock, Mr. S. H. Burford, and Mr. J. A. D. Mackay (Master of the Tallow Chandlers Company).

Lord Riddell, in proposing "The Profession and Industry of Chemistry," said that he had no doubt been asked to propose the toast because he knew less about chemistry than anyone present, but during the dinner he had put a few questions to the chemical pundits near him, and he gathered from them two things, first, that the position of the chemical trade now was much superior to what it was before the war, and secondly, that the chemical trade was one of those businesses in which there was very little money. However, he discounted the latter statement because he very often went to trade dinners and he always heard the same story. Therefore, he was not surprised to hear that while the chemical industry was doing well in a way, it was doing badly financially. He knew sufficient of chemistry to know that British chemistry had a glorious tradition. It was the custom here to run our country down and other countries up; but ours was the best and the most glorious country in the world, because almost every great discovery of importance during the past fifty years had been made by a Briton; that applied especially to the chemical industry. Nearly all the great inventions of the world had been made by Britons. There was no man on earth who could be found with a brighter mind than a Briton, and he could not help thinking that it would be a good thing if politicians had to attend trade dinners, as he had to, and come into contact with the wonderful men who were silently doing all the wonderful things in science and industry, and so changing the face of the world. They did not write about it, and the general public knew little of what they were really doing. He was glad to learn that greater unity was now prevailing in the chemical industry and he only hoped that that would lead to greater exports, because the future of our country depended upon our export trade.

Prof. F. G. Donnan made a humorous reply to the toast, and was followed by Mr. Roscoe Brunner, who said that he had that morning presided at a meeting of the Joint Industrial Council for the chemical industry, where they were lectured by one of the labour men upon brains and how to put them into industry. This man said that he had lately met a man who had so successfully put brains into his business that he had not reduced wages but had been able to lower his wages bill by £20,000 during the past year. He recommended that idea of putting brains into business to all who were connected with the chemical trade, but he entirely agreed with Lord Riddell that Britishers were far too apt to belittle themselves, and he had represented, on behalf of the chemical trade as a whole, to that meeting of the Joint Industrial Council that the chemical industry had always put brains into the business and was putting more brains in now than ever before. Some of those in the industry had been looking to the Club to help bring about greater unity, and they had also been looking to the Federal Council for Pure and Applied Chemistry. It was to be hoped that their efforts might be successful in bringing together the warring but friendly societies which represented the chemical profession and the chemical industry. They all looked forward to the Club doing a great deal for those warring elements, which, it was hoped, would become very much more friendly in the future, to the great advantage of the profession and industry.

Brigadier-General Sir William Alexander, proposing "The Chemical Industry Club," said the history of the Club was a short but glorious one; it was doing a great deal of good. Lord Riddell had pointed out how Britons had usually been the initiators of new inventions, but initiation did not mean everything. There was development after the invention, and if we paid more attention in the future to development we should reap the financial benefits which hitherto we had allowed others to take from us. He had recently returned from America, where he had been the guest of the Chemists' Club of New York. That, to him, was a wonderful institution which brought together chemists of all classes. He hoped that in time we should have in this country a club on the same lines, where chemists from all parts of the Empire and America could meet and converse.

Sir William Pope, who replied, said there was a danger of chemists getting into boastful habits, after the very fine speeches that had been heard that evening. He looked to the Chemical Industry Club to play a very great part in pulling together the various chemical interests in this country, and what they really wanted now was the assistance of men like Sir William Alexander and other leaders of chemical industry to come and help the Club, and to assist in launching it on to a much broader basis. Although they had every reason to be proud of what the Club had already done, all associated with the profession should put their heads together and endeavour to raise the status of the Club, and make it a still greater factor in the advancement of chemical industry and chemical science.

Mr. C. S. Garland, M.P., proposed the Guests, and made special reference to the presence of Sir Max Muspratt and Mr. Duggan.

Sir Max Muspratt, replying to the toast, said he was an extraordinary believer in the human touch in industry. A short time ago he was asked to give an inaugural address at the new Widnes Chamber of Commerce and he chose as his subject "The Human Factor in Industry." He ventured to say there at some length what he would now say in a very few words. There was an absolute necessity that we should allow the human element and the human conception to enter into our industry and our science. Many of the things that Lord Riddell had said were absolutely true. We Britons did underestimate ourselves; we had a certain amount of reserve and thought it was bad form to talk about what Britons had done in industry and science; that was because we did not understand and trust one another sufficiently. No body of friends had the slightest objection to one or the other blowing his own trumpet in reason. The other extreme of not blowing one's trumpet because we were not friends, meant that the whole of the British Empire was losing a valuable asset. We wanted, from the smallest laboratory boy to the biggest professor, to learn that we are all members of a great body of scientists and industrialists. We wanted it to be realised from the most humble apprentice in the works to the chairman of the biggest company that we are all one body striving with heart and soul to keep England in its proud position at the head of the chemical industry of the world; and it was because functions like this helped many members of the chemical industry and profession to realise that human touch that he would always be proud to be present, whether as a guest or as the humblest member.

Mr. T. R. Duggan (Chemist's Club, New York) was also called upon to reply. He said it was twelve or fourteen years since he had had the pleasure of speaking to an English audience. He was in the habit of speaking to Americans, and it was very easy to speak to Americans, whereas it was not so easy to speak to Englishmen. They had made very kind references to the Chemist's Club of New York, and he could only repeat that its members would be extremely pleased to welcome any members of the British Chemical Industry Club at any time they should find it possible to visit New York. Already there had been considerable intercourse between the two Clubs, thanks to the efforts of Mr. Coley, the secretary of the Chemical Industry Club. The New York Club was started many years ago, and it might surprise some of them to know that it owed its existence to Dr. Schweitzer, who was an extremely clever man, a German, but a naturalised American citizen. The American Club had good premises, thanks to the generosity of a chemical manufacturer, which were worth £150,000, half of which was mortgaged. The premises consisted of ten floors nd there were thirty rooms, of which twelve were r residential purposes. The New York Club found essential to have resident members; they helped nsiderably in bringing to the Club those who ould not come if they were not sure of meeting meone. He himself had lived at the Club for leven years. In many ways the Club premises in Whitehall were better than those in New York ecause in New York the restaurant did not pay, nd if the London Club moved into larger premises han those at Whitehall Court and started its own estaurant it might have the same experience. The ifficulty in that case was that on certain days of he week there were hardly any members using the lub and yet the staff had to be maintained all the ame. In New York they had a staff behind the estaurant of fifteen which had to be kept up, and ometimes there were two waiters to one diner. It ad been mentioned that he was one of the original members of the Society of Chemical Industry; he was one of the original starters of the Society, not he original that they had in mind, but the original efore that. There was a dispute as to when it was tarted. It was not started in the north of England ut in London by "Tommy" Tyrer one night owards the end of 1880. He himself had to go down o the Institute at Finsbury and there was a party f fifty or so present, which formed the nucleus of he original Society of Chemical Industry. There was another meeting in the following January at which 150 were present, and he was on the committee which was formed at the first meeting. For ome reason he was not on the second committee, ut that was the real history of the start of the Society of Chemical Industry. Unfortunately "Tommy" Tyrer was no longer with us, but his on would probably remember the meeting.

Proposing the toast of "The Chairman," Dr. E. F. Armstrong said Mr. Craig was a chemical merchant, but there were several kinds of chemical merchants. There was the chemical merchant of the very highest class who rubbed off the German abels from the bottles before he placed his own upon them; there was the chemical merchant who glued his own label, a great big one, on top of the German label; and then there was Mr. Gordon Craig. He thought the Club was very fortunate in having him as its chairman.

The Chairman, in reply to the toast, assured those present that if ever he did deal in German goods he informed his customers that they were German. As to the Club, he wished to emphasise the fact that it was a social club. It was a live club and a growing club, and it was intended that the club should grow and outgrow its present premises. As chairman of the Executive he wished o say that they felt they were on the right lines. They now had the support of the most eminent members of the chemical industry and of the Federal Council on the Executive of the Club, which was a great asset. It was also to be emphasised that the Club was intended for recreation and for bringing all classes of chemists together, rom the academic man right down to the humble merchant, such as himself. It might be that they were sometimes not in sufficiently close touch with he manufacturers; well, here was the opportunity o get into close touch with one another and discuss verything from their own points of view. That was what the Chemical Industry Club wanted and aimed at.

SOCIETY OF CHEMICAL INDUSTRY

NEWS FROM THE SECTIONS

EDINBURGH AND EAST OF SCOTLAND

Dr. H. E. Watt presided at the meeting which was held in the Hall of the Pharmaceutical Society, Edinburgh, on November 14. The admission of seven associates was approved.

Prof. G. Barger delivered an address on "Some Recent Advances in Biochemistry." After a short retrospect of the early beginnings of biochemistry, the lecturer dealt with recent work on the proteins by Dakin and others, particularly that relating to partial racemisation. Dakin's explanation of this phenomenon makes clear the possibility of a separate protein for each species; this is known to be the case with the albumin of the egg of the duck and the hen, the difference between the two proteins having been demonstrated by their anaphylactic relationships. It also explains in part the difficulty of synthesising proteins, as the use of alkali in connecting up different amino-acids will bring about partial racemisation. By the use of butyl alcohol and continuous extraction of the amino-acids from solution in water, Dakin found in casein β-hydroxyglutamic acid, an amino-acid which had not hitherto been detected and which constitutes 10 per cent. of the weight of the protein. Perkin and Robinson's work on harmine and harman was then briefly described, and also recent work on hormones and on the extraction of the very active substance thyroxin from the thyroid gland and of insulin from the islets of Langerhaus. An important development in the therapeutic application of chemistry is the production by the Bayer Company of a substance which is a specific remedy for sleeping sickness, and whose efficiency lies in its power of preventing the fission of the trypanosomes. Of considerable interest in connexion with physiological effects and chemical constitution is the *syn*-oxime of perillaldehyde, which has been prepared in Japan from the essential oil of *Perilla nankinensis*, and is claimed to be 2000 times as sweet as sugar, although the *anti*-oxime of the same substance has a bitter taste. In conclusion the lecturer described the production of glycerol from sugar by alcoholic fermentation in alkaline medium.

NOTTINGHAM

At the meeting held on November 22, Mr. S. F. Burford presiding, Mr. S. R. Trotman read two papers, one on "Bleaching Cotton with Hypochlorous Acid," and the other, in conjunction with Mr. D. A. Langsdale, on "The Action of Ozone on Wool and Chlorinated Wool."

In continuation of work already described (*cf.* J., 1922, 219T) the bleaching of cotton by hypochlorous acid was further investigated. Hypochlorous acid itself, and a solution made from bleaching powder and boric acid, showed very similar rates of absorption by the fabric. The absorption from bleaching powder is much more gradual. The hypochlorous bleach gives whiter goods, the percentages of ash and oil are lower, and the copper value (an index of the oxycellulose formed) is much lower than that obtained by the usual process. The use of hypochlorous acid obviates the necessity for a "sour," and hence saves both material and one handling of the goods.

When commercial chlorinated wool was exposed to the action of ozonised air for a week, all the effects of chlorination already described (*loc. cit.*) are accentuated. The proportion of fibres damaged by the loss of their epithelial scales is increased, and the amount of wool dissolved by alkalis is greater, but there is a loss in felting power and elasticity. Very similar effects are produced by other agents, *e.g.*, *Bacillus subtilis*, which are capable of destroying the scales of the wool fibres. All these results give a foundation for the complaints that unshrinkable wool does not wear well.

LIVERPOOL

A special meeting of the Section was held in the University on November 29, under the scheme for co-operation between this Society and the Chemical Society. Mr. A. T. Smith occupied the chair, and about 60 members, Fellows of the Chemical Society and friends, were present. Prof. E. C. C. Baly delivered a lecture on "Photo-catalysis, Part III.: The Photosynthesis of Naturally-occurring Nitrogen Compounds from Carbon Dioxide and Ammonia," in which he summarised the work on this subject done by himself, in collaboration with Prof. I. M. Heilbron and Mr. H. J. Stern. The chairman, Prof. Heilbron, Capt. F. A. Freeth, Mr. A. Morton, Mr. H. M. Langton, Dr. C. H. Clark and Mr. R. Thomas took part in the discussion.

The Annual Dinner of the Section, in conjunction with the Liverpool and North-Western Counties Section of the Institute of Chemistry, was held on December 2 in the Midland Adelphi Hotel, and was attended by over 120 members and friends. The chair was taken by Dr. F. J. Brislee, chairman of the local Section of the Institute of Chemistry, and among the guests were the President of the Society and Mrs. Armstrong, the Lady Mayoress of Liverpool, Sir Max Muspratt, Bt., the Hon. W. and Mrs. Hulme Lever, Mr. John Gray, Dr. G. C. Clayton, M.P., Mr. Horatio Ballantyne, Alderman and Mrs. W. Muirhead, the Town Clerk and Mrs. Moon, Dr. J. P. Longstaff, and Mr. R. B. Pilcher. After a short toast list, the remainder of the evening was devoted to music and dancing.

OTTAWA

The first meeting of the current session was held on November 9, the subject of discussion being "Domestic Fuel Problems." Mr. Hambly occupied the chair; fifty members and friends were present. In introducing the subject the chairman briefly referred to the problems met with in firing both industrial and domestic furnaces.

The characteristics of different types of fuels were dealt with by Messrs. R. E. Gilmore, J. H. H. Nicolls, and H. Kohl under the following heads: (a) the relative value of chemical and physical analysis of coal and other fuels; (b) the classification of the higher types of fuels; and (c) the ignition temperature of different fuels.

Chemical analysis involves the determination of moisture, ash, volatile matter, and fixed carbon. The moisture and ash determination tell what quantity is not real fuel. The volatile matter indicates whether the fuel is smoky or not and the fixed carbon shows how much coke or charcoal a given fuel will yield. Physical analysis includes the handling, storage and burning qualities. The classification of coal into anthracite, semi-anthracite, semi-bituminous, etc. is accomplished by chemical analysis, but this must not be done without taking into account the physical characteristics. If to a chemist's certificate of analysis were attached an interpretation of the results of analysis, the layman or semi-technical man would place more value on chemical analysis than he usually does.

The Welsh coal now sold in some Canadian cities comprises at least four different grades, and the trouble with it is not due to its chemical, but to its physical properties, particularly its hardness. If the best grades of Welsh anthracite were screened and graded before selling to the consumer, they would be equal to, if not better than, the best grades of Pennsylvania anthracite. American anthracite is, however, considered the standard household fuel, and as long as this supply is available it looks as if only the price factor will control its use.

The various methods of determining the ignition temperature of coal were fully described.

Mr. E. S. Malloch outlined the practical operation of a hot-water furnace with each of the different types of fuel, and described the results obtained in each case.

BIRMINGHAM

A joint meeting with the Midland Counties Section of the Institute of Brewing was held in the University of Birmingham on November 23, when Dr. E. B. Maxted presided and Prof. A. R. Ling read a paper on "Starch and its Estimation in Barley and in Wheat."

After discussing the economic importance of starch, Prof. Ling said that in the absence of an accurate method of estimation the practice had arisen of expressing the starch content by difference as "nitrogen-free extract." This, like most of the methods of estimating starch, was inaccurate and attention was therefore devoted to the researches of C. O'Sullivan and Horace T. Brown, which provided a basis for further inquiry. It had been found that the percentage of apparent maltose produced at the end of, say, 1 hr. by hydrolysing starch with malt diastase bore a constant relation to the starch originally present. To apply this method in practice it was necessary to determine how the percentage of apparent maltose produced by hydrolysing starch varied with the diastatic power of the malt employed. This had been done, and extremely pure wheat and barley starches had been found to give identical results on hydrolysis, due allowance being made for variation in the diastatic power of the malt. The method finally evolved may be summarised as follows:—About 5 g. of finely-ground grain is extracted in a Soxhlet extractor with alcohol (sp. gr. 0·920) for 2 hrs., to remove the sugars, fats and certain proteins. The residue of starch is washed into a beaker, gelatinised by boiling for 10 minutes, cooled to 57° C., and hydrolysed with 10 c.c. of malt-extract of diastatic power 70° (Lintner) for 1 hr., with constant stirring. After boiling, the conversion liquid, together with the washings of the residue, is filtered and made up to 200 c.c.; 30 c.c. of this solution is diluted to 100 c.c. and titrated against 10 c.c. of Fehling's solution. A blank experiment, using water and malt extract only, is carried out in the same way as the actual conversion to enable a correction to be made for the reducing bodies present in the malt tract. The percentage of starch is calculated by e formula S=94·73 M′/M, in which S is the per- ntage of starch in the sample, M the percentage of parent maltose produced from dry barley or heat starch from malt of known diastatic power iven in the form of a graph) under definite con- tions, and M′ the percentage of apparent maltose elded by the sample under the same conditions, d with malt of the same diastatic power. The ethod has given accurate results with barleys and heats from the Rothamsted Experiment Station d the Olympia Agricultural and Research ation, Offchurch.

In the discussion Capt. H. J. Page said that the ethod was valuable and gave very concordant sults which accorded with the percentages of arch they expected to find in barleys and wheats. e hoped that the method would be extended to ply to other starches.

A special meeting, to which Fellows of the hemical Society resident in the Midlands were vited, was held on December 5, in the University. Dr. E. B. Maxted presided, and the following ree papers were presented by Prof. G. T. Morgan d his associates:—(1) Researches on Residual ffinity and Co-ordination. Pt. XV. Interactions Acetylpropionylmethane and the Tetrachlorides Selenium and Tellurium (with Mr. H. G. eeves).

(2) The Upper Limit of Diazotisability in the enzene Series: Aminomesitylene-*bis*-diazonium alts (with Mr. G. R. Davies).

(3) Studies in the Normal Butyl Series. Pt. II. he Four Stereo-isomeric $\beta\gamma$-Di-*p*.tolylamino-*n*- utanes.

(1) The tetrachlorides of selenium and tellurium ch induce characteristic tautomeric changes in active β-diketones such as acetylacetone and its mologues. Acetylpropionylmethane (propionyl- etone), preferably in the form of its copper rivative, behaves towards selenium tetrachloride its ordinary mono-enolic modification,

$$C_2H_5.C(OCH_3):CH.CO.CH_3,$$

l yields selenium acetylpropionylmethane,

$$Se_2(C_6H_8O_2)_2.$$

th tellurium tetrachloride, acetylpropionyl- thane reacts in its methylene-enolic form, $I_5.CO.CH_2.C(OH):CH_2$, giving rise to tellurium tylpropionylmethanedichloride, $Te(C_6H_8O_2)Cl_2$. reduction this dichloride furnishes tellurium- tylpropionylmethane, $Te(C_6H_8O_2)$, a substance ing an intense bactericidal action.

2) When treated with three molecular propor- ns of nitrous acid, triaminomesitylene hydro- oride in acid solution is diazotised only in two its amino-groups, yielding aminomesitylene-*bis*- zoniumchloride identified by conversion into inomesitylene-*bis*-azoimide $NH_2.C_9H_9N_6$ and the ichloride hydrochloride,

$$HCl,NH_2.C_9H_9(N_2.AuCl_4)_2.$$

en, however, this diazotisation with excess of ite is effected in presence of hydrazoic acid, formation of the foregoing *bis*triazo-compound ollowed immediately by the diazotisation of the d amino-group, thus leading to the production *tris*triazomesitylene, $C_9H_9N_9$. It is inferred these results that in a monocylic triamine of benzene series, only two of the three amino- ps can be diazotised concurrently. The diazo- bility of the third amino-group is manifested after the two first-formed diazonium complexes have been substituted by other groups, such as the triazo-radicle.

(3) When $\beta\gamma$-dichloro-*n*-butane, or the corresponding dibromo-compound, is condensed with *p*-toluidine, two isomeric diamines are produced having the same graphic formula:

$$p.C_7H_7.NH.CH(CH_3).CH(CH_3)NH.C_7H_7.p.$$

The less fusible isomeride is a racemoid substance resolvable by the aid of d-*o*-bromocamphor-R-sulphonic acid, into two optically active enantiomorphs, *d* and *l* $\beta\gamma$-di-*p*-tolylamino-*n*-butane. The more fusible isomeride, which is non-resolvable, is meso-$\beta\gamma$-di-*p*-tolylamino-*n*-butane. These four stereoisomeric modifications of the same diamine furnish a complete analogy with the four stereo-isomeric tartaric acids, this being the first instance in which a complete set of four basic substances containing two asymmetric carbon atoms has been isolated in definitely crystalline forms. During the condensation between *p*-toluidine and the dihalogenated *n*-butanes a basic by-product is isolated, yielding characteristic bright yellow salts, and identified as 3.5.7-trimethylacridine.

MANCHESTER SECTION AND THE CHEMICAL ENGINEERING GROUP

A joint meeting of these organisations was held in the Textile Institute, Manchester, on December 1, when Mr. W. G. Fraser read a paper on "The Chemical Engineering of Paper Manufacture." In the abridged form of the paper, as circulated, a brief outline is given of the processes and plant used in the manufacture of paper from various raw materials. The digestion and bleaching operations are described, and reference is made to the importance of beater design on the character of the beaten pulp; for example, with a high backfall close up to the roll, hydration takes place rapidly, whilst with a backfall more tangential and further away from the roll, hydration takes place less readily. Some interesting facts are noted regarding the consumption of water and coal in a paper mill; the quantity of water, including that used in steam-raising, varies from 100,000—150,000 galls. per ton for rag papers to 10,000—12,000 galls per ton for newsprint. The amount of coal may vary from 6—7 tons per ton of rag papers to 16—17 cwt. for newsprint. A table is given showing the approximate quantity of coal used for each operation in a mill which consumed 720 tons of coal in the manufacture of 265 tons of paper.

LONDON

On December 4, in the Engineers' Club, Dr. G. Scott Robertson, chemist to the North of Ireland Government, and Mr. F. Dickinson read a paper on "The Valuation of Insoluble Phosphate by means of a Modified Citric-Acid Test." Mr. E. V. Evans presided over a small attendance.

After enumerating the different kinds of insoluble phosphatic fertilisers, the authors draw attention to the insufficiency of the official citric-acid test when applied to low-grade basic slags, particularly fluorspar slags, and rock phosphate. If 1 gram of phosphate be used in the test, instead of 5 g., the analytical results give a much better indication of the fertilising value.

The discussion served to show up the extremely empirical nature of the citric-acid test, and left the impression that it is advisable to work out a new test, based on scientific principles.

THE JOURNAL

On several occasions in the past the Council and the Publications Committee have considered the feasibility of issuing the *Journal*, or a part of it, weekly instead of twice a month; but there were always obstacles which could not be overcome. Now, however, conditions appear to be more favourable, and the Council has decided to publish a weekly Journal from the beginning of next year.

At the October Meeting of Council, it was resolved, on the motion of Sir William Pope, chairman of the Federal Council, to issue the "Review" section as a separate weekly periodical, under a new name, and as the official organ of the Federal Council. To make the necessary arrangements the Council appointed the following to act as an Executive Committee:—Sir W. Pope, Dr. E. F. Armstrong, Mr. E. V. Evans, Dr. S. Miall, Mr. F. H. Carr, Mr. W. J. U. Woolcock, and Mr. C. S. Garland. In its report, presented to the Council in November, the Committee recommended: that the weekly journal should be called "Chemistry and Industry"; that for a period of one year copies of it should be placed at the disposal of the Chemical Society for distribution among those of its Fellows who are not members of the Society of Chemical Industry; and that the editorship should be offered to Dr. Stephen Miall, as the Committee had failed to come to terms with the present "Review" Editor. In accepting these proposals, the Council expressed the wish that, if possible, Abstracts and Transactions should also be issued weekly, under the same cover. The Executive Committee has since decided that this course will be practicable, and, accordingly, arrangements are now being made to issue:—(a) a weekly journal bearing the two titles "Journal of the Society of Chemical Industry" and "Chemistry and Industry," to be sent to members and subscribers at existing subscription rates; and (b) "Chemistry and Industry," under a separate cover, at a charge of 6d. per copy, or 21s. per annum (25s. abroad). The advertisements will appear in both issues.

MEETINGS OF OTHER SOCIETIES

SOCIETY OF GLASS TECHNOLOGY

The meeting held on November 22 in the University of Sheffield opened with the presentation of the Frank Wood medal, established in honour of the Society's first president, to Messrs. G. G. Middleton and H. W. Howes, students in the Department of Glass Technology of the University. In presenting the medal, Mr. Frank Wood expressed appreciation of the honour of having his name associated with it.

Prof. W. E. S. Turner then described his recent visit to investigate the position of the glass industry in Czechoslovakia. After sketching the difficult economic position, he said that the industry was by no means as advanced technically as the British industry, but was living largely on tradition and existing knowledge. Hardly any machinery was used and hand-work predominated. Much money was made during the boom years 1919 and 1920, and but little had been spent on improving the industry, whereas, despite taxation, British manufacturers had invested large sums in improving and extending their works and plant. From a technical point of view this country surpassed the Continent in many respects, and he hoped that the effect of this technical superiority would soon be evident.

A paper on the use of selenium for producing colourless glass was presented by Mr. A. Cousen, who described a large number of experimental melts made to determine the effect of various batch materials on the decolorising power of selenium. Details were also given of a series of melts designed to show the influence of the duration of melting on the colour developed.

SOCIETY OF DYERS AND COLOURISTS

At the meeting of the Manchester Section, held on November 17 in the Chemical Lecture Theatre of the University, a paper on "Ionamines: a New Class of Dyestuffs for Acetate Silk," by Prof. A. G. Green and Mr. K. H. Saunders, was read by Prof. Green.

Earlier work has shown that although the variety of artificial silk known as "acetate silk" possesses little or no affinity for acidic or direct cotton dyestuffs, it exerts a considerable attraction for many basic compounds and for certain azo dyestuffs in which sulphonic groups are absent. In dyeing with a basic dyestuff it is the base itself which is taken up by the fibre, and if the dyestuff is applied in the form of a salt this must be readily dissociated by water. In the attempt to obtain a class of dyestuffs specially suitable to this material the authors were led to investigate the suitability of methyl-ω-sulphonic-acid derivatives of amidoazo-compounds. These derivatives have the general formula

$$Ar'-N_2-Ar''.NR.CH_2.SO_3Na.$$

They are readily soluble in water, and are easily hydrolysed by dilute acids or alkalis with formation of insoluble amidoazo-bases:

$$Ar'-N_2-Ar''.NR.CH_2.SO_3Na+H_2O$$
$$\rightarrow Ar'.N_2.Ar''.NRH+CH_2(OH)SO_3Na.$$

It was therefore to be anticipated that if the hydrolysis were brought about in the dyebath in presence of acetate silk the latter would be dyed by the liberated base.

Experiment confirmed this, and a series of new dyestuffs termed "Ionamines," based upon this discovery, are now being placed upon the market by the British Dyestuffs Corporation.

Ionamines derived from primary amines, or which contain a free primary amino-group, are capable of being diazotised on the fibre and on development give a wide range of shades from orange to scarlet, red, maroon, violet, blue and black. The direct shades are at present limited to yellow, orange, red and violet.

Those Ionamines which have an affinity for cotton are found to have a smaller affinity for acetate silk, whilst the Ionamines possessing the best affinity for acetate silk have none for cotton. The effect on wool is curious. The omega-sulphonic acids dye wool exactly as other acidic dyestuffs and the omega-sulphonic group is thus protected from hydrolysis. With natural silk the dyestuff appears to be partially hydrolysed, but the investigation in this direction is incomplete.

The new dyeing process differs from the ordinary processes of dyeing in that chemical change is involved. There is thus no possibility of "levelling-up" an uneven shade by longer heating in the bath. The material is best entered at a low temperature and the bath raised slowly to 65—75° C. Dyeing is icilitated by the presence of small quantities of ither acids or alkalis. For diazotisation a weak cidified bath of sodium nitrite is employed, re- ction being complete in about five minutes. Only evelopers containing no sulphonic groups can be tilised, the most generally useful being resorcinol neutral), beta-oxynaphthoic acid (slightly acid with cetic) and beta-naphthol (weakly alkaline). The olours obtained with these developers and four ypical Ionamines are the following:—

	Direct	Resorcinol	Beta-naphthol	Beta-oxy-naphthoic acid
onamine A	Yellow	Red-brown	Red-purple	Navy blue to black
onamine B	Orange	Red-orange	Scarlet	Crimson
onamine H	Orange-yellow	Red-brown	Red-purple	Purple
onamine L	Dull yellow	Purple-brown	Purple	Bright blue

Interesting effects are produced on mixtures of otton and acetate silk. By a suitable selection of lirect cotton dyestuff and Ionamine,. the two fibres an be dyed either in different colours or in a solid hade. This can be done either in a single bath or y "cross-dyeing."

The peculiar properties of the Ionamines, which an exert at the same time the functions of both asic and acidic dyestuffs, render it probable that ther uses may be found for them.

INSTITUTE OF CHEMISTRY

At the annual meeting of the Leeds-Area Section, eld in Leeds on November 22, Mr. W. McD. Mackey presided, and Mr. F. W. Richardson read paper on "The Ethics of Expert Evidence."

There is probably some reason for the disrepute n which expert evidence is held, particularly by he legal profession. In wording reports the public nalyst should not allow himself to be led by a bias n order to secure a conviction. Health authorities nd the police are frequently victims of the will o prosecute and magistrates are overwhelmed by he impulse to convict; but the attitude of the uthorities towards violations of the Food and Drugs Act has improved greatly. Several years ago he speaker, in reporting on a sample of butter eficient in fat, suggested that the cows were either bnormal or fed abnormally and asked for samples f the milk. The report was returned with the emark that it was not for the prosecution to uggest a line of defence. In Court the defence roved that the deficiency in fat was due to ex- essive feeding on cottonseed cake. Public analysts re thus to some extent at the mercy of the health ommittee or the medical officer of health, and it suggested that the public analyst should act in a dicial capacity between the health committee and e offender. It is deplorable that even in me clear case of fraud the defendant has no fficulty in obtaining all the expert help required, d however glaring the adulteration, if the firm is ealthy enough, its case is always supported by an ray of leading chemists. Some of these experts, hilst admitting the accuracy of the prosecution's ta, attempt to confuse the issue by raising sub- diary questions. Such jugglery, which at times ludes the magistrate, is to be resented and there need of a special committee appointed by the embers of the Institute of Chemistry to consider es of unprofessional conduct. Members of the me profession should cease all attempts to score one another and to gain professional "kudos" the cost of the opponent's reputation.

THE CERAMIC SOCIETY

At the November meeting of the Ceramic Society Messrs. A. Brittain and C. Elliott read a paper on "The Gypsum Industry." After consideration of the composition and modes of occurrence of gypsum, the authors discussed their investigations on the dehydration of gypsum by heat, as a result of which they concluded that, under technical conditions: (*a*) in the dehydration of lump gypsum by hot gases, the hemihydrate is formed at a much lower temperature than that existing at the surface, there being an inversion point at about 100° C.; (*b*) in the calcination of finely-ground gypsum, the production of hemihydrate occurs within the temperature limits of about 109°—130° C.; (*c*) the hemihydrate$\rightarrow$soluble-anhydrite change occurs within the temperature zone of about 160°—200° C., the product being practically anhydrous before the further rise in temperature occurs.

Processes for the dehydration of gypsum were described, and a general comparison was made in regard to power required for equal output and fuel consumption. Detailed reference was made to certain recent applications of plaster.

Commercial plasters, according to the temperature and time of calcination, may contain (besides the moisture and impurities present in all commercial plasters) varying proportions of: (1) unchanged gypsum; (2) hemihydrate; (3) anhydrous calcium sulphate in the form of (*a*) soluble anhydrite, which readily absorbs water and reverts to the hemihydrate; (*b*) slow-setting anhydrite, which absorbs water slowly and sets with hardening; (*c*) dead-burnt plaster and anhydrite, which do not rehydrate with water. Unchanged gypsum acts as an accelerator to the setting of plaster, whilst slow-setting anhydrite acts as a retarder. The desirability of standardising the various tests for plaster was strongly urged.

THE FARADAY SOCIETY

At the annual meeting, held in the Chemical Society's Rooms, Burlington House, W., on November 20, Prof. A. W. Porter announced that Sir Robert Robertson had been elected president of the Society, and that future annual meetings would be held in May.

Sir Robert Robertson, in the chair, introduced the following papers to the meeting:—(1) "Intra-Molecular Ionisation," by Prof. T. M. Lowry; (2) "The Viscosity and Molecular Dimensions of Hydrogen Selenide," by Mr. C. J. Smith; and (3) "The Hydrogen-ion Concentration of Natural Waters and some Etching Reagents and their Relation to Action on Metals." Two papers by Mr. E. W. J. Mardles on "Viscosity Changes Associated with the Gel to Sol Transition," and "The Scattering of Light by Organosols and Gels of Cellulose Acetate," were postponed.

(1) Dr. Lowry showed that the hypotheses of Co-valency and Electrovalency in conjunction with the octet theory can account for previously supposed cases of variable valency. The familiar cases of intra-molecular ionisation of the organic amino-acids have led the author to suggest electronic formulæ for various organic compounds. The increase in the stability of the oxy-acids of chlorine, sulphur and phosphorus with increase in oxygen-content, can be shown to be due to the positive charge on the central atom of the ion. The effect of the addition of oxygen in modifying the acidity

of certain compounds can also be shown to be due to the positive charge on the central atom of the ion, and apparent discrepancies, *e.g.*, hypochlorous acid, are explicable on the assumption that the oxygen atom occupies the central position in the molecule in place of the chlorine atom. The decrease of acidity in passing along the series perchloric, sulphuric, phosphoric, and silicic acids may be associated with the diminishing positive charge on the central atom of the ion, as well as with the reduction in the mass of the nucleus. In the discussion that followed Dr. Lowry defended the use of the term " ionisation " in opposition to the view expressed by several speakers that the word " polarisation " was preferable.

(2) In continuation of researches with Prof. A. O. Rankine, Mr. C. J. Smith has shown that the results obtained for the viscosity of hydrogen selenide are consistent with those previously obtained for krypton, hydrobromic acid and arsine. The research was rendered difficult by the instability of hydrogen selenide; by comparison with air at 20° C. and assuming the constancy of Sutherland's constant, the mean collision area of the gas was found to be $0{\cdot}86 \times 10^{-15}$ cm. The method of dividing the mercury pellet in the viscometer into two pellets for correction purposes seems capable of wider application.

(3) Dr. Atkins has estimated by means of " buffer " solutions the influence of peat, carbon dioxide, glass, rubber, calcium and magnesium carbonates on the hydrogen-ion concentration of various natural waters, and he suggests the use of acids of relatively low hydrogen-ion concentration and of " buffer " mixtures as etching reagents for metals.

FEDERAL COUNCIL FUND

First List of Contributors

	£	s.	d.
Dr. E. F. Armstrong, F.R.S.	50	0	0
Sir John Brunner, Bart.	50	0	0
Sir R. Waley Cohen, K.B.E.	50	0	0
E. V. Evans	50	0	0
John Gray	50	0	0
Sir Robert A. Hadfield, Bart., F.R.S.	50	0	0
Dr. J. T. Hewitt, F.R.S.	50	0	0
D. Lloyd Howard	50	0	0
Dr. H. Levinstein	50	0	0
Dr. Stephen Miall	50	0	0
Emile Mond	50	0	0
Robert Mond	50	0	0
Sir Max Muspratt, Bart.	50	0	0
Sir William Pope, K.B.E., F.R.S.	50	0	0
W. J. U. Woolcock	50	0	0
The Hon. W. Hulme Lever	25	0	0
C. T. Heycock, F.R.S.	21	0	0
W. H. Stead	20	0	0
R. B. Brown	10	10	0
Dr. H. G. Colman	10	10	0
Prof. G. G. Henderson, F.R.S.	10	10	0
Prof. T. M. Lowry, F.R.S.	10	10	0
Sir James Walker, F.R.S.	10	10	0
Sir W. A. Wayland, K.B.E.	10	10	0
F. H. Carr	5	5	0
H. E. Coley	5	5	0
Prof. H. Louis	5	5	0
Sir Robert Robertson, K.B.E.	5	5	0
Joseph T. Wood	5	5	0
R. Smith	2	2	0
G. R. Gilks	1	1	0

NEWS AND NOTES

CANADA

Pulp and Paper

The Howard Smith Paper Mills, Ltd., is erecting at Cornwall, Ont., a mill with a capacity of about 15,000 tons per annum of bleach soda pulp. Poplar wood will be the chief raw material.

Work is progressing rapidly upon the erection of the large paper mill of the Backus Company at Kenora, Ont. When completed the output of newsprint from this mill will be 1000 tons daily.

Operations have commenced at the new mill of the Temiskaming Pulp and Paper Co., recently erected at a cost of approximately $1,000,000. The plant will have a daily production of 40 tons of ground wood pulp, which will be shipped to Chicago, Kalamazoo, and points in the State of New York.

The large pulp and paper mill which is to be built at Phillips Bridge, nine miles south of Elko, upon the Elk River, B.C., has been promoted mainly by the *Chicago Tribune* and other newspapers. The company will be known as the Wigwam Pulp and Paper Co., Ltd.; the plant is to cost $10,000,000 and employ about 1500 hands.

Engineers of the Armstrong Whitworth Co. have proceeded to Newfoundland to establish a large pulp and paper plant in that colony. The Toronto *Globe* states that the British Government has guaranteed $10,000,000 on the recommendation of the Trades Facilities Board, to assist the enterprise at Humber, Newfoundland, and the Newfoundland Government has guaranteed a like amount.

It is stated that the control of the Belgo Paper Co., which has been organised to take over the Belgo-Canadian Pulp and Paper Co., will rest in Canada, thus ceasing to be in Belgium. The new company has an issued capital of $14,000,000, out of an authorised issue of $20,000,000, and there are also $1,500,000 of bonds. The output will be increased from 200 to 360 tons daily. The head office will be in Montreal.

Mining and Metallurgy

The Cariboo-Gold Platinum Extracting Co., at Quesnel, B.C., is erecting a plant to handle 10 tons of black sands daily; the sands contain the metals of the platinum group.

It is reported that radium has been found in lead deposits on the south branch of the Petawawa River, 18 miles north-west of Pembroke, Ont. Reports from the United States Radium Co. and the Keystone Metal Reduction Co. state that the radio-activity is equal to that of the carnotite ore in Colorado.

The entire matte production of the Mond Nickel Co. has been shipped from Coniston, Ont. There have been forwarded to Wales 140 carloads in September, 137 in October, and 138 in November. It is expected that the Mond nickel refinery at Clydach will be operating on a pre-war scale before the end of the year.

The monthly sales of the International Nickel Co. are now approximately 1·5 million lb. of nickel and 400—500,000 lb. of monel metal. Before the Canadian company can fully provide for expenses the nickel sales must approach 2 million lb. monthly. The monthly output in pre-war times was between 3 and 4 million lb., and during the war it reached 8 million lb. Since the international disarmament ogramme came into existence the company has en endeavouring to find new uses for nickel. The ills at Huntington, W.Va., which cost $3,500,000, ere erected with this end in view. The company s recently resumed operations on a small scale at Creighton mine and at the Copper Cliff reduction orks; the refinery at Port Colborne, Ont., is orking at capacity.

FRANCE

dustrial Notes

Chemical Industry.—Raw materials have risen in rice with the appreciation of the pound sterling and ome buyers have restricted purchases as much as ossible. Practically all contracts now contain a ause providing for cancellation if the exchange alue of sterling rises above a certain level. Prices f turpentine oil have risen by from 10 to 15 fr. per 00 kg., and quotations for copper and lead salts re higher, owing to the firm prices of the corre ponding metals, new or scrap. Consumption of ichromates, sodium sulphide, ferrocyanides and erricyanides is increasing steadily and prices are ising despite Belgian competition, particularly in he north and north-eastern regions. Perfumes are n great demand and stocks are practically de leted. There is little activity in the fertiliser narket, but the production of phosphatic slags as improved and the demand continues to be ery good. Quotations for nitrates are firm; the ffect of the recent earthquake on the Chilean pro luction is not yet known, but it is believed that nly the ports of shipment are affected. Orders re not being placed for British ammonium sulphate n account of its high price, and as a few more coke vens are to be lit in the Nord area the French pro luction of the fertiliser is likely to increase.

Metallurgy.—Exportation of iron ore to Germany is increasing, because Germany is not now buying from Sweden. Production of ore is good in France, except in the Pyrenees. Shortage of metallurgical coke precludes the lighting of more blast furnaces and the purchase of English coke at the present rate of exchange is an expensive method of compensating the short supplies from Germany.

Coal.—The demand for coal, especially for industrial use, is excellent in the Nord and Pas-de-Calais districts, and the winter campaign in the Loire and central coalfields is promising. Exports from the Saar district to Germany have slackened owing to the low exchange value of the mark, but Switzerland and Austria are still placing important orders. Imports from Great Britain have increased slightly, but are held back by the exchange. During October France imported 1,768,000 metric tons of coal and 441,000 t. of coke, compared with 1,692,000 t. and 421,000 t., respectively, in September. Exports during October were:—coal 400,000 t., coke 46,000 t., briquettes 11,400 t.

General.—Next year the Lyons Fair will be held in the spring, from March 5 to 17, instead or in the autumn. Russia and the new States in the Near East are interested in the Fair and arrangements are being made to induce visits from potential buyers in Switzerland, Spain and South America, with the object of making the Fair as international as possible.

A Canadian exhibition-train is to visit all the chief industrial centres in France next spring to exhibit products of Canadian manufacture that are unlikely to compete with French manufactures. The scheme, supported by the State and the railway companies, is similar to that under which a French exhibition-train covered 13,000 kilometres and stopped at 82 towns in Canada last year.

UNITED STATES

Tantalum a Commercial Article

As the result of research extending over six years, a Chicago firm has developed a process for producing metallic tantalum. The metal combines the properties of softness and workability with extreme resistance to wet corrosion and therefore should become a valuable material in industry. It is manufactured *in vacuo* because it must be free from oxygen, hydrogen, nitrogen and other common gases; large-scale production is not expected and the price will prohibit its use for ordinary purposes. Tantalum is not attacked by *aqua regia* or by any acid or alkaline solution, except hydrofluoric acid. Like aluminium it acts as a valve in electric cells, and although a dielectric oxide is readily formed on its surface, thus making it useless as an anode in electrolysis, this property permits its use in electrolytic rectifiers for alternating current. Tantalum melts at 2850° C., but it combines with gases at high temperatures, forming stable compounds that do not readily dissociate at temperatures below the melting-point of the metal. Since 1914, when the German source was cut off, the metal has not been available in the United States, but the possibilities for its use have greatly increased owing to the development of the electrical arts. Dr. C. W. Balke, director of research to the Fansteel Products Co., is investigating the properties of tantalum and also working on the commercial production and utilisation of its sister metal, columbium.

Factors in the Spontaneous Combustion of Coal

In Technical Paper No. 311 of the Bureau of Mines, Washington (price 5 cents), Mr. O. P. Hood reviews briefly the factors concerned in the spontaneous combustion of stored coal. Among such factors are included, superficial area and freshness of the surface of the coal stored, temperature at time of storage, and ventilation of the pile. Spontaneous combustion originates most frequently in fine coal, below 1·25 inch or nut size. The rate of heat generation at a freshly broken surface of coal appears to depend upon the oxygen content of the coal. A freshly broken surface is initially very much more active than after a few weeks, and this factor is of consequence in considering the question of crushing coal prior to storage. Spontaneous fires rarely occur after the coal surfaces have been exposed for three months, and are more liable to occur in coal put into storage during the summer. Should the temperature of the pile reach 140°—150° F., and continue to rise, spontaneous ignition is probable within a few days or weeks. Removal of the pile is necessary if the temperature reaches 160°—180° F. The natural ventilation of a coal pile due to variations in temperature and barometric pressure is considerable and serves to dissipate the heat generated in the pile. Segregation according to size, the larger pieces of coal collecting at the bottom of the pile, with the smaller coal above, is a factor suggesting that spontaneous combustion is initiated somewhere between the two extremes of the central core of fine coal and the large-piece region, where the ventilating current is just sufficient to supply oxygen for a maximum rise of temperature, and insufficient to remove the heat generated. Some observers state that, in general, fires in large coal piles occur from 5 to 8 feet below the surface, on the flanks of the pile. Factors such as the sulphur and volatile-matter content of coal are regarded as of relatively minor importance in the initiation of spontaneous combustion.

"Anthracoal"

This substitute for coal is made by coking a mixture of culm or waste anthracite coal and coal-tar pitch or other bitumens. Tests indicate that it is denser, harder, tougher, and stronger than coke, and that when struck with a hammer or passed through crushing rolls, it breaks with an irregular fracture, similarly to anthracite, but leaves very little fine material. Anthracoal can be made in a coke oven upon the same large scale as bituminous coke, and as it can be produced at little greater cost, it should prove a valuable means of utilising the anthracite culm now going to waste. Its commercial development is the outcome of experiments made in 1914 in the chemistry laboratory at Lehigh University. It is stated that only mechanical difficulties of a nature that can be remedied stand between the trial runs and the actual utilisation of anthracoal as a domestic fuel; consumers are satisfied with it and it commands the same price as the best anthracite.

AUSTRALIA

The Possibilities of Alkali Manufacture

The committee appointed in 1917 to consider the possibility of manufacturing alkali in Australia has reported that conditions are unfavourable, as the necessary raw materials are lacking. Accompanying this statement is a report by Brunner, Mond and Co., which states that as rock salt or saturated brine is not known to occur in Australia, the suggestion to manufacture alkali by the ammonia-soda process must be abandoned. Manufacture by the electrolytic process is ruled out, owing to the small consumption of chlorine products; if this difficulty were removed the process would be the best suited to Australia. In the meantime the company has decided to form an Australian company to represent it locally. According to Mr. P. J. Blackburn, the report is premature, because the results of boring at Calegero, near Bairnsdale, commenced originally for Messrs. Brunner, Mond and Co., and continued since for the Calegero Salt Mines Co., are promising. The Mount Lyell Chemical Co. manufactures about 500 t. per annum of alkali equal in quality to imported material, but cannot attempt to supply the entire home demand, as the market for caustic soda is so limited. About 7000 t. of lump (double strength) alkali is consumed annually in the Commonwealth.—(*Ind. Austr., Sept.* 28, 1922.)

SOUTH AFRICA

Alcohol from Prickly Pear

The *South African Journal of Industries* (November issue) states that a new company, the South African Motor Fuel Development Co., Ltd., has been registered at Bloemfontein, with a capital of £100,000. The object of the company is to carry on, in South Africa or elsewhere, the business of manufacturers of and dealers in industrial alcohol, motor fuel, and fuel for lighting and heating purposes, and by-products arising from such manufactures (vinegar, sugar, syrup, yeast, oil, and fruit jellies). The raw material will be the prickly pear. It is stated that the motor-spirit will be retailed at two shillings per gallon.

There are said to be about 2 million acres of land in South Africa infested with the prickly pear. Nothing is stated with regard to the cost of collection or the means of transport.

GERMANY

Metallurgical Research in 1922

The present condition of the metallurgical industry in Germany renders necessary the most rigid economies in material and labour. To this end an intensive research campaign to investigate the basic principles on which the various processes of smelting and working metals depend has been organised by the Deutsche Gesellschaft für Metallkunde. At the third general meeting of this society, held at Essen from October 14 to 17, a comprehensive programme of economic and practical questions dealing with the metallurgy of non-ferrous metals was discussed. The tendency of German metallurgical development at the present time is to produce suitable alloys of metals derived from domestic ores to replace those made entirely or partly from imported ores, and thus to render the country independent of foreign supplies in case of need. Most attention is being given to the production of aluminium alloys, but increasing interest is being taken in the possibilities of the use of magnesium, calcium, barium, sodium, and silicon alloys.

The Potash Industry

In his report, read to a meeting of the Potash Syndicate on November 19, the managing director (Forthmann) said that sales up to the end of September, 1922, had been very satisfactory, viz., about one million metric tons of pure potash (K_2O), compared with 621,400 t. in the corresponding period of 1921. Home demand was still good, and were it not for the scarcity of railway trucks, the last quarter of the year would also furnish good results. Sales to foreign buyers had also been very good; they were estimated at 1,250,000 m.t. of K_2O, and thus for the first time since the outbreak of war would exceed the foreign sales in 1913 (1,100,000 t.). By a very large majority the meeting approved a new method of fixing net sale prices in order to avoid selling 40 per cent. manure salts, for which there is a large home demand, at prices lower than those of crude salts, which cost considerably less to produce, are much in demand abroad, and therefore bring in much greater net profits.

The Industrial Situation in October

H.M. Commercial Secretary at Berlin states that, despite the further depreciation of the mark, the economic situation changed but little during October, and only a few industries were forced to restrict production or to work for stock. Orders have decreased, deliveries of raw materials have improved, and labour is more plentiful, but the long-feared slump is not yet within sight. The export trade, however, has not revived to the extent anticipated, owing to tariff restrictions in importing countries, strong competition from France and Belgium, and the fact that the cost of production many industries exceeds the world's market ices. In the chemical industry, the coal-tar dye arket is very uncertain, few home orders are being aced and foreign orders have decreased. Producon is still hampered by shortage of raw materials, articularly soda, salt, and coal, and by transport eficiencies. Many of the smaller and mediumzed factories may have to close down on account lack of inland orders and scarcity of capital. Berlin chemical industry experiences difficulty purchasing foreign raw materials and coal with e mark at its present value, but there is an ctive demand, both home and foreign, and the actories are fully employed on current orders. The emand for fine ceramic products is good, and reign trade is satisfactory. The plate-glass ndustry is more dependent than ever on foreign oal, the situation in the sheet-glass industry emains unchanged, and exports of hollow glass ave increased, despite the shortage of soda.

GENERAL

nsulin, The Hormone of the Pancreas

It has long been known that extirpation of the ancreas in animals leads to a fatal diabetic-like ondition in which the blood-sugar rises above its ormal threshold value, sugar appears in the urine, nd glycogen ceases to be stored in the liver. These acts suggest that the condition of diabetes is due o the lack of an internal secretion necessary for he metabolism of sugar. The pancreas contains, in ddition to its main cells, which secrete the panreatic juice through ducts, a number of tiny islets alled the islets of Langerhans, which apparently secrete the anti-diabetic hormone, insulin, into the blood-vessels surrounding them. Numerous attempts have been made from time to time to obtain proof of the existence of this endocrine substance, but until quite recently all extracts have had little effect on the blood-sugar when injected into normal animals.

To two young Canadian workers, F. G. Banting and C. H. Best, of Toronto, must be accorded the credit of having first prepared an extract which alleviates the symptoms of diabetes, both in animals and in man, in an exceptionally striking manner. With the aid of J. B. Collip, a process was worked out whereby a potent preparation of insulin could be obtained suitable for clinical trials without undue risk to the patients. It consists briefly in mixing minced ox-pancreas with an equal volume of 95 per cent. alcohol and straining. Two volumes of 95 per cent. alcohol are added to the extract, and the protein precipitated is removed. The solution is concentrated at 18—30° C. and extracted with ether, re-concentrated to a paste, and treated with 80 per cent. alcohol. The supernatant layer when poured into a large excess of absolute alcohol deposits the active principle mixed with other substances. It is water-soluble, contains but a trace of protein but no lipoid, is salt-free, and free from alcohol-soluble matter. Its physiological action has been worked out in some directions, but chemically next to nothing is known of its nature. Studies are, however, under way to isolate the active principle, and when this is done it will be identified chemically and synthesised artificially, just as has been done for adrenaline, the hormone of the suprarenal glands.

As yet it is too early to state whether insulin is a cure for diabetes, but what is certain is that it alleviates the symptoms, enabling patients to partake of a relatively hearty meal, to put on weight, and to recover their mental and physical vigour. Its method of administration is not devoid of complications, the only effective way at present being hypodermic injections twice daily.

Fertilisers—A " Key " Industry

Under the heading " Fertilisers before and after the War " (reprinted from the Transactions of the Highland and Agricultural Society of Scotland, 1922) Prof. James Hendrick, of the University of Aberdeen, gives an interesting review of the present fertiliser position as compared with that obtaining before the war. The enormous growth in the production and consumption of the most important nitrogenous, potassic and phosphatic fertilisers during the years immediately preceding hostilities is illustrated by selected statistics, after which the radical alterations in the fertiliser position which were brought about owing to war conditions are briefly explained. The author rightly points out that the fertiliser industry is of just as much, if not more, importance to the country in time of war as the dyestuff and fine chemical industry, although it is almost exclusively the latter that has attracted attention in this connexion. Whereas the dyestuff industry can be adapted in time of war to the actual manufacture of munitions, it is the fertiliser industry which is the mainstay of the country for the production of the sulphuric acid, nitrates and ammonia, without which the munitions cannot be manufactured. The present position with regard to the production and the agricultural value of the three great classes of artificials is then dealt with in some detail, the relative value of the newer fertilisers of each class in comparison with the older ones being illustrated by the results of manurial trials carried out at the Craibstone Experimental Farm of the University of Aberdeen, and in other parts of N.-E. Scotland.

Propyl Alcohol as a Disinfectant

The best disinfectant for use on the skin is propyl alcohol because it is a strong germicide and harmless to the skin, even after extended use. Solutions of 35 to 50 per cent. strength have given good results with facial acne and various diseases of the hair, whilst poultices containing 10 to 20 per cent. solutions have often proved useful in treating bacterial eczema.—(*Pharm. Zentralh., No.* 31, 1922.)

Fusel Oil and Acetone in Czechoslovakia

The annual output of fusel oil in Czechoslovakia is about 150 metric tons, of which 5 per cent. is consumed locally and the remainder exported, mainly to Germany, the United States, Holland, Austria, Hungary, and Switzerland. The whole output of fusel oil in the Succession States of Austria-Hungary in refined in one factory in Bohemia. Butyl alcohol, which competes with fusel oil in the United States, is not used in Czechoslovakia. Acetone, obtained from the dry distillation of beech wood, is produced by five factories, and of the total annual output of 600 t., about four-fifths is exported. About 3000 workpeople find employment in the acetone industry and the question of fiscal protection is being considered. Acetone is used chiefly in making paints and related products, artificial and patent leathers, and celluloid articles. In Czechoslovakia the manufacture of photographic films is negligible and that of artificial silk and cellulose acetate in its infancy.—(*U.S. Com. Rep., Sept.* 11, 1922.)

New Deposit of Talc in Austria

Work has been commenced on the talc deposit recently discovered near Mautern, in Steiermark, Austria. The deposits are from 1 to 1·8 metres thick and about 2000 m. long.

The World's Production of Electric Iron and Steel

Prior to 1913 electric steel was produced almost exclusively in the United States and, especially, in Germany and France; although production began in 1908–9, it did not attain importance until 1913. Under the stimulus of war conditions, however, the world's production increased rapidly, reaching a maximum in 1918, as is shown by the following statistics:—

I.—*Output of Electric Steel Ingots and Castings*

	1913	1915	1916	1917	1918	1919	1920	1921
				Metric tons				
United States	30,663	70,523	171,621	309,416	519,546	390,603	510,186	172,211
Germany	88,881	131,579	190,036	219,700	240,037	55,382	—	—
Great Britain	—	22,352	47,456	100,169	117,295	78,232	90,526	27,534
Canada	—	5,715	17,813	45,774	108,051	14,060	25,669	17,114
Austria-Hungary	26,837	23,895	47,247	47,152	41,163	—	—	—
France	21,124	21,000	44,429	54,031	58,222	42,559	58,080	24,457
Italy	—	26,946	32,677	47,744	71,964	88,824	119,378	140,000*
Sweden	2,276	2,187	6,648	10,664	13,089	11,818	12,356	—

* Estimated.

After 1918, despite a temporary revival in 1920, production fell rapidly, except in Italy, reaching a low level in 1921, a year in which the German output was probably about 45,000 tons. Especially noteworthy was the increased production of electric steel castings and cast alloy steels in the United States, the respective figures being 9354 t. and 450 t. in 1913, and 86,457 t. and 10,245 t. in 1921. The Italian industry has developed continuously, and at the end of 1921 there were about 50 works possessing 180 electric furnaces with a total capacity of about 800 tons. Most of the furnaces are of the Stassano type, and although Héroult and Girod furnaces are in use, they are gradually being replaced by Fiat and other Italian makes. The number of electric furnaces in Great Britain has increased from 21 (owned by 16 companies) with capacities ranging from 1 to 3·25 t. in 1914 to 150 with capacities varying from 0·25 t. to 20 t. in 1922. In 1921 the first electric furnace was installed in Ireland. An indication of the growing importance of electric furnaces in the steel industry is given by the increased output of electric steel castings in Great Britain, viz., from 3032 t. in 1915 to 16,967 t. in 1921. Similarly, in Canada the proportion of steel castings to total output of electric steel has risen from 43·6 per cent. in 1919 to 83·2 per cent. in 1921. Recent statistics for Germany are not available, but, owing to the loss of large areas under the Peace Treaty, it will be long before the country recovers its former importance as a producer.

Electric pig iron is made by reducing iron ores with coke or charcoal, and by preparing "synthetic" iron or re-melting steel scrap with cast iron; the former method is used in Sweden and Norway, the latter in France, Canada, and Italy.

II.—*Output of Electric Pig Iron*

	1913	1915	1916	1917	1918	1919	1920
				Metric tons			
France	28,753	29,760	46,208	90,309	83,959	55,422	59,656
Sweden	31,966	35,075	44,782	67,059	75,684	64,470	82,575
Italy	4,160	3,800	16,911	56,524	61,888	29,057	—
Norway	—	8,742	6,233	6,295	9,007	2,032	2,862
Canada	—	—	—	12,418	29,052	6,985	8,013

The future of this branch of the iron and steel industry appears to be promising despite the reduced production in 1919; the production from five countries in 1921 is reported to be more than twice that of six countries in 1913. At the end of 1920 there were 15 completed blast furnaces (14 in Sweden, 1 in Japan); 15 were being built (4 in Sweden, 6 in Italy, 2 in Brazil, 3 in Norway); and all of them, except those in Italy and Japan, were designed for utilising charcoal as fuel. In 1920, out of a total production in Sweden of 82,575 t. of electric pig iron, 15,793 t. was made in low-shaft furnaces, which resemble those used in making iron alloys and carbide. These furnaces were used because of the shortage of pig iron; they have a small capacity and much of the heat and all the valuable gases evolved are lost, so that their use is only profitable in special circumstances. During the war many furnaces of this type were used for making "synthetic" iron in countries possessing hydro-electric power.—(*Stahl u. Eisen*, Oct., 1922.)

The Olive-Oil Industry in Italy and Tunis

Although Italy has a larger area planted to olive trees than any other country in the world, it only takes second rank as a producer, the output being about 26 per cent. of that of the world, compared with 37 per cent. from Spain. Production and exportation have recently been as follows:—

	Area Acres	Production	Exportation
		Metric tons.	
1913	4,315,584	156,780	22,340
1919	4,248,400	103,590	1,090
1920	4,226,170	171,000	1,236

The large domestic consumption is the cause of the disproportion between production and exportation; thus, in 1913, when 22,340 t. was exported, 2086 t. of (crude) foreign olive oil and 13,462 t. of cottonseed oil had to be imported. Exports in 1921 were only 3199 t., and this failure to regain the pre-war level of exportation is due to decreased production, prohibition on imports of cottonseed oil, and the tendency of other countries to refine their own oil. Exports of sulphur oil, mainly to the United States and France, have risen from 8878 t. in 1913 to 10,821 t. in 1921.

Tunis takes fourth rank among producers of olive oil, and although the area under olive trees decreased from 889,560 acres in 1910 to 579,820 acres in 1918, the output of oil increased from an average of 22,217 t. during the period 1910–15 to 37,489 t. during the period 1916–20. War conditions stimulated the industry and exports rose from 13,067 t. in 1913 to 21,415 t. in 1919 and 23,287 t. in 1921, in which year the production was 70,000 tons. Tunisian oil is of little interest to the world's trade as the output is sold to France and Italy a year or more before it is produced.—(*U.S. Com. Rep., Sept.* 25, 1922.)

n Italian Forerunner of Solvay

The process of making sodium carbonate by the nteraction of salt and ammonium carbonate bears he name of Solvay, because, although not the first o discover the process, he was the first to apply it uccessfully on an industrial scale. The October ssue of the *Giornale di Chimica Industriale ed pplicata* contains an article by Signor V. Ravizza n a predecessor of Solvay named A. G. Forni, who resented a project for manufacturing soda by the mmonia-soda process to the Austrian Viceregent 1 1836, two years before Dyer and Hemming took ut their patents and 25 years before the patent of . Solvay. The project comprised a description of e plant required to produce 250 metric tons of nhydrous sodium carbonate per annum, and the rection of a small experimental plant in Milan was uthorised by the Austrian Government. Nothing me of the trial, owing to the illness and financial oubles of the inventor, and after a commission of emists had, on erroneous grounds, reported gainst the process, Government support was withrawn. Efforts to obtain private assistance were so unsuccessful, and the only record now remaing is a descriptive pamphlet written by Forni in 341.

REPORTS

EPORT ON THE COMMERCIAL, INDUSTRIAL AND FINANCIAL SITUATION IN JAPAN IN 1921 AND UP TO JUNE 30, 1922. *By* SIR E. T. F. CROWE, *H.M. Commercial Counsellor, and* G. B. SANSOM, *Acting H.M. Commercial Secretary, Tokyo. Department of Overseas Trade. Pp.* 59. *H.M. Stationery Office,* 1922. *Price* 1*s*. 6*d*.

The hope entertained early in 1921 that pan was on the way to economic recovery was t realised; although production and stocks minished, and the home demand was active, the neral situation remained unfavourable. The lue of the exports in 1921 fell from 1948 million n to 1253 mill. yen, and that of the imports from 36 mill. yen to 1614 mill. yen, so that the adverse ade balance decreased by 27 mill. yen to 361 mill. n (average value of yen in 1921 = 2s. 2d.). though the value of the exports in 1921 was arly three times the annual average for the riod 1909–1913, this increase was due almost tirely to progress in the silk industry, whose osperity depends on "fashion" in the United ates. Exports of porcelain, glassware, sugar, d matches declined, but a considerable trade was ne in bottles and tumblers. Negotiations took ace between the chief Japanese match manucturers and the Diamond Match Co., U.S.A., with e object of forming a ring to control the eastern arkets for matches. The fall in prices was the ain cause of the smaller value of the imports, and rge increases were shown only by cotton (30 per nt. of the total imports), woollen textiles, achinery, rubber, photographic materials, and ientific instruments. Great Britain is still far om having recovered her pre-eminence in the etal trade, the imports of iron and steel and tinate originating as follows (per cent.):—United ates 45, United Kingdom 17, Germany 15, China , Belgium 8, and India 5. Attempts to manucture tinplate in Japan have failed, and the onworks are said to be unable to work at a profit. Of fertilisers, only 18,000 t. of nitrate was imported from Chile (121,000 t. in 1921), and phosphate was in small demand. The United Kingdom supplied only 12 per cent. of the imported ammonium sulphate, the bulk coming from the United States, and a small proportion from Germany. In the heavy chemical trade, the chief features were keen competition in soda ash and large imports of rosin. Caustic soda is now manufactured in Japan from soda ash. Germany has regained dominance in the dye market and supplied 4 mill. lb. in 1921, the United States coming next with 877,000 lb.; in this industry the Japanese cannot compete with Germany, and many of the companies floated during the boom have ceased operations. Owing to the Government being compelled to cut prices, there was a marked revival of demand for camphor. The Japanese spend large sums on photographic materials, and of the importations, plates are purchased mainly in Great Britain, and paper and films in the United States. Statistics of the import and export trade are appended:—

Imports:—	Long tons
Sugar	300,629
Salt..	190,004
Leather	2,914
Paraffin wax ..	15,284
Rosin	7,982
Caustic soda, soda ash	44,710
Coal-tar dyes ..	2,491
Sodium nitrate ..	17,896
Ammonium sulphate	77,962
Paper pulp ..	38,727
Phosphorus ores ..	208,963
Coal	777,255
Iron ore	568,785
Iron, pig	223,551
Lead	33,158
Tin	3,307
Nickel	2,244
Rubber, crude ..	21,323
Kerosene (galls.) ..	27,073,000
Glass (£)	692,220*

Exports:—	
Starch	2,699
Sugar, refined ..	43,641
Oils, vegetable and fish	5,849
Camphor	851
Menthol	136
Cement	167,684
Rubber tyres ..	1,314
Matches (1000 gross)	23,154
Coal	2,387,709
Soap (£)	224,547*
Pottery, glass, etc. (£)	3,084,424*

* Value; yen = 2s. 2d.

The output of minerals and metals in 1921 was as follows:—

Gold ..	oz. troy	236,969
Platinum ..	„	231
Silver ..	„	4,185,502
Copper	Long tons	53,238
Lead ..	„	3,089
Bismuth ..	„	0·7
Tin	„	289
Mercury ..	„	6
Zinc ..	„	10,211
Iron, pig ..	„	88,540
Iron-sulphide ore ..	„	92,404
Chromite ore	Long tons	3,309
Manganese ore	„	3,811
Arsenic ..	„	1,374
Arsenic ores	„	1,481
Phosphorus ores	„	29,348
Graphite ..	„	856
Lignite ..	„	24,035,550
Asphalt ..	„	6,823
Sulphur ..	„	33,539
Sulphur ores	„	24,777
Petroleum, crude ..	galls.	77,854,400

Compared with 1920, nearly every item shows a big decrease.

THE TRADE IN INDIAN MYROBALANS. *Imperial Institute. Indian Trade Inquiry. Reports on Cinchona Bark and Myrobalans. London: John Murray,* 1922. *Price* 4*s*. *net.*

Myrobalans, the dried fruits of species of *Terminalia*, mostly *Terminalia Chebula*, Retz, are one of the chief tanning materials produced and used in India and are also exported in large quantities. The collection of the fruits affords a valuable minor source of revenue and is so largely in the hands of a combination of Indian dealers that it is considered unlikely that European firms would be able to compete successfully. Usually the season's crop is sold by tender on the trees, but contracts over a period of several years are sometimes made, the buyers undertaking to collect and dry the nuts, which are then sent to the warehouses where they are sorted and cleaned before being packed for shipment.

Five varieties of myrobalans are recognised in commerce, named according to the district of origin, as follows:—"Bimlies," or "B's," from Bimlipatam, Madras; "Jubbelpores," or "J's," from Jubbulpore, in the Central Provinces; "Rajpores," "R's," from Kohlapur State; "Vingorlas," "V's," from Bombay forests; and "Coast Madras"; each variety being separated as a rule into No. 1 and No. 2 grades.* The grading of nuts is usually done carelessly and gives rise to complaint among buyers in the United Kingdom, but as a rise in the price of No. 1's reduces the demand and stimulates that for No. 2's, there is not much inducement to improve grading. It is recommended that all unsound nuts be removed before shipment. At the present time myrobalans are bought by tanners in this country largely on appearance, and although it would be preferable to sell on a basis of tannin content, and colour determination, it must be remembered that the value of myrobalans to the tanner depends not only on the high tannin content, but also on other properties, such as deposition of "bloom" on the leather, and fermentation with the production of acid necessary to swell the hide.

It has been largely supposed that the immature nuts are richest in tannin, but analyses of fruits of different stages of maturity made at the Imperial Institute and also by Puran Singh (*Indian Forester*, 1915, 41, 15) show that fully ripe fruit contains most tannin. Myrobalans alone do not form a satisfactory tanning material, but are most useful when blended with other materials; in sole-leather tannage quebracho with 25—30 per cent., mimosa bark with 15—20 per cent., or mangrove bark with up to 50 per cent. of myrobalans, are generally used.

Myrobalans are usually shipped to Europe as whole nuts, but recently increased quantities of crushed nuts (freed from stones) have been exported, and if improvements in crushing were introduced it is considered that the bulk of the demand would be for the crushed material. It appears that the crushed material is often packed wet, so that it becomes sticky and forms lumps which cannot be extracted, whilst many of the crushed fragments are also too large for easy extraction. The preparation in India of liquid or solid extracts for export does not appear to offer any advantages, as in neither case would the extract contain more tannin than the nuts. Considerable amounts of liquid extract are prepared in the United Kingdom.

Myrobalans, either in the form of fine powder or as extract, are also used in the dyeing industry, chiefly in the "heavy woollen district" of Yorkshire, where the cloth consists of "shoddy" with 50—70 per cent. of cotton. Myrobalans are used in conjunction with iron for dyeing the cotton black, but as the colour is not fast to acid, this method has been replaced to some extent by the use of Cotton Milling Black. In the Bradford trade the use of myrobalans for the production of black on cotton is declining owing to the superiority of Direct Dyeing Blacks, which permit the subsequent dyeing of the wool by acid colours. A small demand also exists for myrobalans in the indigo-dyeing industry, where it is employed to remove surplus dye from the fabric. The demand for myrobalans in dyeing is not likely to increase, but may be maintained, as they are cheaper than sumach (the only other available pyrogallol tanning material).

The importance of the trade in myrobalans is considerable. Prior to the war Indian exports amounted to about 1,400,000 cwt. annually, valued at nearly £400,000; of the 40—50 per cent. shipped to parts of the British Empire, almost all went to the United Kingdom; the remainder was taken chiefly by Germany (one-fifth of the total export), the United States (one-sixth), Belgium (one-ninth), and smaller quantities to France, Italy, Russia and Japan.

It is proposed to investigate, in India, the different varieties of *Terminalia*, and to carry out analyses and tanning trials in the Imperial Institute with fruits of the different varieties; and the Committee suggests that an inquiry be made into the methods of collection, drying, grading and storing myrobalans in India.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for November 23 and 30)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W. 1, from firms, agents or individuals who desire to represent U.K. manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Argentina ..	Metals, tinplate	619
Australia ..	Pottery, glassware	567
Belgium ..	Pharmaceutical and industrial chemicals	573
„ ..	Special steel, aniline oil, cresylic acid, potassium and sodium bichromates, boric, carbolic and citric acids, benzine, benzol, bleaching powder, dyeing and tanning extracts, formaldehyde, nicotine, sulphites, bisulphites, petroleum jelly, pitch, potassium cyanide, soda	575
„ ..	Rubber goods	597
Brazil ..	Paint, varnish, oils	591
British India	Metals, cement, soap, perfumery, paper, glassware	568
Canada ..	Pottery, perfumery	†
„ ..	Insulating porcelain and glassware..	9998/E.D./E.C.
China ..	Asbestos roofing	617
Egypt ..	Drugs, medical stores (tender for) ..	9409/F.E./C.C.
„ ..	Paper (tender for)	9483/F.E./M.P.
Latvia ..	Kerosene, asbestos sheet, varnish, chalk, ozokerite, pigments, tin (tender for)..	6610/F.B.
Morocco ..	Leather, rubber	9357/F.E./G.C.
Norway ..	Oils, fats	606
Peru ..	Earthenware, lead sheets and pipes	593
South Africa	Disinfectant fluid (tender for) ..	10040/E.D./C.C.
Sweden ..	Chemicals used in tanneries and rubber factories	584
Switzerland..	Technical and pharmaceutical chemicals	613
„ ..	Leather	615
„ ..	Oils, fats, chemicals, metals, alloys, tin, fertilisers	616
United States	Leather scrap..	17639/F.W./M.P.

---

* For a comparison of the tanning properties of commercial grades cf. J., Parker and Blockey, 1908, 1181.

† Canadian Government Trade Commissioner, 73, Basinghall Street, London, E.C. 2.

TARIFF CUSTOMS EXCISE

Austria.—Increased consumption taxes are payable on spirits, wine, sugar, matches, various beverages, acetic acid, and artificial sweetening substances. Export duties are leviable on raw hides and skins, horn, wood, ores, magnesite, rosin, turpentine, paper pulp, and rubber waste.

British Guiana.—Surtaxes of 10 per cent. of the specific duties are applied to goods included in the first schedule of the Customs Duties Ordinance, 1922, and of 20 per cent. to goods specified in the second schedule.

British India.—Regulations have been issued controlling the importation of preparations of morphia, opium and cocaine.

Canada.—Under a recent customs ruling silica, magnesia, and chrome firebricks are entitled to entry free of duty.

Denmark.—A modified scale of import duties has been applied to alcoholic beverages, ethers, perfumery and perfumed articles. Denatured spirit or spirit for medicinal use are exempted from the additional duty now payable on spirit of 50 per cent. strength.

Federated Malay States.—Draft rules have been issued providing for restrictions on the export of rubber.

France.—The commercial arrangement with Italy which was signed on November 13 came into force on November 28.

French Togoland.—New import tariffs have been fixed for spirits, alcoholic dyestuffs and perfumery, sugar, salt, and denatured alcohol; and new export tariffs for palm oil and kernels, copra, cotton and sisal. The duty-free list includes fertilisers, coal, bottles, and scientific products.

New Hebrides.—A recent regulation prohibits the import of pure alcohol, crude spirit, or any alcoholic liquids, but not of pure alcohol for industrial, pharmaceutical or medical use.

Nigeria.—Fuel oil for power purposes may be imported duty-free.

Poland.—Surtaxes have been applied to the customs duties on certain goods, as follows:—900 per cent.: certain fertilisers, graphite, antimony, nitric acid, certain edible oils, metals, cellulose and paper; 4900 per cent.: superphosphates, olein, asbestos, electrical carbons, silica and magnesite bricks, various wares of glass, certain coal-tar products, sulphur, rare-earth products, sodium bicarbonate, carbon bisulphide; 14,900 per cent.: ammonium nitrate, chloride of lime, sodium sulphite and hydrosulphite, acetate of lime, sulphuric ether, tanning extracts, etc.

Rumania.—Opium and its derivatives may be imported only by special authorisation.

San Thomé and Principe.—By a recent decree the export duties are doubled, as are also the import duties, except those on sugar, calcium carbide, olive oil, medicines, quinine salts, matches, and paraffin.

Sweden.—Export prohibitions have been withdrawn from gold, silver, and platinum.

Uganda.—The customs tariff now in force in Kenya has been applied to Uganda.

United States.—The rules of procedure under the "flexible-tariff" provisions of the new customs tariff are published in the issue for November 30.

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Merchandise Marks Bill

Sir P. Lloyd-Greame, President of the Board of Trade, informed Mr. Hannon that this Bill could not be re-introduced before Christmas, and he was unable to state when such legislation would be considered.—(Nov. 27.)

Guarantees under the Trade Facilities Act

Answering Mr. Briggs, Mr. Baldwin, Chancellor of the Exchequer, said that the total amount guaranteed under the Trade Facilities Act up to September 30 was £23,563,645. The guarantees given since that date included £2,000,000 to the Newfoundland Products Corporation, Ltd., £50,000 to the Dolcoath Mine, Ltd., and £850,000 to the Tata Power Company.—(Nov. 27.)

Coal Output in Great Britain and the United States

In reply to Commander Bellairs, Mr. Lane-Fox stated that the output of coal per man in Great Britain was 257 tons in 1910, 144 t. in 1921 (when all pits were idle for 3 months), and 216 t. in the year ending September, 1922. In the United States the output per man (including that of anthracite) was 618 t. in 1910 and 549 t. in 1921. These figures were not strictly comparable as coal-mining was much easier in the United States than in this country.—(Nov. 27.)

Surplus Government Chemicals

Mr. Baldwin, in a written answer to Mr. Hancock, said that the Disposals Board had held sales of chemicals on other dates than September, 1920, but the preparation of statistics showing the results of such sales would be too expensive.—(Nov. 28.)

Charges for Town Gas

In answer to Mr. Jephcott, Sir P. Lloyd-Greame said he had received requests for an inquiry into the present method of charging for town gas on a thermal basis, and had appointed a Departmental Committee of Inquiry consisting of Sir C. Hyde, Mr. A. Balfour, Sir J. Martin, Mr. A. A. Pugh, and Mr. W. J. U. Woolcock.—(Nov. 30.)

Petroleum Production

In reply to Mr. Hancock, Sir P. Lloyd-Greame said that the production of crude petroleum in 1921 in Great Britain, Trinidad, Egypt, and Mexico was 140,000 tons (estimate), 334,000 t., 190,000 t., and 28,000,000 t., respectively. The cost of production could not be stated.—(Dec. 4.)

"Reparation" Dyestuffs

Sir P. Lloyd-Greame, answering various questions, said that the appointment of the British Dyestuffs Corporation as distributing agent for "reparation" dyes had been approved by the Colour Users' Association and dye manufacturers other than the Corporation. The agreement was terminable at three months' notice on either side, and the commission payable to the Corporation was 6·5 per cent. on gross turnover, plus 1 per cent. for guaranteeing accounts. The commission was to cover charges for importation, packing, storage, etc., but the Board had agreed to make a maximum annual grant of £30,000 towards the cost of these charges. He was not aware that any information obtained by the

Corporation in the conduct of the agency was being utilised improperly.—(Dec. 4.)

Blast Furnaces

In a written answer to Major Kelley, Sir P. Lloyd-Greame stated that, at the end of October, 151 out of 487 furnaces were in blast in the United Kingdom, 109 out of 221 in France, and 33 out of 54 in Germany. Particulars for Germany could not be given.—(Dec. 4.)

Disposal Board

Mr. Baldwin informed Sir A. Hunter-Weston that the expenditure of the Disposal Board during the past year was £2,600,000, of which a large proportion was incurred in the destruction of poison-gas shell, breaking down ammunition, etc. The cost of maintenance of Gretna factory during the last year was £27,000, but revenue amounting to £20,000 had been received, and sales of plant since January 1 had realised £250,000, the sale expenses being 5 per cent. of the prices realised.—(Dec. 5.)

Feeding Stuffs and Fertilisers

In reply to Mr. Dixon, who asked whether the proposed departmental committee on the cost of agricultural produce to the consumer would also inquire into the cost of feeding stuffs and fertilisers, Sir R. Sanders, Minister of Agriculture, said that the terms of reference would be limited to questions relating to agricultural, horticultural and dairy produce and that the committee would have to decide what articles were included within the scope of the terms of reference.—(Dec. 5.).

British Empire Exhibition

In a written answer to Sir H. Holbrook, Sir W. Joynson-Hicks said that the President of the Board of Trade had invited him to investigate the use of materials and supplies of Empire origin in the British Empire Exhibition.—(Dec. 6.)

Home-Grown Sugar-Beet

Replying to Mr. A. Bennet, Sir R. Sanders wrote that an area of 3776 acres at Kelham and 4180 acres at Cantley, *i.e.*, a total of 7956 acres, was planted with sugar-beet. Both crops were to be worked this season at the Cantley factory, which employs 600 men; the average weekly wage is about £2 14s. 8d. —(Dec. 6.)

Pasteurisation of Milk

Major Boyd-Carpenter, replying to Sir J. Leigh, said that there was some distrust of pasteurisation as now practised, partly on account of the high temperatures frequently employed commercially. There was no evidence that pasteurisation properly conducted would destroy the essential qualities or constituents of milk. It was hoped that the steps now being taken by the Ministry of Health would conduce to the provision of wholesome milk at reasonable prices.—(Dec. 7.)

Safeguarding of Industries Act

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Key Industries.—The Act has enabled the industries covered by Part I to continue, and to extend the range of production considerably. Returns are to be supplied showing the state of employment in these industries.—(Nov. 27.)

Receipts from Duty.—The amounts of duty collected under Part II, up to November 24, are as follows:—Fabric gloves, £50,695; glassware, domestic, £995; glassware, illuminating, £3599; hollow-ware, domestic, £8370; incandescent gas mantles, £35. The date of the Order respecting gas mantles was October 9, and of that respecting the other goods August 8. The cost of collection has been less than the receipts.—(Nov. 27.)

Sodium Hyposulphite of photographic quality is well known to the trade, but there is no fixed standard to which it must conform; hyposulphite of this quality is dutiable.—(Dec. 4.)

Potassium Permanganate is not dutiable unless of "R" quality. If a claim for duty is disputed on the ground that the consignment is not of dutiable quality, the importer can apply to have the matter referred to a referee under Part II. of the Act.—(Dec. 4.)

Sulphocyanides.—The sulphocyanides of aluminium, barium, and copper were removed from the lists because the Referee's observations in the cream-of-tartar case indicated that he would probably regard these compounds as heavy chemicals. These observations do not apply to sodium and potassium sulphocyanide, and they were therefore left in the lists.—(Dec. 4.)

Scientific Instruments.—The report of the committee which investigated the application for a duty of 33⅓ per cent. on scientific instruments is being considered and an announcement will be made shortly.—(Dec. 4.)

Vulcanised Fibre.—The report of the committee appointed to consider the complaint regarding the dumping of vulcanised fibre from the United States is unfavourable to the complainants and will be published and presented to Parliament at an early date.—(Dec. 4.)

Duties.—The total amount collected in duties under the Act, up to and including December 1, 1922, is £432,575.—(Dec. 7.)

During the debate on the motion for an Address in reply to the King's Speech, Sir J. Simon moved an amendment, regretting that no mention was made in the Speech of the repeal of the Safeguarding of Industries Act and other protective measures which were raising prices, hampering trade and limiting employment. Sir J. Simon discussed the administration of the Dyestuffs Act and observed that this and similar measures tended to restrict the free rights of British merchants to purchase in the best market. The licensing system under the Dyestuffs Act implied selection and therefore favouritism, and exporters were unable to know whether they could safely accept repeat orders. It was right to protect a "munitions industry," but the worst way to do so was to enable selected manufacturers to make additional profits out of their fellow-subjects. The duties under the Safeguarding of Industries Act had been imposed on 6300 chemicals instead of on a few directly connected with military preparedness. Imported chemicals were being detained at the ports to ascertain whether their purity made them dutiable. It was claimed that, as a result of the Act, 2000 fine chemicals were now being made in this country, but the highest chemical authority stated that the list consisted very largely of impure German chemicals that had been purified in this country.

In reply, Sir P. Lloyd-Greame observed that when the war began we lacked optical glass, drugs, and chemicals of every kind, and Lord Balfour of Bur-eigh's Committee had recommended that those key ndustries should be protected, as an essential assurance against war. To-day, optical-glass factories were being steadily developed, many new chemical factories were being started, the range of production was growing, and so excellent were our scientific nstruments that scientific institutions in France, Belgium and Italy bought them in preference to cheaper foreign products. Prices of optical glass had fallen by from 20 to 50 per cent. and of chemicals by from 20 to 30 per cent., and if the consumer did not always benefit, that was the fault, not of the Act, but of the middleman. It had been arranged that the Board of Trade and the Department of Scientific and Industrial Research should investigate the key industries to ascertain what progress had been, and was being, made. The legislation against dumping and unfair competition was promised during the war, and it would be unwise to repeal it just when the United States had set up a prohibitive tariff that would probably lead to dumping in this country. The principle upon which the Act and the duty levied under it were based had been accepted by each successive Government, and he asked the House not to reject it.

Sir A. Mond said that the disappearance of key industries might put the country in a serious position, but it was never anticipated that the Schedules to the Act should be extended or applied in the way they had been, and he believed the administration of the Act required revision. The attempt was being made to establish the dyestuffs industry—one of the most difficult in the world—in face of able competitors who had 40 or 50 years' experience, and free competition would make the task almost impossible. The progress made was disappointing and should be investigated. Mr. G. C. Clayton, in opposing the motion, recalled the history of tungsten manufacture in this country and of the German monopoly of supply prior to the war. Without the present Act, manufacture of tungsten at Widnes would now have to cease. Mr. Asquith remarked that the Act was a farce; there was no evidence of any dumping now; and the remedy was worse than the disease. Lt.-Com. Astbury gave instances to show how German makers reduced the prices of certain dyes when British makers began to produce them, and pointed out that if the Dyestuffs Act were repealed, Germany would force every British maker to close within six months. British dye-makers had produced 500 new colours, 516 colours equivalent to German colours, 28 vat colours (made for the first time in this country), and 82 research chemicals. It was pointed out by Mr. H. Spencer that the price of the commonest Swiss dye was one-half that of the British equivalent, and that British dyers still refused to guarantee the fastness or wearing qualities of their products. It was true that the cost of dye represented a small fraction of the total cost of the textile, but that small fraction was sufficient to make competition with foreign makers impossible. Sir R. Horne said that the duty of 33⅓ per cent. applied under Part II. was intended, not to stabilise the exchange, but to give at least some help in adjusting the difference between the internal and the external purchasing value of the foreign currency. The amendment was defeated by 269 votes to 207.—(Dec. 4.)

REVIEWS

Theories of Organic Chemistry. *By* Dr. F. Henrich. *Translated and revised from the 4th German edition by* Prof. T. B. Johnson *and* Prof. Dorothy A. Hahn. *Pp. xvi+603. New York: John Wiley and Sons, Inc.; London: Chapman and Hall, Ltd.*, 1922. *Price 30s. net.*

Many English readers who are familiar with the German edition of this work will probably agree with the reviewer that its chief defect is the tendency to omit reference to work carried on outside Germany. The translators of the book appear to have been aware of this defect, and they are quite frank concerning the treatment of it, for in the preface it is stated that "in presenting the work to an American public it has seemed desirable to stress wherever possible the contributions of American investigators." In pursuing this plan the translators have improved the original work. Thus the section on electronic conception of valency has been rewritten and now includes a new chapter containing an account of the theories of Falk and Nelson, Lewis, and Fry; but this account will hardly attract the full interest of British readers, since the work of Langmuir has been omitted with the notable developments made by Lapworth, Robinson and other English research workers. Another welcome addition is the chapter dealing with Nef's theories, and in the reviewer's opinion the translators have done wisely in reproducing the original paper in which these were summarised. The account of intramolecular rearrangement has been greatly improved by revision and by the addition of the researches of Stieglitz and of Wheeler and Johnson, which received very brief notice in the original. These are the chief additions, but other changes have been made in the order of treatment, with the result that the logical sequence of the subject is improved; for example, an account of pseudo-acids and bases is now given immediately following that of tautomerism.

These alterations have undoubtedly enhanced the value of the book, but it is unfortunate that the translators did not carry out their revision on a broader basis. The reader will notice that no reference is made to the work of Thorpe and his collaborators on the glutaconic acids, ring-chain tautomerism and the stability of spirane systems. In the chapter dealing with rotatory power and constitution the researches of Pickard and Kenyon, Lowry and others are omitted, and the work of English investigators on the relation of absorption of light to constitution is hardly noticed. An account of recent research in stereochemistry is wanting, and in the reviewer's opinion a few pages devoted to the work on molecular asymmetry would have been a useful addition. In further criticism it may be added that some subjects seem to be unduly stressed, particularly the description of Stark's hypotheses and the work of Hantzsch on chromoisomerism. Beyond these remarks there appears to the reviewer little to be said by way of criticism, whilst in praise of the book much could be said; it will undoubtedly receive a wide welcome.

The work of translation has been well done; the style is clear and in a book of this kind, which contains so many complex formulæ, it is surprising to meet with so few errors in the text. One of the chief purposes of the translators is to increase the research worker's knowledge of the history of the science and his appreciation of the work of its founders. These valuable advantages, together with a more correct perspective of modern work, are, in the reviewer's experience, to be gained by reading some book such as Graebe's History of Organic Chemistry before the study of the present volume is undertaken.

SAMUEL SMILES.

CRITICAL SURVEY OF QUESTIONS AFFECTING THE COKE-OVEN INDUSTRY. *By* DR. CARL STILL. *Translated from the German by Coke and Gas Ovens, Ltd., Salisbury House, London Wall, E.C. 2, and published by permission of Glückauf. Pp.* 137—300.

The survey is an excellent translation of various articles from *Glückauf* by Dr. Carl Still, now published in a convenient and compact form. The work is divided into three sections dealing with (1) Benzol Recovery, (2) Design of Coke-Oven Flues, and (3) Manufacture of Sulphate of Ammonia, respectively. Each branch is treated exhaustively from a purely theoretical standpoint and the author has gone to considerable pains in a praiseworthy effort to apply the laws underlying physical phenomena to the numerous problems met with in the designing and practical operation of modern coke-oven plants. The work abounds in formulæ and equations, some of which are of a complicated nature and demand a mathematical knowledge beyond the powers of many associated with the routine of a coke plant. This, however, does not detract from the value of the work, as the necessary data, having been collected from well-known authorities, have the merit of authenticity. Moreover, and (in the mind of the writer) of supreme importance, the conclusions arrived at are in the majority of cases in remarkably close accord with the result of the writer's practical experience. To quote an example: the author condemns the common practice of endeavouring to obtain from a benzolised wash oil a crude product rich in benzol, giving, say, 65 per cent. distillate at 120° C., instead of aiming at the recovery of the whole of the absorbable hydrocarbons, whatever their nature may be, even if by so doing the distillation test be reduced considerably. In the case of a "rich" crude benzol, the author's theories point to a loss in absorption efficiency and an actual loss of benzol. During the war period the writer had occasion to investigate this point, and has now ample proof from tests on a commercial scale that at the plant under observation the manufacture of a "straight" 65 per cent. product entailed a serious loss of hydrocarbons, including toluol, and only by effectively stripping the wash oil with a consequent product of less than 50 per cent. was the toluol recovered efficiently. The concordance of practice with theory in this case gives one confidence in the theories expounded, and on the whole, where the details of the equations are obscure they may be safely "taken as read" and the mind concentrated on the summaries and conclusions arrived at.

In section (1) the author discusses the determination of vapour tension, general rules for benzol absorption, internal conditions in scrubbers, benzol yields, effect of re-circulation of wash oil, etc., terminating this section with a *résumé* of the highest possible significance to workers in this particular branch. In the second section the author deals with the design of coke-oven flues, going very fully into the question of the relative areas and sections of individual flues in ovens of the vertical-flue type, sizes of gas-nozzles, effect of varying widths of ovens, taper of ovens, etc. The points raised should be of great value in plants where the general construction allows of reasonable adjustment of the details of control. In section (3) the manufacture of sulphate of ammonia is discussed from the point of view of the more recent hot and cold, or, as commonly described, the direct and semi-direct, processes for the recovery of ammonia. The thermal aspect under varying conditions is treated fully and useful tables and charts are included. The writer has been highly interested in the work and can wholeheartedly recommend it as worthy of very serious consideration by all workers in the coke-oven industry.

J. E. CHRISTOPHER.

AMERICAN FUELS. *By* R. F. BACON *and* W. A. HAMOR. *Vol. I, pp. ix+628; Vol. II, pp. vi+629. London: McGraw-Hill Publishing Co., Ltd.,* 1922. *Price* 60*s. net.*

These two volumes are inscribed as being of the Mellon Institute Technochemical Series. They consist of a series of twenty-six essays, by various authors, on different problems of fuel technology. As is perhaps inevitable with such a compilation the arrangement of the material is not always happy; for example, some of the problems relating to power production are described under "coal preparation," and those relating to coal-washing under "finely-divided fuel."

Whilst the work no doubt makes a fairly complete survey of modern American practice, there appears to be a bias in favour of untried processes, which may or may not be still in the early experimental stage; and it is often difficult to judge whether the essayists describing these processes take them seriously or regard them as means of brightening their narratives. Some of the novelties described, with such details as are available, or the imagination of their inventors has anticipated, are such methods of cleaning coal as the Trent amalgam process, the Chanco sand-flotation process, and electrostatic separation; a rotary gas-producer employing a pulverised fuel; the Dayton process for making producer gas from liquid fuel; and a mercury-vapour turbine, destined to rival the Diesel engine as a prime-mover; such things make interesting light reading.

Undoubtedly the most important article in the volumes is that dealing with the preparation and uses of pulverised coal; it is a long article (242 pages), and presents what is probably the best coherent account that has yet been published of this rapidly developing branch of fuel technology. Another commendable chapter is that on surface combustion, which as an industrial heating process seems to have had better luck in America than in this country. The remaining chapters are, as a whole, devoid of interest, though there are occasionally to be found, amongst the welter of commonplace, items of information regarding American thought and practice which have not been impressed hitherto upon British readers; it is, however, somewhat surprising, in view of the rapid development of fuel technology in America, often to find adherence to antiquated and incorrect views of the phenomena involved in the preparation and use of the various fuels. No chemist can feel satisfied with the present extent of the application of scientific knowledge to fuel problems as exemplified in writings of this character.

The work is furnished with one inadequate index, annoyingly placed at the end of the second volume.

R. V. Wheeler.

Electricity. By S. G. Starling. *Science in the Service of Man Series. Pp.* 245. *London: Longmans, Green and Co.,* 1922. *Price* 10*s.* 6*d. net.*

Within the limited compass of about 240 pages the author of this book has endeavoured to cover the whole range of electrical engineering and the modern theory of electricity, and the result is that everything has had to be severely clipped, mathematics is entirely omitted, explanations are somewhat vague, and certain essential details are absent.

The first nine chapters are treated in the conventional way, and it is not until Chapter X is reached that real interest is stimulated; from here onward the author has done real service in putting modern theory in a simple and understandable form to those who have an elementary knowledge of the subject. Such defects as occur in this part of the book are due more to the author's desire to seek a simple and concise explanation of a difficult point without the aid of mathematics, than to a want of familiarity with the subject; had these chapters been expanded and made to cover the whole range of the preceding ones, even at the expense of eliminating such old friends as rubbed amber, loadstones, etc., which are to be found in scores of similar books, a real advance would have been made. As it is, we fear that the average chemist will find very little to interest him in the first part of the book, whilst those parts dealing with the strictly electrical-engineering problems are decidedly weak.

The treatment of the direct-current dynamo and motor and the description of the three-wire system of distribution are unsatisfactory. For the measurement of power the Kelvin watt-balance is described rather than the more simple and generally employed dynamometer-wattmeter of the two-coil type, and the Thomson energy-meter is the only type described, no reference being made to ampère-hour meters either of the magneto-motor or electrolytic type, although these are now almost universal on DC supply. The chapter on alternating currents is still more unsatisfactory. The author studiously avoids dealing with the effect of inductance and capacity in the AC circuit, with the result that from the outset he is in difficulty. The reader is left with the impression that resistance is the controlling factor in transformer windings, that single-phase generation is the rule rather than the exception, and that the single-phase induction motor is n most general use. How the latter machine is onstructed, and how the split-phase necessary for starting is derived are left to imagination.

Polyphase currents are considered outside the cope of the book, and are therefore dismissed in a ew words. We wonder what the power engineer will think of the statement on page 67:—"For hese reasons the synchronous motor is no use for pplying power, and is only employed in certain maller pieces of apparatus where constancy of peed is of the greatest importance."

In the chapter on electric lighting undue prominence has been given to subjects which have been written up so many times before. The carbon-filament lamp and the open carbon-arc occupy a large amount of the space which might well have been devoted to the more modern developments of electric illuminants. More on the processes of producing wire-filaments, the process of "dark or chemical" exhaust with the employment of "getters and fillers," metallic arcs, mixed electrode arcs, and vacuum-tube lighting would have been welcome.

The treatment of electrolysis and batteries is very elementary, and to the general reader will probably be of interest, but to the chemist a much fuller treatment would be more welcome. A brief description is given of the Nodon valve, now practically obsolete, but no mention is made of the more efficient mercury-arc-rectifier.

The chapters on Electromagnetic Theory and Wireless Telegraphy, Gases and X-rays, and Radioactivity are well done so far as they go, but they might have been expanded. The book concludes with a glossary of electrical terms, and here again we experience disappointment. The definitions of the ampère, ohm, and volt will not prove very helpful to the general reader, and the same applies to several of the other definitions.

In conclusion, it may be said that where the author has to deal with the purely physical problem the book is useful, but those parts dealing with the technical and engineering side of the subject require considerable revision; and the value of the work would be greatly enhanced by the inclusion of such subjects as the modern theory of magnetism, magnetic alloys, arc welding, electric furnaces, thermo-electricity and the electrical methods of measuring high temperatures, and the more recent developments in electric lighting.

CORRESPONDENCE

THE NEW COLOUR INDEX

Sir,—I appreciated greatly the review and constructive criticism of the Colour Index by Prof. H. E. Fierz in the last issue of the *Journal*, and am indebted to him for drawing attention to some errors and omissions. The fact that the Colour Index is published in parts affords the opportunity of incorporating such information in the list of corrections and additions in the final part.

The nucleus of the Colour Index represents mainly a collection of information on dyestuffs which has been published up to the present. This is then submitted to colour manufacturers and to members of the Revision Committee, and, as a result, numerous corrections have been made and additional facts have been included in the Colour Index as published. Unfortunately colour manufacturers are not always prepared to correct an inaccurate statement, as is shown in the case of Erio Azurine B (No. 59) quoted by Prof. Fierz, for Messrs. Geigy and Co. had an opportunity to make the correction but did not do so.

As Prof. Fierz states, absolute accuracy in a work of this kind is impossible for numerous reasons; the Colour Index represents an attempt to make the best use of the information at my disposal.

The desirability of including references to "Friedländer" was considered, and these references were omitted because almost every German Patent quoted is contained in "Friedländer" and, consequently, can be found readily. It is intended to index, not only all the commercial names of dyes in the Colour Index, but also all the patent numbers quoted. The inclusion of a column in this patent index giving references to "Friedländer" is under consideration and, if decided upon, will meet Prof. Fierz's point.

Parts I, II and III of the Colour Index have now been published, and it is anticipated that the remaining parts will appear at monthly intervals until completion.—I am, Sir, etc.,

F. M. Rowe,
Editor, Colour Index.

Manchester,
Dec. 2, 1922.

OBITUARY

H. J. POWELL

The death of Mr. Harry James Powell, C.B.E., B.A., removes from the glass industry a prominent and well-known figure, and one who did much, over a long period of years, to maintain contact between science and industry.

The glassworks at Whitefriars are the oldest and most famous in London, the business having been commenced about 1680, coming to the Powell family in 1834. Mr. Harry Powell, after a training at Rugby and Trinity College, Cambridge, where he took a second class in Classical Moderations, entered the business in 1873, and throughout the long period of his control showed himself in sympathy with progressive ideas in the industry. Thus, in 1875, de la Bastie carried out experiments at the works on glass-toughening, whilst in that same year glasses were melted at the works containing salts of didymium and erbium for experiments to be conducted at Oxford.

This service to science was but the forerunner of many. Thus, Mr. Powell had vacuum vessels made for Prof. Sir James Dewar's low-temperature work in 1895; in 1897, special glasses for Lord Berkeley's experiments on electrolysis, and glasses for Professors Gray and Dobbie for use in investigations on the relation between the dielectric constant and the composition of glass. Commencing in 1911 a series of glasses was made to assist Sir William Crookes in his researches on glasses affording protection from heat and ultraviolet radiations. Under Mr. Powell's managership of the works there were also produced, at various dates during the period of 25 years before the war, X-ray bulbs, glasses for artificial eyes, and special glasses for thermometers of very small depression constant. Technical investigations of special interest to the glass manufacturer were also carried out and were briefly summarised by Mr. Powell in a paper to the Society of Glass Technology in 1918. Because of his wide experience, as well as the ability of the factory to make a variety of scientific glass, Mr. Powell's services were of great value during the war period.

Mr. Powell was Juror for glass at the Paris Exhibition in 1889, one of the first vice-presidents of the Society of Glass Technology, chief contributor to the article "Glass" in the Encyclopædia Britannica, joint author with Messrs. Chance and Harris in 1882 of "Principles of Glassmaking," and the author of a number of papers on glass technology. He also took an interest in public work before the war, representing Dulwich in the first and second London County Councils, was a governor of Dulwich College from 1898, a co-opted member of the London Technical Education Board, and a member of the Board of Education Committee for Advice on Art Education.

W. E. S. Turner.

PUBLICATIONS RECEIVED

Flavouring Materials: Natural and Synthetic. *By* A. Clarke. *Oxford Technical Publications. Pp.* 166. *London: Henry Frowde and Hodder and Stoughton*, 1922. *Price* 8*s.* 6*d.*

Oxidations and Reductions in the Animal Body. *By* Dr. H. D. Dakin. *Monographs on Biochemistry. Second edition. Pp.* 176. *London: Longmans, Green and Co.*, 1922. *Price* 6*s.*

Tables Annuelles de Constantes et Données Numériques de Chimie, de Physique, et de Technologie. *Published under the auspices of the International Union for Pure and Applied Chemistry. Vol. IV.* 1913, 1914, 1915, 1916. *Part I. Pp.* 626. *Part II. Pp.* 627—1377. *Paris: Gauthier-Villars et Cie.; London: Cambridge University Press; Chicago: University of Chicago Press*, 1921.

Gasworks Recorders. *By* Dr. L. Levy. *Pp.* 246. *London: Benn Brothers, Ltd.*, 1922. *Price* 35*s.*

Technologic Papers of the United States Bureau of Standards. *Department of Commerce. Washington: Government Printing Office*, 1922:—

Tensile Properties of Some Structural Alloy Steels at High Temperatures. *By* H. J. French. *No.* 205. *Price* 5 *cents.*

Effect of Heat Treatment on the Mechanical Properties of 1 Per Cent. Carbon Steel. *By* H. J. French *and* W. G. Johnson. *No.* 206. *Price* 15 *cents.*

Weighing by Substitution. *By* C. A. Briggs *and* E. D. Gordon. *No.* 208. *Price* 5 *cents.*

Thermal Stresses in Chilled Iron Car Wheels. *By* G. K. Burgess *and* R. W. Woodward. *No.* 209. *Price* 5 *cents.*

The Redwood Viscometer. *By* W. H. Herschel. *No.* 210. *Price* 10 *cents.*

Publications of the United States Bureau of Mines. *Department of the Interior. Washington: Government Printing Office*, 1922:—

Inclusions in Aluminium-Alloy Sand Castings. *By* R. J. Anderson. *Technical Paper* 290. *Price* 10 *cents.*

Experimental Production of Alloy Steels. *By* H. W. Gillett *and* E. L. Mack. *Bulletin* 199. *Price* 15 *cents.*

Tests of Gas Masks and Respirators for Protection from Locomotive Smoke in Railroad Tunnels, with Analyses of Tunnel Atmospheres. *By* A. C. Fieldner, S. H. Katz *and* S. P. Kinney. *Technical Paper* 292. *Price* 10 *cents.*

Corrosion Under Oil Films, with Special Reference to the Cause and Prevention of the After-Corrosion of Firearms. *By* W. J. Huff. *Technical Paper* 188. *Price* 5 *cents.*

REVIEW

Vol. XLI] DECEMBER 30, 1922 [No. 24

THE ARTIFICIAL SEASONING OF WOOD BY THE OZONE PROCESS

ALEX. RULE

M. OTTO, the inventor of the well-known Otto process for the sterilisation of water by means of ozonised air has ntroduced a process which makes use of the ame agent for the artificial seasoning of wood n an industrial scale (British patents 125,846 nd 133,263).

The object of this process is to obtain a material possessing all the characteristics of wood which has been dried and seasoned by the natural method. Natural seasoning proceeds very slowly and, in extreme cases, must be allowed to extend over several years, whereas the Otto process produces similar results within a few weeks. In freshly cut wood the cells are filled with sap consisting chiefly of water, which constitutes about 40 per cent. of the total weight of the wood; but, in addition, the sap contains a large number of complex substances, which may be classified into two main groups:—(1) Amylaceous substances, closely resembling starch in composition. (2) Resinifiable substances. In natural seasoning the wood gradually loses water, the starchy substances are converted into sugars and the resinifiable substances undergo oxidation to form solids. Only the ligneous tissue of the wood remains unaltered. These changes are accompanied by gradual alteration in external orm; the wood shrinks, and, if the seasoning rocess is irregular, distortion may also occur—or example, a flat surface may gradually ecome curved.

The disadvantages of using incompletely easoned wood in the various arts are too well nown to need recapitulation; if these disdvantages are to be avoided care must be aken only to employ wood which has reached condition of stability as a result of the comlete oxidation of certain components of the ll-sap. This condition can only be attained ith extreme slowness, as illustrated by the ct that wood, which has been exposed to the ction of air for three years, still contains nchanged starch and unoxidised resinous atter. In certain industries, for example, the manufacture of pianos, it is not at all unusual to leave the wood to season in the air for at least ten years before use. Wood left to season in this manner naturally represents capital lying idle and entails charges for storage-space, etc., most of which may be avoided by adopting a suitable process of artificial seasoning. At the present time the question of increasing the rate of seasoning is particularly important owing to the fact that, during the war, the existing stocks of seasoned wood were consumed almost completely: well-seasoned timber is therefore scarce and in many cases shortage of capital renders it practically impossible to continue to rely on the natural method in building up new stocks.

Several processes of artificial seasoning exist already, but according to M. Otto, none of these produces a material which possesses the same characteristics as naturally-seasoned wood. To reduce the moisture-content of wood to 10 per cent. by treating it with hot air, is a comparatively simple process; at the same time very few of the plants used for this purpose are really efficient. Wood, after treatment in this way, is certainly dry, but if the temperature in the drying plant does not exceed 60°C., all the above-mentioned components of the sap remain in the cells unchanged; subsequently certain of these components undergo slow oxidation, which is accompanied by contraction in the contents of the cells; as a result the wood gradually shrinks, just as it would have done if it had been employed in the green state. The starch, which still remains unaltered in the cells, attracts parasites and gives rise to the formation of mould; moreover, these unchanged components of the cell-sap are distinctly hygroscopic, consequently the wood absorbs moisture again from the air. If the temperature of drying is raised with the object of decomposing these substances the results are not very greatly superior. It is true that in these conditions the organic components of the sap are destroyed and disappear, but the general effect is to leave the cells empty, thus rendering the wood brittle and lifeless.

Other processes consist in removing the sap, previous to drying, by treating the wood with hot water or steam. In this way it is, indeed, possible to eliminate the organic components of the sap and to ensure that after the wood has once been dried it will remain so, but again, the cells are left empty and the wood possesses the same defects as arise from drying at a high temperature.

As a matter of fact no process is capable of producing the same results as natural seasoning unless it provides for the oxidation, without elimination, of the organic components of the cell-sap. If an artificial oxidising agent is employed for this purpose it must act rapidly, it must penetrate to the innermost portions of the wood without affecting the ligneous tissue, diluting the sap, or discolouring the wood, and it must leave no residue. These conditions prohibit the use of the majority of oxidising agents ordinarily employed in chemical industry; ozone, on the other hand, fulfils all these conditions and, as employed in the Otto process, is capable of reproducing exactly the phenomena and results of seasoning by exposure to air, but at a rate about three hundred times more rapid.

After a long course of experimental work on the subject M. Otto has now established his process on an industrial scale. It consists essentially in submitting the wood to the combined action of gentle heat and ozone, which brings about simultaneous evaporation of water and oxidation of the organic components of the call sap. Two forms of apparatus, namely, compartment kilns and progressive kilns are employed. The latter form is illustrated by Figs. 1, 2, and 3.

Fig. 1.

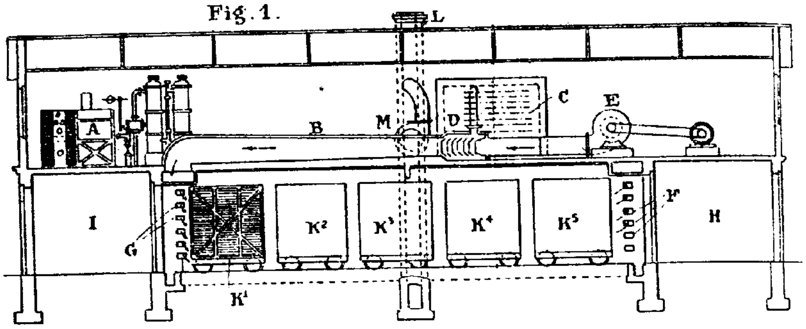


Fig. 2.

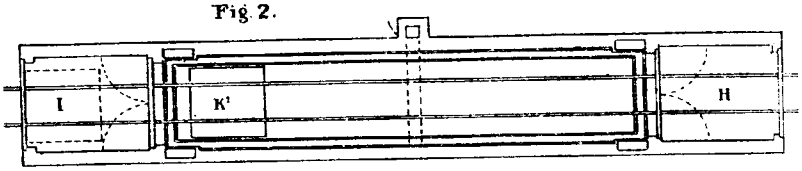
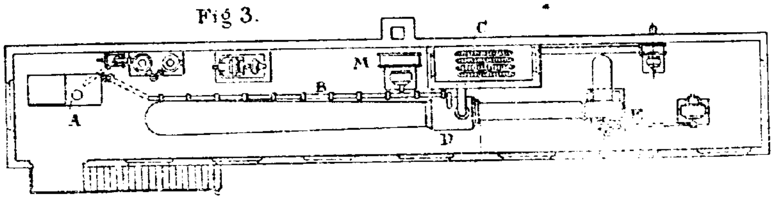


Fig 3.



A is an ozone generator of the type employed in the Otto process for sterilising water. The electrodes consist of cast-iron plates, which are cooled by a current of air and are separated by glass di-electrics. The air entering the ozoniser is dried beforehand in earthenware columns containing calcium chloride. B is a duct for circulating the ozonised air, C a heat generator, D an emulsifying mixer, which intermixes hot air and ozone and consists of a series of conical nozzles suitably arranged (Fig. 1). E is a fan for producing circulation of the air. F, G are distributing ports, H and I hot-air locks at the entrance and exit respectively of the kiln, and K¹, K², K³, K⁴, K⁵ are the wagons for containing the wood.

After normal operation has been established the wood is submitted successively to the action of hot air, of ozonised air alone, and of a mixture of ozonised air and hot air. The duration of eatment varies from ten to fifteen days, cording to the nature of the wood. In that riod green wood can be converted into asoned wood possessing all the characteristics wood which has been exposed to the action of r for ten years; the physical properties are entical, and no differences are detectable by e mechanical, chemical or microscopical sts usually employed to distinguish between turally-seasoned and stove-dried wood.

The Otto process has undergone a thorough ries of trials extending over two years, at the perimental factory in Paris, with perfectly tisfactory results. The "Conservatoire ational des Arts et Métiers" has examined the ocess in its experimental laboratory and fully nfirms the results claimed by the inventor.

In France the process is exploited by "La mpagnie Française des Bois," which possesses factory at Paris containing two compartmentlns, each with a capacity of 240 cubic metres. new factory is being erected at St. Denis to erate the process in progressive kilns similar that illustrated above.

HE EXTRACTION OF GASOLINE FROM NATURAL GAS

GEORGE A. BURRELL

Part II.—Extraction with Charcoal, and Plant Design

The third method used for extracting gasoline om natural gas is based upon the adsorptive wer of "activated" charcoal. This process was rfected within the last four years by the writer d his associates.

A very porous charcoal was developed during the r for use in gas-masks. It was introduced by nglish chemists and first appeared on the battleld in the form of the well-known box respirator the English armies. Its method of preparation d mode of action have been widely discussed ewhere, so that it must suffice here to say that best activated charcoal for absorbing gasoline, d probably for most other absorption purposes, made by first charring coconut shells at a derate temperature, grinding the charcoal thus duced, and activating it (freeing it from residual rocarbons and other substances) by heating it a high temperature in the presence of an diser, usually steam.

n gasoline practice the activated charcoal, of 14 mesh, is placed in three absorbers, which, for lant producing 1000 galls. of gasoline per day, about 6 ft. high and 5 ft. in diameter. The ural gas is passed through one of the absorbers, when the charcoal in it has become saturated h gasoline up to about 15 per cent. of its weight, gas is passed into the second absorber; and then the third. In the meantime saturated steam urned directly into the first absorber to drive gasoline out of the charcoal. The gasoline our and steam pass out of the absorber and ugh water-cooled coils, where they areconed and separated. At any given moment one rber is absorbing gasoline, one is being treated with steam, and one is cooling. The residual gas is passed through the absorber being cooled in order to hasten this operation.

One advantage which the charcoal process has over other processes is that at very low pressures, 2—5 lb. per sq. in., the absorbent action of the charcoal is very efficient. At these pressures an oil plant requires very much more oil than is needed to treat the same quantity of gas at high pressures.

Five charcoal plants are now in operation and two more are being built.

Designing Gasoline Plants

In constructing a gasoline plant it is necessary that the quantity and quality of the natural gas be carefully determined. This is simple in the case of absorption plants built to treat natural gas at one of the main lines of a natural-gas company. Tests are usually made by means of a small portable absorber filled with absorbent oil. The gas is measured, and at the end of the absorption the gasoline is distilled from the oil with steam and measured again. Varying types of small absorbers are used. One built of pipe and coils on the principle of a Friedrich wash-bottle gives good results owing to the long contact between the gas and oil, and the best results are obtained with two or three of these absorbers placed in series. The gasoline content of natural gas may be deduced roughly from its density, and also by shaking a measured volume of it with the absorbent oil in a Hempel or similar pipette.

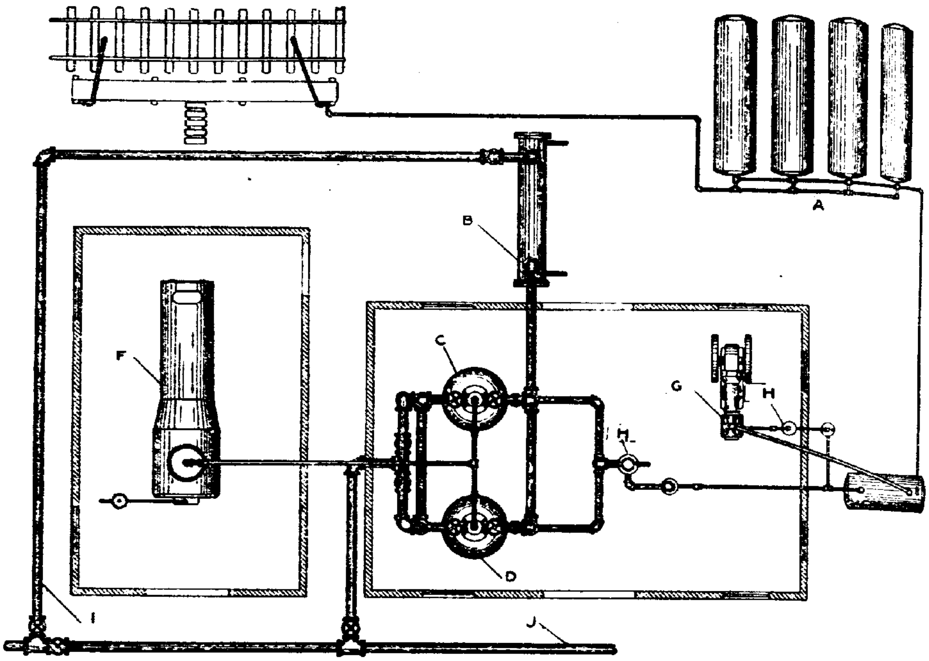
Casing-head natural gas is frequently tested by actually compressing and cooling the gas, as it comes from the well, in a small portable compressor, frequently mounted on a motor car and belted to its engine. Tests have also been made by passing the gas through a small coil embedded in a mixture of solid carbon-dioxide and acetone. Another method is to pass the gas through tubes containing charcoal, and to distil the gasoline from the charcoal by heating it in a distillation-flask about one-half filled with glycerin. There is a host of different testing methods, but those whereby the gasoline-content is directly determined with a small oil-absorber, a portable compressor, charcoal, or a freezing mixture, are the more reliable.

Compression Plant Design

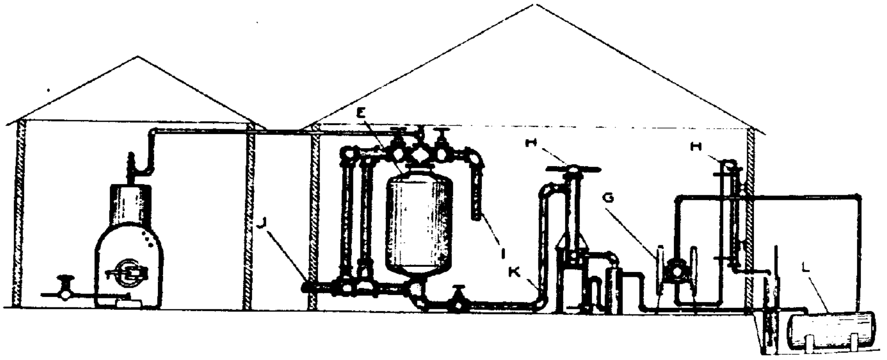
In fixing the size of a compression plant based on small-scale tests, one has to make allowance for a future decrease in the quantity of the gas resulting from the action of vacuum pumps which sooner or later partially exhaust the gas; as this occurs the gas becomes richer in gasoline, and sometimes the net yield of gasoline increases considerably. However, the quantity of gas invariably declines.

Four- to six-inch main gathering lines are used for connecting groups of wells to the plant, and two-inch lines are laid from the main lines to the individual wells. Vacuum pumps are placed preferably at the plant, but at times the distance from the wells may be so great as to necessitate placing the pumps in the field, and using booster pumps to take the gas from the discharge-side to the vacuum pumps and force it, at 0—10 lb. pressure, to the suction side of the compressors at the plant. Compressors of different type are on the market.

Cooling-coils are preferably of the atmospheric type, consisting of 2-inch coils in headers on which



Plan



Elevation

A—Storage tanks
B—Gas cooler
C—Absorber No. 1
D— ,, No. 2
E— ,,
F—Boiler

G—Compressor
H—Condenser
I—Treated gas outlet
J—Untreated gas inlet
K—Vapour line
L—Run tank

Fig. 1.—Gasoline Extraction Plant
Charcoal recovery process

ater drips, frequently from sprays in a cooling ower. The radiating area of the coils is usually 6—0·7 sq. ft. per 1000 cb. ft. of plant capacity.

Run tanks, which collect the condensate direct rom the coils, are equipped with automatic traps discharge the condensate into storage tanks. he discharge gas should be passed through an bsorption tower, preferably in contact with aphtha to extract the last portions of gasoline.

The plant, if possible, should be located close to railroad so as to provide for inexpensive shipment f the product; but many small plants ship their roduct in steel drums, of 50 gallons capacity, by eans of auto-trucks.

There follow data covering four compression asoline plants located in different parts of the nited States.

less fuel. The industry principally uses steam because the fire hazard is thus reduced.

Oil cooling-coils are best made of 2-inch pipe arranged in headers, and with about 1·0 sq. ft. of surface per gallon of oil circulated per hour. Those of the atmospheric cooling type are best.

Fuel Consumption.—In many absorption plants fuel is the largest item of cost. To reduce it as much as possible, gas-engine power should be employed to run the pumps, compressor, generator, and small items of tool machinery, with the exception that if steam is employed for distillation, enough is used in two or three of the pumps to provide exhaust steam for the stills, otherwise steam would have to be generated for this purpose alone. In most compression plants fuel is not an item, because gas otherwise wasted is used; hence no special economy is practised at the power station of a compression gasoline plant.

Data Relating to Compression Plants

Plant No.	Low-stage compression												High-stage compression			
	Intake			Discharge		Cooling coils				Compressor discharge			Cooling coils			
	Rated horse-power	Pressure inches of vacuum	Temp. deg. F.	Pressure lb. per sq. in.	Temp. deg. F.	Total surface area sq. ft.	Sq. ft. per h.-p.	Sq. ft. 1000 cb. ft. gas	Discharge temp. deg. F.	Pressure lb. per sq. in.	Temp. deg. F.	Rated horse-power	Total surface area sq. ft.	Sq. ft. per h.-p.	Sq. ft. per 1000 cb. ft. gas	Discharge temp. deg. F.
1*a*	55	2		55		220	4·0	0·490	68 (20°C.)	250		55	220	4·0	0·490	68 (20°C.)
2*b*	900	6	80 (26·7°C.)	35	245 (118·3°C.)	3600	4·0	0·481	76 (24·4°C.)	250	245 (118·3°C.)	900	3600			78 (24·4°C.)
3*c*	50	3		45		210	4·2	0·600		250		50	420	8·40	1·20	

a Plant produces daily 700 galls. gasoline of sp. gr. 0·6731—0·6667 from 450,000 cb. ft. of gas.
b Plant produces daily 7,500 galls. gasoline of sp. gr. 0·7000 from 7,500,000 cb. ft. of gas.
c Plant produces daily 1,590 galls. gasoline of sp. gr. 0·6195 from 350,000 cb. ft. of gas.

(From Bulletin 151, U.S. Bureau of Mines.)

DESIGN OF OIL-ABSORPTION PLANT

The design of oil-absorption gasoline plant requires more skill than the design of compression plants. The nature of an oil plant lends itself to the design of a multitude of apparatus for performing the work, and many fantastic kinds of absorbers, stills, heat-exchangers, vent-tanks, etc. were built in the early days of the industry. At the present time, however, designs are fairly well standardised, and different plants now being built are fairly uniform in construction.

Absorbers should be of the vertical type and up to 60 ft. high. Their diameter is limited by the pressure they have to withstand. Twelve feet for low- and 3 ft. for high-pressure absorbers are the customary maxima.

Heat-exchangers are preferably of the double pipe type, because when properly welded they do not leak so readily as those of the built-up tubular types; but the latter are more efficient. They should be designed to give about 0·25 to 0·30 sq. ft. of exchange-surface per gallon of oil circulated per hour.

Steam stills will vary from 4 ft. in diameter and 15 ft. long for heating about 2800 galls. of oil per hour to 12 ft. in diameter and 35 ft. long to treat 20,000 galls. of oil. Pan-type stills heated with free steam, are best when steam is used as the distilling medium, but direct fire-heated stills consume

QUANTITY OF OIL REQUIRED

The quantity of oil necessary to circulate through an absorption plant will vary with the gasoline-content of the gas and with its pressure. More oil is required at low pressures. This follows from well-known laws. The quantity actually required has been found by much experience to vary from about 4 galls. for 1000 cb. ft. of gas at pressures of 150 lb. or more, and containing about one-eighth gall. of gasoline per 1000 cb. ft. of gas, to 150 galls. per 1000 cb. ft. for gas treated at 5 lb. pressure and containing eight galls. of gasoline per 1000 cb. ft.

The cost of constructing an absorption plant depends upon the richness of the gas, the amount of gas, and the pressure under which the gas is treated. A plant handling 20 million cb. ft. of gas at 150 lb. pressure, and containing 200 galls. of gasoline per million cb. ft., will cost about $150,000·00, completely erected.

CALCULATIONS FOR DESIGN

The steam, water, heat-exchange cooling area of coils, fuel requirements, etc. can all be fairly closely calculated after preliminary tests have been made of the gasoline-content of the gas and its pressure and quantity.

Steam requirements can be based on the following average data:—

Temperature of oil entering still ..	135°F. (57·2°C.)
Temperature of vapours from still ..	210°F. (98·9°C.)
Temperature change	75°F. (23·9°C.)
Specific heat of absorption oil	0·50
Weight of absorption oil	7 lb. per gall.
Heat required to raise 1 gall. absorbent oil from 135°F. (57·2°C.) to 210°F. (98·9°C.) = 75 × 0·50 × 7 = 262·5 B.Th.U. per gall.	
Specific heat of gasoline	0·58
Latent heat of gasoline	100 B.Th.U. per lb.
Weight of gasoline	5·5 lb. per gall.

The water requirements for the gasoline cooling-coils can be calculated from the temperature of the gasoline vapour leaving the knock-out box, which will be about 180° F. (82·2° C.), its final temperature, which can be assumed to be about 60° F. (15·6° C.), and the specific heat and latent heat of the gasoline. The last is about 100 B.Th.U.

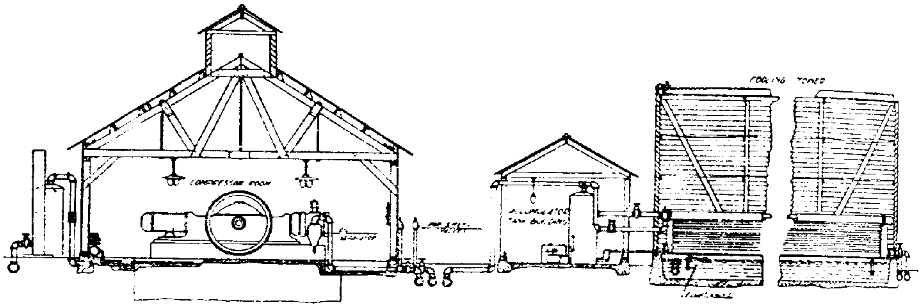
The water for the oil cooling-coils can be calculated from the temperature of the oil leaving the heat-exchangers, which will be about 160° F. (71·1° C.) in open steam-stills, its final water-cooled temperature before entering the absorbers, about 70° F. (21·1° C.), the temperature of the water before and after it is used to cool the oil, approximately 60° F. (15·6° C.) and 100° F. (37·8° C.), respectively, and the specific heat and weight in pounds per gallon of the absorbent oil.

The capacity of the absorbers in terms of cubic feet of gas per 24 hours can be approximately determined from the formula:—

$$Q = 314{\cdot}16d^2\sqrt{\frac{P}{G}}$$

where P = absolute gas pressure.
G = density of gas.
Q = capacity in cb. ft. per 24 hours.
d = diameter in inches.

The diameter of the absorbers is determined by the gas pressure which they have to withstand. The spreading or absorbent surface of the filler used



From Bulletin 151, U.S. Bureau of Mines.

Fig. 2.—Compression Plant

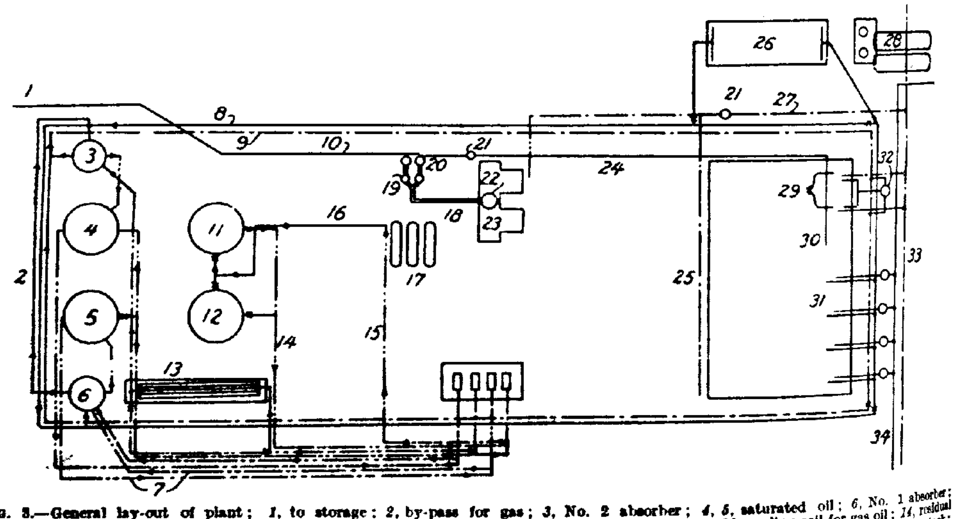


FIG. 3.—General lay-out of plant; *1*, to storage; *2*, by-pass for gas; *3*, No. 2 absorber; *4*, *5*, saturated oil; *6*, No. 1 absorber; *7*, recirculation lines; *8*, wet gas; *9*, dry gas; *10*, gasoline to tanks; *11*, residue; *12*, storage; *13*, cooling-coil for gas oil; *14*, residual gas to cooler and absorber No. 2; *15*, saturated oil to still; *16*, residue from still; *17*, heat-exchangers; *18*, vapour stack; *19*, dephlegmator; *20*, condenser; *21*, trap; *22*, evaporator; *23*, still; *24*, still vapour to compressor; *25*, engine fuel line; *26*, compressor and wet-gas cooler; *27*, fuel line; *28*, blending drums; *29*, boosters; *30*, still-vapour compressors; *31*, 4 vacuum pumps; *32*, scrubbers; *33*, dry gas to field; *34*, wet gas.

Fig. 3.—General Lay-out of Oil-Absorption Plant.

(From Technical Paper 263, U.S. Bureau of Mines.)

inside the absorbers decreases their capacity, and allowance has to be made for this. Their diameter also should be such that the velocity of the gas through them does not exceed 150 feet per minute, otherwise absorbent oil will be carried out of them and into the gas lines by the gas, despite oil-traps placed to catch the oil.

The amount of piping required in constructing the heat-exchangers and oil cooling-coils can be calculated from the constants already given.

General

The industry is now firmly established. Its future growth will not be so rapid as its growth in the past because a tremendous amount of gas, long wasting its gasoline, was "caught up with" and treated, as operators learned of possibilities in extracting the gasoline. Every oil and gas well is, however, a potential gasoline producer, and just as the natural gas and petroleum industry thrives, so will its by-product industry, the natural-gas gasoline industry.

More natural-gas gasoline will be required each year for mixing with heavy refinery distillates to make them suitable for motor use, thus providing the low-boiling constituents needed to make motor-engines start and to accelerate them when running.

Users of gasoline in Europe demand a much higher grade of gasoline for their motor cars than do consumers in the United States. Hence a very large amount of natural-gas gasoline is added to gasoline destined for exportation.

Different grades of natural-gas gasoline are sold at the present time. The most desirable and the highest priced gasoline in the country is so-called "straight absorption gasoline" of sp. gr. about 0·6667. This grade suffers less loss by evaporation than others, in its handling and utilisation. Other grades consist of "straight compression gasoline" of different distillation-ranges and end-points, and a host of blends ranging from specific gravity 0·667 upwards.

Refiners, of course, prefer to buy the crude natural-gas gasoline product and mix it with their efinery "cuts." On the other hand natural-gasoine operators prefer to do this blending themselves t their plants because they save thereby much 'wild" gasoline which they could not otherwise etain. The refiner has the upper hand in the rgument because he has better access to the retail narkets and can better dispose of blends than the natural-gas gasoline operator. The ideal combination is that of a company possessing both refineries nd natural-gas gasoline plants; all the large oil ompanies are in this position.

Natural-gas Gasoline: Distillation Data

Per cent.	A Typical compression product Sp. gr. 0·6114 Deg. F.	B Typical absorption product Sp. gr. 0·667 Deg. F.
Initial	54 (12·2°C.)	75 (23·9°C.)
10	68 (20·0°C.)	98 (36·7°C.)
20	78 (25·6°C.)	114 (45·6°C.)
30	87 (30·6°C.)	127 (52·8°C.)
40	98 (36·7°C.)	141 (60·6°C.)
50	112 (44·4°C.)	155 (68·3°C.)
60	134 (56·7°C.)	172 (77·8°C.)
65	160 (71·1°C.)	—
68	190 (87·8°C.)	—
70	—	190 (87·8°C.)
80	—	218 (103·3°C.)
90	—	276 (135·6°C.)
92	—	302 (150°C.)
	Loss 32 per cent.	Loss 8 per cent.

Both these compression and absorption products were withdrawn as made without blending or allowing them to "weather." In actual plant practice, the compression product is both blended and weathered in order to save as much of the "wild" parts as possible and to reduce the vapour pressure to conform with shipping regulations.

SAFEGUARDING OF INDUSTRIES ACT

SODIUM PHOSPHATE

A complaint to remove "sodium phosphate" from the list of dutiable articles was preferred by the Chemical Merchants' and Users' National Vigilance Committee (represented by Mr. K. Swan and Mr. R. L. Parry), and opposed by the Board of Trade (Mr. Whitehead) and Thomas Tyrer and Co., Ltd. (Sir A. Colefax, K.C., and the Hon. S. Cripps). The one and only sitting, held on November 25, was devoted to a consideration of the form of the complaint. For the complainants Mr. Swan contested that the term "sodium phosphate" was often used by the trade in a generic sense, *i.e.*, as including the three sodium salts of orthophosphoric acid and sodium pyrophosphate; these substances were all heavy chemicals. The opponents held that to chemists, the trade, and the public "sodium phosphate" meant di-sodium hydrogen phosphate and none other; as this substance was included in the Board's list with the prefix "R" and not otherwise, they contended that the Referee had no power to hear or adjudicate on any complaints in respect of other substances. Without prejudice to this objection, the Board asserted that sodium phosphate, mono-, sodium phosphate, di-, "R.," sodium phosphate, tri-, and sodium pyrophosphate were each of them fine chemicals, and that sodium phosphate, di-, "R.," was also extensively used as an analytical reagent. Sir A. Colefax urged that the notice of the complaint was bad because it did not specify any particular phosphate. After much legal argument, the Referee said he would take evidence as to whether "sodium phosphate" had a specific meaning or not. Mr. Swan then handed in a "family tree" showing the relationships between the three sodium salts of orthophosphoric acid, the sodium salts of pyrophosphoric acid and sodium metaphosphate, contending that the term "sodium phosphate" covered all these substances.

Mr. E. J. Parry, in his evidence, referred to a number of text-books and chemical dictionaries of somewhat ancient date in which the term "sodium phosphate" was used rather loosely, but in reply to the Referee said he could not show any reference to "sodium phosphate" being used to connote any substance other than disodium hydrogen phosphate. Speaking as a chemist, the expression "sodium phosphate" was used generically in all the text-books, but when he saw the words "sodium phosphate" alone and without qualification, he understood them to mean the disodium orthophosphate. Cross-examined by Sir A. Colefax, Mr. Parry repeated a previous assertion to the effect that although ortho-, pyro-, and metaphosphoric acids were distinct chemical individuals, they were always treated as separate varieties of phosphoric acid; they were modifications of one original substance. Sir A. Colefax contended that they were not modifications of any single substance, and asked witness for its formula. Mr. Parry replied that there were three formulæ.

The Referee's award, dated December 4, is as follows:—

In this case the complaint referred to me is that sodium phosphate has been wrongly included in the list of dutiable substances. The complainants claim that under this complaint they are entitled to ask me to consider the propriety of the inclusion in the list of: Monobasic phosphate of sodium; dibasic phosphate of sodium; tribasic phosphate of sodium; and pyrophosphate of sodium, both in the neutral and acid varieties. The words "sodium phosphate" do not occur in the list without some further word of description. It is therefore necessary to determine which article or articles in the list is or are referred to by these words.

It is the duty of a complainant to indicate with at least reasonable certainty which article is the subject of his complaint. There is no difficulty about using the exact description appearing in the list. Departure from such a course must lead to ambiguity. The evidence called by the complainants established quite clearly, and I find as a fact, that both in the trade and among chemists "sodium phosphate" is the substance described in the list as sodium phosphate, di-.

The evidence does not suggest that the words "sodium phosphate" have been used or are used to describe any other substance. Yet I am asked to treat the words as co-extensive with the words "phosphates of sodium." I do not think I should be justified in so doing. I cannot see how I can give the words "sodium phosphate" any meaning other than that which they in fact have. The result is that the only article which I have jurisdiction to consider is that described in the list as sodium phosphate, di-. The letter "R" appears against it in the list, and it is conceded that so qualified the inclusion is not open to objection. The complaint therefore fails. No costs.

I understand that there are other complaints referring specifically to sodium phosphate, mono- and tri-. Nothing I have said prejudices in any way the further prosecution of these complaints.

OXALIC ACID

A complaint, lodged by the Chemical Merchants' and Users' National Vigilance Committee, that oxalic acid had been improperly included by the Board of Trade in the list of articles subject to duty under Part I of the Act, was heard by Mr. Cyril Atkinson, K.C., on November 11, 17, 18, and 20. The complaint was opposed by the Board of Trade (represented by Mr. Whitehead) and by certain other interests, and by J. D. Pritchard and Co., Ltd., of Swansea, formerly manufacturers of oxalic acid by the potash-fusion process. This firm was represented by Sir Arthur Colefax, K.C., and the Hon. S. Cripps, and the complainants by Mr. K. Swan and Mr. R. Lambert Parry.

Early in the proceedings Sir A. Colefax stated he would mainly rely upon the contention that oxalic acid was a synthetic organic chemical, and to a less extent he would claim that it was an analytical reagent when in a very high state of purity. The Board of Trade maintained that oxalic acid was not only a fine chemical by reason of its method of manufacture, but a synthetic organic chemical and an analytical reagent.

Mr. Swan's case was that oxalic acid is a heavy chemical; if that were proved it would follow from the wording in the schedule that oxalic acid was not a synthetic organic chemical, or an analytical reagent, or any other fine chemical. [The relevant words of the Schedule are: "Synthetic organic chemicals (other than synthetic organic dyestuffs, colours and colouring matters imported for use as such, and organic intermediate products imported for their manufacture), analytical reagents, all other fine chemicals (except sulphate of quinine of vegetable origin) and chemicals manufactured by fermentation processes."] According to the trade a synthetic organic chemical was a fine chemical; the process of manufacture of oxalic acid through sodium formate was not truly synthetic; and oxalic acid was only used in minute amounts as an analytical reagent.

The Referee stated that he would adopt the definition of "synthetic" that he laid down in the camphor case:—

"The word 'synthetic,' as used in the Act, means a building-up of carbon compounds either from their constituent elements or from groups of differently constituted molecules by orderly steps, the result of which can be followed, and from which the constitution of the structure can be deduced or inferred" (*cf.* J., 1922, 239 R).

Mr. A. F. Butler, of R. W. Greeff and Co., Ltd., said that the trade had always regarded oxalic acid as a heavy chemical: in lists issued by his firm in 1914 and 1922 it was classified as a technical chemical, and (in answer to Sir A. Colefax) it appeared in one recent list under the heading "Fine Chemicals and Pharmaceutical Products." He had never heard it described in the trade either as a synthetic organic chemical or as an analytical reagent. Before the war commercial oxalic acid was of 99—100 per cent. purity, but to day from 98 to 100 per cent. Prior to hostilities his firm was agent for a German combine of manufacturers and he dealt with the agency known as the Verkaufs-stelle für Oxalsäure. Nearly all the acid he had imported in 1921 came from Holland, where it was manufactured, he believed, by the formate process.

Mr. W. G. Wilson, a director of Charles Page and Co., Ltd., gave similar evidence. In addition to trading with Germany and Holland, his firm imported a little oxalic acid from Norway and from the United States, representing in this country the Victor Chemical Works, of Chicago, where the output, by the formate process, was over 1000 tons per annum. American oxalic acid could not compete in Europe. His firm dealt in quantities ranging from one cask (up to 5—8 cwt.) to 10-ton lots, and sold it mainly to the textile and leather industries and for bleaching straw.

Mr. John Brown, of Brown and Forth, Ltd., said that he always associated the term "fine chemical" with a B.P. standard of purity. He imported oxalic acid in 5—10-ton lots from Holland, Germany, and Norway, and he also bought from Pritchards, but this firm could not compete with the foreign suppliers. America, however, was "down and out." He was not importing oxalic acid at the present time, preferring to wait to see which way the cat jumped. (The Referee: "Am I the cat?")

Mr. E. J. Parry stated that he had searched trade literature and found that oxalic acid was always classed as a heavy chemical except in two places, in this *Journal* and in the price list of Greef already mentioned. He did not regard the process of manufacture through sodium formate as a synthetic process in the sense laid down by the Referee (*cf. s.*). The first stage of that process, viz., the reaction (a) $NaOH+CO=H.COONa$, was exactly analogous to the reaction between caustic soda and carbon dioxide, and if the formate was called "synthetic," so also must be sodium carbonate. No organic radicles took part in this reaction, and there was no increase in the number of carbon atoms. The reaction *per se* gave no clue to the constitution of sodium formate. The next stage: (b) $2H.COONa=H_2+(COONa)_2$ was a mere decomposition at a very high temperature and lacked every characteristic of synthesis ("a temperature of 400° C. is totally antagonistic to any idea of synthesis"); the course of the reaction was entirely unpredictable. Only if the word "synthetic" were used in the sense of "artificial" could oxalic acid made by this process be called a synthetic organic chemical; and if this broad sense of the word were used, a great number of admittedly heavy chemicals would have to be included. On the point that oxalic acid was claimed to be an analytical agent, Mr. Parry said that its use for this purpose had become discredited; personally, he had not used it for ten years, sodium or ammonium oxalate was now always used instead.

Cross-examined by Sir A. Colefax, who asked if the synthesis of urea from ammonium cyanate was not everywhere admitted to be a true synthesis, although it involved no building up of carbon atoms, Mr. Parry said he would prefer to call it a "preparation"; and he admitted that the analogy between reaction (a) and the action of carbon dioxide on caustic soda was not complete in that in the latter case there was a simultaneous production of water. Reaction (b) was not a synthesis because, for one reason, it was not possible to follow the intermediate steps; probably a considerable number of subsidiary reactions took place and the yield of oxalic acid was only about 45—55 per cent.; but in the first stages of all the classical syntheses the intermediate steps were generally not known. Further, one could not deduce the constitution of the acid from this reaction. He did not regard the polymerisation of acetylene into benzene as a true scientific synthesis, but only a synthesis if that word were used as synonymous with "artificial," in which sense it was often used by chemists. Asked why he did not regard reaction (a) as synthesis, he replied that, except in a few cases, the word "synthetic" was not applied to inorganic chemicals; if it were, nearly every inorganic heavy chemical would be synthetic.

Dr. J. Gordon Parker, the sole witness for J. D. Pritchard and Co., said that if he had been asked five years ago, he would certainly have replied that oxalic acid was a fine chemical, because he had always associated heavy chemicals with productions of hundreds of thousands of tons and with comparative ease of manufacture. He had never heard the mode of preparation through sodium formate referred to otherwise than as a synthetic process, and it was so designated by a large number of authoritative text-books (Ullmann, Perkin and Kipping, Richter, Roscoe and Schorlemmer, Molinari, etc.). He disagreed with Mr. Parry that the final product of a reaction was not synthetic, (a) if its constitution could not be inferred from the method of preparation; (b) if there were subsidiary reactions involving destruction of intermediate products and formation of by-products; and (c) if a high temperature played a part in the process. It was customary for tanners to keep oxalic acid in the same store as reagents, the finer dyes, and fine chemicals. The process of manufacture necessitated very careful control.

In cross-examination by Mr. Swan, Dr. Parker said that in his view "synthesis" did not imply any necessity to be able to deduce the constitution from the reaction or reactions; and in the Referee's definition (*cf. s.*) he would prefer the word "likely," *i.e.*, not haphazard, to "orderly" (steps). Reaction (a) was a synthetic reaction and sodium formate a synthetic organic product. Organic synthesis did not only mean addition of carbon but of hydroxyl and other groups. In the technical process of manufacture the yield was much higher than 65 per cent. Examined by Sir A. Colefax, witness gave as an instance of an organic synthesis taking place at a higher temperature, the conversion of acetylene into benzene; from this reaction alone, the constitution of benzene could not be inferred. An important difference between the reactions of caustic soda with carbon dioxide and carbon monoxide was that the dioxide was the anhydride of an acid, whereas the monoxide was not. He did not regard the manufacture from sawdust as a synthetic process.

Dr. L. A. Jordan, who is the manager of a syndicate about to promote the manufacture of oxalic acid in this country by a new process, said he had specialised in the manufacture of synthetic organic compounds, and he held the view that oxalic acid was a fine chemical; it was of a high degree of purity, and was made neither in very big quantities nor in large batches, by a process which needed careful supervision and skilled labour. Beyond applying the usual tests for a fine chemical he was a chemist and knew by instinct what was a fine chemical and what was not (Referee: "I wish I did"). Oxalic acid was a synthetic organic chemical; he could not imagine any chemist doubting it; it was built up by a series of operations which were individually and collectively synthetic, and which involved the commonest ideas on synthesis such as linking of carbon atoms and a progressive increase in molecular weight, although these points were not absolutely essential to synthesis (*e.g.*, the synthesis of urea, and of aniline from nitrobenzene). The most important points in a synthesis were knowledge of the initial substance and of the final product; knowledge of the intermediate steps might assist in deducing the constitution of the product, but to this end other data, derived from analysis and determination of molecular weight and basicity, had also to be obtained. The Referee alluded to the definition of synthesis used in the camphor case and asked the witness if he could adduce examples of synthesis in which the reacting molecules were not dissimilar. Dr. Jordan instanced the formation of diphenyl from benzene, of the hexoses, $C_6H_{12}O_6$, from formaldehyde, and the condensation of benzaldehyde to form benzoin. In reply to the further question "if as the result of experimentation you arrive at a substance B but want A, is B a synthetic product?" the witness related a number of classic instances in which discoveries now recognised as syntheses had resulted from reactions following unforeseen courses. Finally, Dr. Jordan stated that he took a very wide view of the term "synthesis"; practically all artificially prepared carbon compounds were synthetic, but, of course, there were organic compounds, *e.g.*, certain alkaloids, which had not yet been synthesised.

In his final speech, Sir A. Colefax dealt with certain of Mr. Swan's fallacies, as he termed them. The interpretation that if oxalic acid is not a fine chemical, it cannot be a synthetic compound, was untenable. No one on his side had maintained that every step in a synthesis must itself be synthetic; or that it was essential to be able to deduce constitution from any one reaction involved in a synthesis. The question of high temperature was irrelevant. Although the bulk of the trade evidence was in favour of the view that oxalic acid was a heavy chemical, he would rely upon the abundant evidence to the contrary, supplied by the text-books and Drs. Parker and Jordan.

Mr. Whitehead said that the production of phenol from benzene was a clear case of synthesis not involving an increase in the number of carbon atoms. Mr. Swan's construction, that if oxalic acid was not a fine chemical, it could not be a synthetic organic chemical, was quite wrong; in law, they did not use general terms to define particular terms, but *vice versâ*. On the question of inferring constitution, he submitted that synthesis depended entirely upon the possibility of inferring and not upon the intention of the chemist when he started work or upon the accomplishment.

Mr. Swan, in his address, recalled the evidence as to trade usage which was to be found in the catalogues, price lists, Kelly's Directory, and trade journals; and he contended that this view applied equally well to oxalic acid made by the formate method as by the sawdust process. He reiterated his view of the interpretation to be put upon the wording of the Act, submitting that all synthetic organic chemicals were fine chemicals, and even if that view were wrong the inclusion of a heavy chemical, *i.e.*, oxalic acid, among them would be anomalous and unique. On the question of synthesis he took his stand upon the definition given in the camphor case; Sir A. Colefax had shifted his ground in that respect. Nothing could be gained from a text-book definition unless the author stated what he meant by "synthetic," and he urged that a reaction could not be called synthetic if it were unintelligible or obscure. In the present case the evidence was conclusive that the reaction involving the transition from formate to oxalate was not known with certainty; if it were understood with certainty to-morrow, it would become synthetic. The acetylene→benzene reaction involved the artificial production of benzene; it was not a synthesis within the meaning of the Act.

The Referee's award was issued on December 18, as follows:—

The question in this case is whether oxalic acid is properly included in the list of dutiable articles. The inclusion in the list is justified on three grounds:—1. That oxalic acid is a synthetic organic chemical. 2. That oxalic acid is a fine chemical. 3. That oxalic acid is an analytical reagent. I am not satisfied that oxalic acid is a fine chemical. Indeed, I think it is not. I am quite satisfied that its inclusion cannot be justified on the ground that it is an analytical reagent. But I have come to the conclusion that it is a synthetic organic chemical, and as such rightly included in the schedule.

The question whether oxalic acid is a synthetic organic chemical is one of considerable difficulty. It is, I think, entirely a matter of opinion, depending upon the particular view held as to the precise limitations of the meaning of the word synthetic. In the synthetic camphor case I accepted the following definition of synthesis: "A building-up of carbon compounds either from their constituent elements or from groups of differently constituted molecules by orderly steps the result of which can be followed and from which the constitution of the structure can be deduced or inferred." It may be that on some future occasion it will be necessary to reconsider this definition, but I do not understand that this definition is challenged by either side in this case. The difference of view has reference to the question whether the steps in the building up of oxalic acid from caustic soda and carbon monoxide come within it. There is no doubt that oxalic acid is an organic body which can be built up from its elements. The process begins with the use of carbon, the number of carbon atoms in the molecule is increased and the molecule becomes heavier. The molecular construction contains two atoms of carbon linked together. Although in practice the first step in building up is the combining of carbon monoxide and caustic soda, both these substances can be obtained from their elements.

The real dispute is as to whether the steps taken in the building up are orderly steps and steps from which the structure of the resulting molecule can be deduced or inferred.

The decision seems to turn upon the view taken of the main step—the heating of the sodium formate causing the hydrogen to be liberated and the two unsaturated links to combine, forming sodium oxalate. The temperature necessary to produce this reaction is no haphazard temperature. A temperature of 440° C. or thereabouts is necessary except in the presence of sodium carbonate or certain other substances when a lower temperature will suffice, viz., 300° to 350° C. In this sense it is a controlled temperature. It seems to me quite impossible to rule out a reaction depending upon a controlled degree of heat from those steps regarded as synthetic. But it is said that it is impossible to draw any inference as to the structure of sodium oxalate from the reaction in question. If the molecular structure of a substance is known before it is synthesised, and that knowledge is capable of suggesting, and does suggest, steps which may possibly bring about that result and then by experiment it is found that these steps do in fact produce that result, it seems to me that such steps are entitled to be considered as synthetic. I think that one might well have reasoned that if by heat the hydrogen could be expelled from the molecule H.COONa leaving the unsaturated link COONa it was at least possible that two or more of these links might combine and give the structure desired. The reasoning back from a known structure seems to me to be just as much a basis of synthesis as the reasoning forward towards an unknown structure. Further, I do not think that the definition demands that the hypothetical operator should know exactly what is going on during the experimental reaction.

The view I take after a very careful review of the evidence both in this and the camphor case is that oxalic acid obtained by the formate process is synthetic. There is one other matter with which I must deal, namely, Mr. Swann's argument that the expression "synthetic organic chemicals" is limited to fine chemicals. He relies on the words "all other fine chemicals" as indicating that this part of the schedule is only intended to cover chemicals that are fine. There seem to me to be insuperable difficulties about this view. It would give no independent effect to the words "all synthetic organic chemicals" or "analytical reagents." I quite agree that the word "other" creates a difficulty, but I adhere to the view I expressed in the sodium phosphate case that the particular description "all synthetic organic chemicals" cannot be cut down or defined by the more general words "all other fine chemicals." I therefore decide that oxalic acid manufactured by the formate process is properly within the schedule. It is conceded that the acid imported into this country is all manufactured by this process. I therefore award that the complaint fails.

CHEMICAL INDUSTRIES IN CANADA

The Dominion Bureau of Statistics has recently published a report on the production of chemicals and allied products in Canada for the calendar years 1919 and 1920. The statistics cover the following groups: Coal tar and its products; acids, alkalis, salts and compressed gases; explosives, ammunition, fireworks and matches; fertilisers; medicinal and pharmaceutical preparations; pigments, paints and varnishes; soaps, perfumery, cosmetics and other toilet preparations; inks, dyes and colour compounds; wood distillates and extracts; miscellaneous chemical industries. The report is disappointing in so far as the number of industries treated is limited; the paper and pulp, alcohol, glucose and other well-known industries, involving the application of chemical methods and generally associated with chemistry, are, unfortunately, not included, and the reason for these exclusions is not quite clear. Technologists and others having occasion to consult the Canadian report may conclude that many substances which are classed as chemicals are not made in Canada, and there would be good ground for such opinion, because of the detailed information regarding such industries as the manufacture of baking powder, cosmetics, and shoe blacking, which are treated fully in the report.

The report, although somewhat circumscribed in the industries treated, and also belated in making its appearance, is instructive and will prove a source of valuable information; the statistics are more authoritative, fuller, better arranged, and more free from anomalies than any issued in previous bulletins upon these industries. In some instances the textual comment is of such a character that it may induce the manufacturer to think and investigate his methods with a view to ultimately increasing production and lowering cost of manufacture.

The returns for the year 1919 practically cover the transition period arising from the abnormal conditions of war to those of peace, and is particularly marked by the falling-off in the output of the chemical industries employed in the manufacture of war materials.

	1919	1920
Total plants operated	429	456
Par value of stocks and bonds held in—	$	$
Canada	31,905,063	38,930,012
Great Britain	21,869,469	23,417,928
U.S.A.	121,622,220	129,161,069
Other countries	583,091	1,221,247
Total	$175,979,843	$192,730,256

From the foregoing it will be observed that in 1919 nearly 70 per cent. of the par value of stocks and bonds was held by residents of the United States, and that in 1920 this figure had fallen to about 66 per cent.

The total capital, including fixed assets—as lands, buildings, machinery, etc.—and liquid assets—as stocks and materials on hand—was $111,760,019 in 1919, and $118,840,897 in 1920, the capital being almost equally divided between the fixed and liquid assets. The average number of employees and amount of wages paid for the respective years were as follows:—

	1919	1920
	No.	No.
Males, salaried	2,539	2,790
Females, salaried	834	890
Male wage-earners	9,190	10.623
Female wage-earners	3,040	2,980
	$	$
Salaries	5,674,203	7,115,734
Wages	10,710,226	14,580,398
Salaries and wages (total)	16,384,429	21,736,132

The average salary for 1919 was, approximately, $1680, and for 1920 about $1940; the approximate wage rate for the respective years was $875 and $1070. The percentage ratio of the numbers of salaried and wage earners in the two years was almost constant.

The following financial statistics cover the costs of fuel, materials, miscellaneous expenses, total expenditure (including wages and salaries), and selling value of product:

	1919.	1920
	$	$
Fuel	2,009,526	3,298,117
Materials	48,303,812	60,082,027
Miscellaneous	17,667,486	21,053,223
Total expenditure	84,365,253	106,877,136
Selling value of products	96,463,988	121,789,336

The total power equipment in 1919 was as follows:—Total rated horse-power of prime movers (exclusive of boilers), 77,171; alternating current, 5896 kv.a., and direct current, 5746 kw. In the year 1920 the total rated horse-power of prime movers employed (exclusive of boilers) was 293,380.

The difference between the selling value of the products in 1919 and the total expenditure was $12,098,735, being about 14·4 per cent. in favour of the former; in 1920 these figures were $15,619,837 and 15 per cent. respectively. Calculating these differences in relation to capital—fixed and liquid assets—they represent in 1919, 10·8 per cent. and in 1920, 13·1 per cent. upon total invested capital.

An examination of some of the expenditure charges is interesting in view of the fact that the excess profit tax and income tax were practically *post bellum* enactments. An industry in which a large portion of the capital is invested in land and in buildings and machinery, which should not call for expensive repair, in 1919, charged 4 per cent. upon the fixed capital to repairs of buildings and machinery, and 13·8 per cent. in 1920; these and wages paid for the respective years, represent the cost of repairs as 32·2 and 64·4 per cent. The buildings and machinery, although in active use in 1918, must have suddenly developed marked signs of post-war weakness, which undoubtedly brought pleasure and relief in the preparation of the taxation schedule.

The values of the imports of chemicals, under the classes enumerated in the report, have been as follows: 1919, total $34,282,647, of which $3,397,095 came from the United Kingdom, $28,719,765 from the United States; in 1920 the total was $29,886,102, derived as follows: U.K. $4,154,345; U.S.A. $23,854,300. In 1921, total $36,334,612; U.K. $6,048,717; U.S.A. $26,766,364. In 1922, total $24,041,885: U.K. $3,238,465; U.S.A. $17,688,482.

The exports were as follows: 1919, total $56,799,799: $20,176,855 to U.K., $30,671,606 to U.S.A.; 1920, $22,581,049: $3,595,936 U.K.; $13,803,067 U.S.A.; 1921, $19,582,057: $3,225,947 U.K., $11,694,858 U.S.A.; 1922, $9,271,027: $939,529 U.K., $5,937,114 U.S.A.

The above customs returns are for the fiscal years ending March 31 of each of the above years.

The imports were at a maximum in the year 1921, in which period the output of Canadian industries was the greatest in value since the termination of the war. The exports in 1919 were the highest ever attained, owing to the shipment of military stores; since that year there has been a steady and heavy decline.

The calendar year 1921 exhibits a marked decrease in value of chemicals produced ($77,748,000), plants employed (444), capital $109,225,000), employees (12,289), salaries and wages ($15,853,000), and cost of material ($36,203,000). Notwithstanding the decline in the chemical industry during the past year, the statisticians are of the opinion that the worst is past, and that Canadian chemical trade will advance to a higher position than it ever held in pre-war times.

THE COAL INDUSTRY

The Dominion Bureau of Statistics has issued a comprehensive report reviewing the coal industry and trade of Canada in the years 1919—20—21. This is one of the best trade returns published by the Bureau; it contains in detail the output of collieries, imports of coal by ports of entry, exports, information regarding capital invested, plant equipment, men employed, time worked and lost tonnage, and statistics of the production from each province. The apparent coal consumption of Canada is estimated at between 30 and 35 million tons annually, half of which is imported from the United States. In 1921 there were 396 coalmines in operation, covering an area of 713,000 acres. Total capital invested, at the close of the year 1921, was $176,991,495, of which $77,000,000 was in British Columbia, over $3,000,000 in Saskatchewan, and $1,000,000 in New Brunswick. The coalmining industry gives employment to about 30,000 men, and in 1921 wages amounted to $42,758,471, and salaries aggregating $3,717,238 were paid to about 1600 officials.

The two reports referred to are entitled "Chemicals and Allied Products in 1919 and 1920" and "Coal Statistics for the Years 1919, 1920, 1921," respectively, and are published by the Mining, Metallurgical and Chemical Branch of the Dominion Bureau of Statistics, Ottawa.

SOCIETY OF CHEMICAL INDUSTRY

NEWS FROM THE SECTIONS

SOUTH WALES

A meeting of this Section was held in the Technical College, Cardiff, on December 1, Prof. C. M. Thompson presiding. Mr. H. W. Webb read a paper on the Oxidation of Ammonia, in which he described some of the pioneer experimental work on the process of manufacturing nitric oxide and nitric acid from ammonia, derived from waste gas liquor, by catalytic oxidation with very fine platinum gauze. The conditions of temperature, the preparation and construction of the catalyst, concentration and purity of the gases, and other factors which govern the capacity and efficiency of the oxidising unit were discussed. It was shown that the mixture of air and ammonia which is sufficiently rich in ammonia to maintain the catalyst temperature at its optimum value, does not yield the highest efficiency. The best result, *i.e.*, an efficiency up to 94 per cent., is obtained by using a mixture containing less than 10 per cent. by volume of ammonia and maintaining the catalyst at about 850° C. Catalyst poisons, especially hydrogen sulphide, phosphine and pyridine, were also dealt with. In the discussion it was pointed out that no unchanged ammonia passes the catalyst, so that the product contains no ammonium nitrate; ammonia not oxidised to nitric oxide appears as nitrogen.

MONTREAL

At the meeting held on November 20, the chairman, Dr. A. R. M. MacLean, presiding, Prof. Ruttan read a message of greeting from the President, Dr. Armstrong, to the Dominion Sections, which was greatly appreciated. There were present about 40 senior students from McGill University and the Université de Montreal, and the spirit of good-fellowship displayed between the two nationalities was a happy augury for still closer co-operation in the future.

"The Manufacture of Calcium Carbide" was the subject of the evening's lecture, by Mr. Witherspoon, General Manager of the Canada Carbide Co., who described the development of the electric furnace from the small experimental Moissan furnace to the present-day furnaces producing a ton an hour by a continuous process. He emphasised the fundamental importance of a correct balance between a given weight of material and a given amount of heat. The best method of mixing the lime and coke, and the degree of fineness of the two substances have been the subject of much experimentation, and the conclusion reached is that rough-mixing of coarsely crushed coke of ¼-inch to 1 in. mesh, with lime of 1 in. to 2 in. mesh gives the best yield.

The lecturer then described the developments which led to the adoption of a continuous process of manufacture, the chief of which was the increased supply of current. It was, however, early discovered that a reduction in voltage from the prevailing 75 volts was necessary. Two furnaces were then run in series and an efficiency of 90 per cent. was attained with 1000 kw., but developments rapidly followed, and to-day each furnace is rated at charges, based upon the total amount of salaries

15,000 kw. It is not correct to describe the modern furnace as an arc furnace, as the charge itself is a conductor, and the current passes quietly and steadily through the pasty mass. The arc exists only during the warming-up period, and a true balance in one of these large furnaces is not reached for several days. The different forms of electrodes were described.

The numerous derivatives of acetylene were referred to and a new, entirely Canadian product, Acetylene Black, was introduced to the audience. This substance has a very low specific gravity; it can be easily compressed, and even when compressed is 50 per cent. more bulky than carbon black. Rubber manufacturers have found it satisfactory, and when used in paints it yields a clear neutral grey. As a decolorising black in sugar-refining, and for filtering water, it has proved very efficient.

LIVERPOOL

At a meeting held on December 8, in the University, Dr. J. T. Conroy presiding, a paper was read by Mr. H. M. Langton on "Some Problems connected with the Saponification of Fatty Oils."

After a brief reference to the importance of industrial saponification, the author discussed the theory of hydrolysis of oils and fats, and pointed out that, as a result of the work of Lewkowitsch, Marcusson and others, we must conclude that the saponification of the triglycerides takes place in stages, passing from the triglyceride through the diglyceride to the monoglyceride, and ultimately to the products of complete saponification, fatty acids and glycerol, the complete reaction consisting of three consecutive bi-molecular reactions which are interdependent, though not necessarily taking place at the same rate. The author emphasised the fact that as industrial saponification involves a heterogeneous system, it might well be that physical considerations outweigh purely chemical ones, and experimental facts were quoted in support of this view. It is important to realise that as saponification resolves itself ultimately into a reaction between molecules of a triglyceride and of water, three possibilities are open, viz., (a) reaction in the oil phase, (b) reaction in the aqueous phase, (c) reaction in the surface of contact between the two phases; and Treub has shown that it is the third possibility which supplies the clue to the operation. The importance of emulsification in saponification is made apparent from the circumstance that in an emulsion, the velocity of the reaction which takes place at the surface of contact of the two phases, depends on the magnitude of this surface; anything which increases this surface, *i.e.*, diminishes the surface tension between the fatty matter and the aqueous solution, accelerates the reaction. From this aspect, the function of the particular reagents used technically in the acid, autoclave, Twitchell and fermentation methods of saponification, respectively, becomes apparent.

The importance of the time factor in saponification was then dwelt upon, reference being made to the conflicting views of different investigators, some of whom concluded that all oils and fats are saponified at the same rate, and others that the glycerides of the fatty acids are more easily hydrolysed the higher the molecular weight of the fatty acids. The author pointed out, however, that as most of the experiments were carried out in homogeneous solution, they may have little bearing on industrial saponification. A summary was given of previous industrial investigations on the rate and extent of the hydrolysis of different oils and fats, but as the conditions differed considerably no definite conclusions could be drawn. The author then described his own large-scale experiments on the rate and extent of saponification, by the autoclave process, of tallow, palm oil, linseed oil, palm-kernel acid oil, Nos. 1, 2, and 3 whale oils, lime and magnesia being used as the splitting bases. In all cases a constant steam pressure of 8 atm., a charge of 3 tons of oil or fat, an amount of base equal to 2½ per cent. of the weight of oil, and a period of treatment of 10 hours, were employed, the course of the reaction being followed by the withdrawal and testing of samples hourly. The results obtained were shown in a series of curves, which are of the exponential type, being characterised by a slow initial stage followed by a rapid second stage, when about 90 per cent. of the oil is split in the first 4 hours, after which the rate of reduction is much retarded. Magnesia was the most effective base for tallows, palm-kernel acid oil and the whale oils, lime being superior for palm oil, but with linseed oil the rate and extent of hydrolysis were identical for each base. Using magnesia as the base, tallows were hydrolysed most quickly, and in decreasing order come whale oils, linseed oil, palm oil and palmkernel oil. Beef tallow hydrolyses much more quickly with magnesia than mutton tallow. In the case of the whale oils, whichever base is used, the rate of hydrolysis is in the order No. 1, No. 2 and No. 3, No. 1 giving the highest value. Lastly, the author submitted in tabular form numerical details of the average extent of hydrolysis of various oils and fats after treatment with lime and magnesia, respectively, for 8 hours under the conditions outlined above. These averages are compiled from the working of 625 3-ton charges. It appears that a split of upwards of 98 per cent. was obtained with tallow and 92 per cent. with linseed oil.

NOTTINGHAM

On December 13, Mr. S. F. Burford presiding, Prof. H. E. Armstrong gave an address on "Legislative and Departmental Interference with Industry and the Common Weal."

The future of chemistry in England, and the welfare of an industrial population greater than the country can carry depend upon the extent to which chemists are mastered by the idea of their solidarity, and insist on being represented on all bodies dealing with questions in which chemistry is involved. By an abuse of the Food Acts, the lowering of the quality of milk has been allowed to continue unchecked for fifty years. The Act providing for the sterilisation of milk by heating was passed with insufficient knowledge, but evidence is accumulating that the new dangers so introduced are greater than those which were to be removed in this manner. The bureaucrat and the sentimentalist are trying to deprive us of our most effective paint. This is clearly shown by the inner history of the Home Office inquiries and of the proceedings of the International Labour Conference last year.

The inquiries into the smoke nuisance were entrusted to technically unqualified persons, who concentrated on a totally unnecessary proof of the nuisance and almost neglected the question of low-temperature carbonisation. Private persons of vision and imagination have investigated this problem with a success that will never be attained by H.M. Fuel Research Board. The Safeguarding of Industries Act is a most unhappy example of lack of clear thinking. The chief, if not the only, gainers are the members of the legal fraternity. Chemists should protest against the shameful way in which the traditions of their craft have been treated. The whole lists should now be put in order by competent advisers. In the dyestuffs industry the first condition of success is direction by persons who understand. No general in the army, however distinguished, can lead the attack on dyestuffs.

In the matter of research freedom of action, which is as much the right of scientific investigators as of artists and poets, is being threatened by a bureaucratic body, largely in the hands of literary men. This has displaced the Royal Society, which has made no attempt to influence the public, as it did in the days of Faraday.

COMMITTEES OF COUNCIL

PUBLICATIONS COMMITTEE

The President and Hon. Treasurer (*ex-officio*), J. Allan, J. L. Baker (chairman), F. H. Carr, W. H. Coleman, J. W. Hinchley, H. Levinstein, G. T. Morgan, J. A. Reavell.

Co-opted Members: E. R. Bolton, C. F. Cross, W. R. Hodgkinson, E. Grant Hooper, J. R. Partington, W. F. Reid, W. G. Wagner.

Nominated by Local Sections, etc.: J. T. Dunn, C. J. Goodwin, W. J. Jones, E. Lewis, L. L. Lloyd, B. D. W. Luff, F. M. Potter, and H. D. Richmond.

WEEKLY JOURNAL EXECUTIVE COMMITTEE

The President and Hon. Treasurer (*ex-officio*), Sir W. J. Pope, W. J. U. Woolcock, F. H. Carr, C. S. Garland.

GENERAL PURPOSES COMMITTEE

The President and Hon. Treasurer (*ex-officio*), J. L. Baker, F. H. Carr, C. S. Garland, J. M. Wilkie, W. J. U. Woolcock (chairman).

REPRESENTATIVES ON OUTSIDE BODIES, 1922–23

Federal Council for Pure and Applied Chemistry: F. H. Carr, Dr. S. Miall, and W. J. U. Woolcock.

National Physical Laboratory (General Board): Sir W. J. Pope and Prof. F. G. Donnan.

Institute of Chemistry Standards Committee: Dr. A. Holt, Prof. A. R. Ling, and Mr. W. G. Wagner.

British Engineering Standards Association: Aircraft Sub-Committee on Chemicals: Prof. W. A. Bone. Sub-Committee on Textiles: Mr. C. F. Cross. Sub-Committee on Dopes: Dr. J. N. Goldsmith.

Imperial Mineral Resources Bureau: Lead, Silver, Zinc, and Cadmium Sub-Committee: Mr. H. M. Ridge. Aluminium, Magnesium, Potassium and Sodium Sub-Committee: Dr. R. Seligman. Minor Metals Sub-Committee: Mr. W. G. Wagner. Publications and Libraries Sub-Committee: Mr. W. J. A. Butterfield. Abstracts Sub-Committee: Prof. H. Louis and Mr. T. F. Burton. Chemical Industries Sub-Committee: Mr. C. S. Garland.

British Empire Sugar Research Association: Prof. A. R. Ling and J. W. Macdonald.

Committee on "Tests of Graduated Glassware": J. L. Baker, F. H. Carr and Dr. B. Dyer.

Governing Board of Imperial College of Science and Technology: Sir W. Pearce.

Sectional Committee of Chemical Engineering of the British Engineering Standards Association: C. J. Goodwin, J. A. Reavell, C. S. Garland and Dr. W. R. Ormandy.

MEETINGS OF OTHER SOCIETIES

SOCIETY OF PUBLIC ANALYSTS

Mr. P. A. Ellis Richards presided at the meeting held in the Chemical Society's Rooms on December 6, when the following papers were presented.

A note on the estimation of formaldehyde and acetaldehyde, by Messrs. E. W. Blair and T. S. Wheeler, stated that in investigating the action of oxygen and ozone on various hydrocarbons, the authors had had to devise accurate methods of analysing solutions containing mixtures of (a) formaldehyde and acetaldehyde, and (b) formaldehyde, hydrogen peroxide, formic acid, with a trace of ozone. For (a), satisfactory results were obtained by estimating the total aldehydes by Ripper's bisulphite method (Monat. für Chem., **21**, 1079) and the formaldehyde by the cyanide method. For (b), the components were estimated *seriatim*, the formic acid with $N/100$ alkali, ozone with neutral potassium iodide, hydrogen peroxide by Kingzett's method (Analyst, **9**, 6), and formaldehyde by Romijn's method.

Mr. H. A. Peacock has found that sulphur dioxide may be absorbed by cattle cakes and meals during fumigation, but that it disappears after about a week. Therefore any harmful effect ascribed to the consumption by stock of such cakes is not due to sulphur dioxide. The amount absorbed was found to depend on the variety of cake, the harder cakes absorbing less than the softer, and on its physical condition, *i.e.*, whether in block or powder form.

Mr. C. H. D. Clark described a sliding scale designed to assist in titrating strong solutions against weaker standards by dilution and measurement of a known volume. The scale, which is easily made and set in positions depending on the dilution, indicates what alternative dilutions are available in any particular case, in order that a convenient burette-reading may be obtained at the end of the process.

Some notes on the unsaponifiable matter of fats were presented by Mr. D. W. Steuart, who dealt with the difficulty of deciding whether a margarine containing no coconut, palm kernel or butter fat is made of true animal fat, or whether it contains palm oil or hardened vegetable oil. The amount of sterol in the unsaponifiable matter and the melting-point of the sterol acetate do not give the information desired. The proportion of sterol in the unsaponifiable matter varies from 48 per cent. in maize oil to 7 per cent. in palm oil, and from 38 per cent. in lard to 9 per cent. in hardened whale oil. Highly hardened fats still contain sterol. The cholesterol acetate of animal fats melts at 114°—114·5° C., and the phytosterol acetate of vegetable fats is a mixture, of which a fraction melts at 125° C. or higher, but some pure vegetable oils yield a fraction melting about 114° C.

In a note on the sulphuric-acid test for fish-liver oils, Messrs. N. Evers and H. J. Foster show that the sensitiveness of this test is greatly increased by adding natural oils (*e.g.*, olive, arachis, lard oils, tallow) which do not give a colour reaction. Oxidation of the oils destroys this power, but it is unaffected by hydrogenation. The active substance is not cholesterol or phytosterol, and it is not present in commercial oleic or stearic acids, mono- or di-glycerides. The brown coloration produced by sulphuric acid with liver oils, after oxidation, is also intensified by the addition of natural oils.

BRITISH LEATHER MANUFACTURERS' RESEARCH ASSOCIATION

Following the third annual general meeting of the Association, held on December 7, Dr. R. H. Pickard, director of research, gave a lecture on the work of the Association in the large hall of the Leathersellers' Company. The lecture was open to all members of the trade and was attended by members of the Association and a large number of others. Mr. J. H. Williams, Worshipful Master of the Leathersellers' Company, presided, and in opening the proceedings emphasised the importance of research to the industry. Col. W. E. Walker, chairman of the Association, explained that the results of research were, of course, the property of the members, but that this meeting had been arranged to increase the interest of the trade in the Association.

Dr. Pickard commenced by paying a tribute to the work of Prof. H. R. Procter, to whom was practically due the creation of the science of leather manufacture. Some tanners were at present wondering whether they could afford to join the Association; it would soon become apparent that they could not afford to remain outside. The policy of the Association had been to study fundamental principles, and he believed that they had now reached the point at which the laboratory results were capable of being translated into works practice. As an example, they had started to investigate the composition of the actual chrome-tanning agent. Initally, he had been told that this was not likely to interest the tanners and, moreover, was already being done in America. They were still trying to do it in America. He and his staff were now hot upon the trail of the actual chrome-tanning agent, and incidentally believed that they had discovered one of the main causes of, and probably the means of preventing, the occurrence of a very important trouble in chrome-tanning, namely "spue." After referring to some common misconceptions in the trade, Dr. Pickard exhibited a remarkable series of lantern slides, showing the effects on the arrangement and structure of the fibres in goat, ox, and sheeps skins of various swelling, plumping, and depilatory agents; and by means of a projection microscope he demonstrated the swelling of single fibres in acid and other liquors.

Mr. J. Turney Wood said that the lecture had been a revelation to most of them. If there was any part of the work of the Association which tanners could not understand they should employ a chemist who could. Dr. Gordon Parker congratulated Dr. Pickard on the work generally and on the magnificent lantern slides. Mr. Seymour Jones proposed a vote of thanks to Dr. Pickard and his staff for their valuable work, and this was seconded by Mr. E. D. Evans, president of the United Tanners' Federation.

THE BIOCHEMICAL SOCIETY

A meeting was held in the Biochemical Department, Institute of Physiology, University College, London, on December 11. Prof. J. C. Drummond occupied the chair and the following papers were communicated.

"Cod-liver Oil in the Winter Feeding of Milch Cows," by J. C. Drummond, J. Golding, J. Mackintosh, S. S. Zilva and K. H. Coward.

Further confirmation was brought forward of the fact that the amount of vitamin A in cow's milk is largely determined by the diet of the animal. In an experimental group of cows brought in to stall under winter conditions and fed on a typical winter ration of roots, hay and concentrates deficient in vitamin A, the milk secreted soon showed a marked falling off in vitamin content. It was found possible to raise the amount of vitamin A in the milk very considerably by giving the animals a small supplement of cod-liver oil of high potency daily. As little as 2 oz. per day was highly effective. Amounts up to 4 oz. per day were given without any evidence being obtained that the taste or flavour of the milk or butter were affected, but it is advisable to employ only oils of high grade. Cows permitted to have limited access to pasture during the winter show a gradual improvement in the vitamin-A value of their milk as the spring advances and the pasturage freshens.

"The Chemistry of the Vitamin-A Fraction of Cod-Liver Oil," by J. C. Drummond and K. H. Coward.

The vitamin A can be almost quantitatively transferred to the unsaponifiable fraction of highly potent fish-liver oils if precautions are taken to prevent oxidative changes. The only crystalline substance which has been isolated from this fraction with certainty is cholesterol, which constituted about 35 per cent. of the fraction in the case of the sample of oil examined. The whole of the cholesterol may be removed by crystallisation from methyl alcohol and precipitation with digitonin, leaving the physiological activity wholly in the filtrate. Small traces of another crystalline material have been obtained from the cholesterol-free residue but in an amount too small for identification or growth tests. Benzoylation, acetylation and bromination of the unsaponifiable fraction yielded only the derivatives of cholesterol. From the filtrates, which retained the activity, no further crystalline substances could be obtained. There was no evidence of the presence of hydrocarbons of the spinacene type nor or ketonic or aldehydic substances. Incomplete removal of the lipochrome pigment did not appear to lessen the activity of the fraction, so that it is improbable that the active substance is of this class. No confirmation of Iscovesco's work on the association of the active substance with a substance of the lecithin type could be obtained. Many highly active oils gave no precipitate by following his technique. The active fraction, if prepared from a high grade oil, is free from nitrogen, iodine, sulphur and phosphorus. Attempts to separate the potent substance by steam distillation, super-heated steam or high vacuum distillations of the unsaponifiable matter demonstrated that this substance is volatile under these conditions but no sharp separation was obtained. In most cases there was a considerable loss in spite of all operations being carried out in a vacuum or an inert atmosphere. Fractional crystallisation from numerous solvents only yielded cholesterol with concentration of the vitamin in the mother liquors.

THE PHYSICAL SOCIETY

At the meeting held on December 8, a paper on "The Relation between Molecular and Crystal Symmetry as shown by X-ray Crystal Analysis" was read by Mr. G. Shearer. After a discussion of the nature of the elementary crystal lattice, a table was given showing the number of asymmetric molecules per unit lattice necessary to produce the symmetry of the various crystal classes, thirty-two in number. These range from 1 in the case of the triclinic asymmetric class to 48 in the case of crystals of the hexakisoctahedral class. The existence of fewer molecules than the "symmetry number" in the unit cell implies the existence of symmetry in the molecule itself. Only certain positions of the variously oriented molecules in the crystal lattice are possible. Supposing that the minimum material necessary to satisfy the symmetry conditions is employed in building crystals, it follows that each unit cell contains one and one only of each differently oriented molecule. There is considerable evidence to show that certain molecules possess symmetry which, in crystal building, is shared with the crystal. Thus the fact that naphthalene and anthracene form monoclinic crystals with two instead of four molecules in the unit cell implies that each of these molecules possesses a two-fold symmetry. Such symmetry is destroyed by the addition of an OH-group to one side of the naphthalene molecule. Similarly, the addition of COOH and other groups to the benzene molecule, as in benzoic, salicylic and phthalic acids, which form monoclinic prismatic crystals having four molecules to the cell, destroys the symmetry of the benzene molecule. The symmetry of the benzene molecule is found to be fourfold, consisting possibly of a plane of symmetry and a diagonal axis perpendicular to the plane. Neither the Kekulé nor the Claus structural formula for benzene satisfies this condition. The formulæ of Ladenburg and Dewar, respectively, conform with the condition.

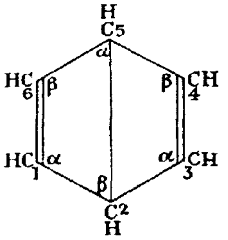


FIG. 1

Dewar's formula is shown in Fig. 1, and much chemical evidence in support of its validity has recently been advanced by Ingold. If the structure is a puckered hexagon, as suggested by Bragg, the points α lying above, and those marked β lying below the mean plane of the ring, it is found that the molecule has the required symmetry. X-ray analysis shows that the naphthalene molecule has a two-fold symmetry—probably a centre of symmetry. All formulæ hitherto proposed for naphthalene appear to possess too great symmetry. Structural formulæ 2a and 2b satisfy the symmetry requirements of the naphthalene molecule.

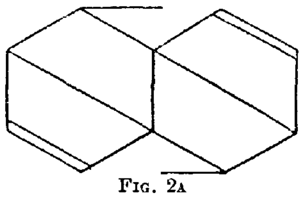


FIG. 2A

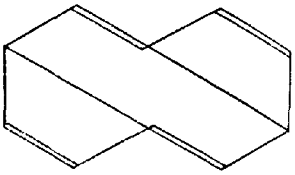


FIG. 2B

The structure of anthracene is shown in Fig 3. Among inorganic compounds, the results of X-ray analysis and the theory developed in the present paper were applied to determining the molecular structure of ruby, silica, ice, sodium and potassium chlorides, calcium carbonate, sodium nitrate and sodium chlorate. It was shown that if the molecule of sodium chloride actually exists, the sodium atom to which any particular chlorine atom belongs is not one of the six surrounding it at equal distances, but one of the sodium atoms disposed diagonally relative to the chlorine. In any case, molecular models having the requisite symmetry can be constructed by consideration of the distribution of electrons round the atomic nuclei. Finally, the factors underlying the selection by a molecule of some particular crystal class were briefly discussed.

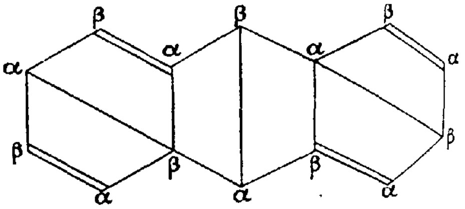


FIG. 3

A paper on "A Modification of the Powde Method of Determining the Structure of Met Crystals" was submitted by Dr. E. A. Owen an Mr. G. D. Preston. Instead of being reduced to powder, the metal to be investigated is subjected t heat treatment necessary to produce throughout i volume a mass of crystals about 1 mm. or less i size; the plate is etched to remove the deforme surface layer of crystals or oxide, and is smeare with vaseline to prevent further oxidation. Th plate of metal is then mounted on the X-ray spectr meter and its structure investigated by the ionisation method devised by Bragg. Crystal structures of aluminium, copper and lead are derived from the face-centred cube, iron from the centred cube. The values of the length of the side of the elementary cube were found to be respectively 4·041, 3·628, 4·983 and 2·869 Ångstrom units. Magnesium possesses a hexagonal lattice of the close-packed type. The length of the side of the hexagon is 3·17, and the axial ratio 1·631 Ångstrom units.

Dr. A. B. Wood submitted a paper on "The Cathode-ray Oscillograph." The instrument is a robust form of oscillograph of the type used by Sir J. J. Thomson and D. A. Keys in the application of piezo-electricity to the measurement of high pressures and is adapted for commercial production. Photographic records are best obtained by action of the cathode rays upon Schumann plates containing a proportion of calcium tungstate, a type of plate previously employed for X-ray purposes by Levy, West and Baker. A visible photographic impression is obtained on Schumann plates when the velocity of the beam across the plate is as great as 1000 metres per second. A further increase in sensitivity of the plates is desirable.

A low-voltage form of cathode-ray oscillograph was exhibited by the Western Electrical Company.

THE CHEMICAL SOCIETY

The ordinary meeting, held on December 7, was presided over by Prof. S. Smiles. Prof A. Smits, of Amsterdam, attended the proceedings.

The papers read were as follows:—(1) "The Iso-Electric Condition of Gelatin": S. O. Rawling and W. Clark. (2) "Studies on Metal Hydrides: the electrolytic formation of stibine in sulphuric acid and caustic soda solutions": H. J. S. Sand, E. J. Weeks and S. W. Morrell. (3) "Three-carbon Tautomerism in the Cyclopropane Series": F. Goss, C. K. Ingold and J. F. Thorpe.

(1) According to the latest theory, gelatin possesses the formula HX.OH, where X is a large complex which may undergo ionisation in the following two ways:—$HX^{\cdot}+OH' \leftarrow HX.OH \rightarrow H^{\cdot}+XOH'$. In the case of gelatin the left hand and right hand reactions become equal at the iso-electric point. The P_H value of gelatin at the iso-electric point was found to be 4·7, and at this point certain physical properties have a maximum and others a minimum value. The authors have studied the relationship between minimum viscosity and the presence, in increasing quantities, of sulphuric and acetic acids.

(2) Dr. Sand dealt with the relationships between the yield of stibine in caustic soda and sulphuric acid solutions, and overvoltage and current density, the yield being measured by passing through silver nitrate solution.

(3) Dr. Ingold, in an interesting paper, adduced evidence which pointed to a possible new form of isomerism.

The three papers, concerned respectively with the debatable subjects of the constitution of gelatin, overvoltage, and isomerism, gave rise to good discussions.

On December 14, in the Institution of Mechanical Engineers, Prof. C. H. Desch lectured on "The Metallurgical Applications of Physical Chemistry."

Corrigendum.—In the issue for December 15, page 519 R, line 2, delete "Louis."

PERSONALIA

Prof. A. Mailhe, of Toulouse, has been appointed to the Chair of Liquid Fuels in the University of Paris.

Mr. T. Edward Lescher has been appointed managing director of Evans Sons, Lescher and Webb, Ltd., drug manufacturers, of Liverpool and London.

Dr. H. Plauson, the inventor of the Plauson mill, etc., has been appointed professor by the Government of Esthonia for his researches in colloid chemistry, and in particular for his work on the utilisation of oil-shales.

Dr. Anthony McGill, Chief Analyst and Head of the laboratories of the Department of Health of the Dominion Government, Ottawa, has retired, upon superannuation. He has been chief analyst for 17 years and in the Government service for 35 years.

The following have been nominated executive members of the Italian Government Commission on Chemical Industry:—Prince Ginori Conti, president; Prof. Nasini, vice-president; Prof. Serono, treasurer; and Professors Paternò and Villavecchia.

Other official appointments announced from Italy are:—Prof. D. Girasoli to be professor of chemistry in the Royal Industrial Institute of Reggio Calabria; Prof. A. de Dominicis to the chair of agricultural chemistry in the Royal Agricultural High School at Portici; and Professors M. Betti, G. Daccomo, and P. Spica have been appointed directors of the schools of pharmacy in the Universities of Genoa, Modena, and Padua, respectively.

Dr. E. H. Tripp, who has edited the "Review" section of this *Journal* since its inception 5½ years ago, is retiring from the Society's service at the end of the year, when that section will be replaced by the new weekly periodical "Chemistry and Industry." Dr. Stephen Miall, who will edit the new venture, assisted by Mr. G. H. Ford, was formerly a practising solicitor and is now chairman of the Brimsdown Lead Co., Ltd., a position which he will retain.

The following appointments are announced from Germany and Austria:—Prof. E. Müller, director of the electrochemical laboratory in the Technical *Hochschule*, Aachen; Dr. F. Straus, professor of chemistry in the Technical *Hochschule*, Breslau; Professor Börnstein, to the chair of fuel chemistry in the Technical *Hochschule*, Charlottenburg; Dr. J. Eggert, to the chair of physical chemistry in the University of Griefswald. Dr. H. Suida has been appointed professor of organic chemical technology in the Technical *Hochschule* of Vienna, and Prof. Dr. Fuhrmann to the chair of technical mycology and food chemistry in the corresponding institute at Graz.

* * *

Among the deaths recently announced on the Continent are those of Prof. F. P. A. Barbier, a pupil of Berthelot, at the age of 75 years; of Prof. August Horstmann, one of the earliest workers in the field of thermochemistry, aged 80 years; and of Dr. C. von Martius, formerly chemist to the Osmose Gesellschaft and managing director of the A.-G. für Anilin-Fabrikation, Berlin.

CORRESPONDENCE

THE "REVIEW"

The subjoined correspondence has been received by the Editor for publication in the last issue of the "Review." In one or two cases, the letters and messages have had to be condensed slightly, owing to pressure on our space. The Review Editor wishes to take this opportunity to thank not only those who have communicated with him on this occasion, but also the many friends and contributors at home, in the Overseas Dominions, and in foreign countries who have helped to make the "Review" the success which our correspondents claim it to be. He would like especially to thank Dr. Charles A. Keane, for several years chairman of the Review Committee, Mr. W. J. A. Butterfield, Dr. Charles Carpenter, and other members of that Committee for much helpful advice and criticism received, particularly in the early days of the "Review."

From Dr. R. F. Ruttan, Professor of Chemistry, McGill University, Montreal, and President of the Society in 1921–22:—

I saw, with great regret, in the minutes of the Council of the Society of November 13, which only reached me on December 1, that you were severing your connexion with the Editorial Staff of the *Journal*.

The "Review," which you have developed to such a high degree of interest and importance during the past five years, has always been the attractive portion of the *Journal* to the Canadian members of the Society. It must be a satisfaction to you to have the Council recognise your efforts by converting it into a weekly publication. Wishing the new venture of the Society every success . . . .

From Prof. E. C. C. Baly, F.R.S., Professor of Chemistry in the University of Liverpool:—

I most cordially wish success to the new venture of the Society of Chemical Industry in issuing the "Review" as a weekly publication. There is no question but that the "Review" has fully justified its existence since its inception a few years ago. As time progressed it was felt by many of us that the old *Journal* did not entirely meet the needs of the day, and that the aims and objects of the Society were not fully served. The decision of the Council to issue the "Review" was a wise one, and the new *Journal* was most enthusiastically welcomed on all sides. Under the direction of its editor, Dr. Tripp, it has steadily consolidated its position, and it now occupies a very high position among the chemical industrial journals of to-day. The weekly publication of the "Review" under its present standard of excellence will certainly be a landmark in the Society of Chemical Industry, and its success cannot but enhance the reputation of the Society.

From Prof. A. R. Ling, Professor of Biochemistry, University of Birmingham:—

I consider that during the past five years the "Review" has been a most valuable supplement to the *Journal* of the Society of Chemical Industry. The promises that were made in the leading article printed on page 1 of the first number of the "Review" in 1918 have been fulfilled in every way, and I learn of the "Review" Editor's retirement with great regret.

From Dr. H. E. Howe, Editor of the *Journal of Industrial and Engineering Chemistry*:—

Believing as I do in the importance of publishing scientific information of all kinds, and holding that one of our most important functions is quickly to advise research men of the accomplishments of their fellows, I cannot do otherwise than applaud the Society of Chemical Industry upon its decision to issue a weekly under the title of "Chemistry and Industry."

At the same time it will be something of a loss no longer to find the "Review" in the *Journal* of the Society. We have come to look upon this section as one of much value to us, particularly as regards many fields of work in Great Britain and other parts of the world. The "Abstracts" have been most helpful, the "Transactions" are always read with interest, and the reports of foreign meetings are particularly helpful. The place which the "Review" section has won sets something of a high mark which, to be surpassed by the weekly, will require an unusual amount of hard work and persistent effort.

From W. J. A. Butterfield, Esq., M.A., Gas Referee, London:—

I desire to put on record my appreciation of the signal service which the "Review" section of the Society's *Journal* has rendered to chemists and chemical industry during the five years of its existence, and at the same time to express my deep regret that it is no longer to be issued as such. In its early years I think no member of the Publication Committee devoted more time to the "Review" than I did, and I much regretted that my association with it was severed through my resignation of membership of the Council and Publication Committee on account of my disapproval of the policy of the Council. I believe that the "Review" will stand as a model of a succinct record of current affairs in chemical industry, and will be more valued for reference in the future than the more cumbersome reports of the weekly technical press. You, Sir, are to be warmly congratulated on your five years' work, much of it done in times of great difficulty, as Editor of the "Review."

From Mr. E. Grant Hooper, late Deputy Government Chemist:—

I was originally opposed to the establishment of the "Review," as I thought that everything necessary and desirable by way of addition could have been inserted in the "Transactions" and "Abstracts" at a minimum cost to the members of the Society. I feel bound to say, however, that the "Review" has most successfully and most usefully cultivated a field previously somewhat neglected and occasionally contemned. The subjects treated have covered a wide range; the matter has appeared timely; the presentation has been generally attractive; and attention has been promptly called to all new work. I have myself found the "Review" most interesting, though as a busy man I had previously demanded useful, rather than merely attractive matter. I am sure that a great many members of the Society feel as I do, and I offer you both thanks for what we have received and congratulations on the success of your work.

From **Mr. W. T. Burgess**, F.I.C., Water Analyst and Consulting Chemist, London:—

It is with much regret that I learn from the last number of the *Journal* that the present arrangement of publishing the "Review" fortnightly is to be discontinued. I do not subscribe to any of the trade journals, and the information under the various headings in the "Review" kept me in touch with the state of chemical affairs, both at home and abroad, at sufficiently frequent intervals.

From **Sir Edward Thorpe**, C.B., F.R.S., President of the Society in 1894–95:—

It is news to me that the "Review" is to cease publication at the end of this year, and that your editorship terminates with it. I am very sorry to gather that your connexion with the Society's publication comes to an end. I know nothing of the inner working of the *Journal*, but my general impression, as derived from a constant perusal of the *Journal* itself, was that it was eminently satisfactory. The *Journal* appeared with unfailing regularity and the editorial business, as it was conducted, left nothing to be desired. The issue of the *Journal* weekly is an experiment which I shall watch with interest.

From **Prof. Arthur Smithells**, C.M.G., F.R.S., retiring Professor of Chemistry in the University, Leeds:—

The addition of the "Review" section to the *Journal* seems to me to have achieved something like the transformation of an automaton into a living being. I say this with all respect to old friends, who brought the *Journal* into being and showed so much solicitude and discretion in establishing its impartiality and its security from caprice. I do not think that these essential elements have been impaired in the slightest degree by the change which has taken place, whilst the interest of the *Journal* has been increased beyond measure. I should like to join in what I am sure will be a chorus of congratulation to the "Review" Editor on the great skill and judgment with which he has carried out a most valuable reform.

From **Prof. A. G. Perkin**, F.R.S., Professor of Colour Chemistry and Dyeing in the University of Leeds:—

I was originally an opponent of the addition to the *Journal* of a "Review" section. I feared that the extra expense incurred by such an extension, and which appeared to be hardly necessary, would injure the circulation of the *Journal*, and also that the additional work in conjunction therewith might detract from the attention given to its other very important sections. I am happy, however, to own that my apprehensions have proved to be groundless, and as a constant reader of the "Review" I now consider this to be a valuable addition to the *Journal*, and of service to myself.

From **Principal J. C. Irvine**, F.R.S., Principal of the University, St. Andrews:—

With many others, I regret the passing of the "Review." This section of the Society's activities served a useful purpose and added to the value of the *Journal* by the inclusion of subjects possessing a real human interest. Our President, who yields to no one in his appreciation of what a chemist ought to be, sounded a true note when he reminded us recently that we must not content ourselves by being merely chemists, and I believe the "Review" has been a factor in securing this end. At least it has prevented some of us from remaining merely academic chemists, and the "Review" Editor has earned the gratitude of those who have to look out on the busy world of chemical industry from the seclusion of the Professor's Chair.

From **Colonel Sir Edward Brotherton**, Leeds:—

I have always looked to the "Review" section of the *Journal* to give me some general acquaintance with movements in the chemical trade in various parts of the world, as well as to present me with valuable information respecting the latest publications in chemical literature. I am, therefore, sorry that this section of the *Journal* is not to appear after the end of the present year in its present form.

From **Prof. T. Phillips Bedson**, late Professor of Chemistry in the Armstrong College, Newcastle-on-Tyne:—

So we are to have a change in the *Journal*. Changes come, but improvement lingers. It is much to be regretted that this change is coincident with the loss of the services of the "Review" Editor, in whose skilful hands it has been created, and has grown from month to month to be *the* feature which, by the interest of its articles and the information supplied, has procured a circle of constant readers of the *Journal*—the great asset of the Society. To the "Review" Editor are the members greatly indebted, and all will join in expressing their regrets at the severance about to take place, and all are grateful to him for the able manner in which he has contributed to the success of the venture.

From **Dr. W. R. Ormandy**, London:—

In the last issue of the *Journal*, I noted with great regret that Dr. Tripp would shortly be ceasing to work as "Review" Editor; I am one of the many who appreciate very highly the wonderful improvement in the *Journal* that has taken place since his connexion therewith. To those of us who are interested in the world-wide ramifications of the chemical industry, but have not time to read up the subject, the "Review" has proved of the greatest value and interest. I should not like Dr. Tripp's connexion with the *Journal* to cease without taking an opportunity of expressing appreciation of his past services, and regret that he has found it necessary to sever that connexion.

From **Dr. Thomas R. Duggan**, of New York:—

It is with regret I notice that the "Review" Section of the *Journal* is to be discontinued, and think I am voicing the view of my American friends in this statement, that ever since its commencement it has been one of the great features of the *Journal*. Most of us are busy people and can usually turn to the "Review" to find matters of interest without wading through some dozen or so of other journals, knowing that the matter is sound, otherwise the Editor would not have passed it. I sincerely hope that with the new form of *Journal*, the "Review" will not be entirely overlooked.

SAFEGUARDING OF INDUSTRIES ACT

SIR,—Now that the opposition to the Safeguarding of Industries Act is dying down somewhat, one may perhaps be allowed to inquire where things went wrong from the chemical standpoint, for there is no doubt that chemists as a body have not covered themselves with glory in their appearances before the Referee. Much has been learned from these hearings, but much remains to be learned, not only by the individuals concerned, but by the profession as a whole.

Some are beginning to appreciate the difficulties in combating nonsense (especially scientific nonsense) before a lay tribunal, especially when it has to be done through the medium of words, often of uncertain meaning. Some are beginning to realise after all that chemical merchanting is apparently the important thing in chemical industry; so very useful when the enemy was at the gate, and our men dying by thousands for want of proper support in the factory line! Some have not yet recovered from the shock of realising that what "So-and-so" wrote in '92 is necessarily of far greater moment than the dictates of common sense to-day. And some have realised that chemists have failed in their public duty, and are not a little worried as to what is to be done about it. Reference is particularly made to those chemists who are in contact with the industrial world (though who amongst us is without blame?), for upon them rests the honour of upholding the profession of chemistry in the public mind. When they fail we all suffer, and it is difficult to see how the position can be improved until all chemists indulge in some good plain thinking. At Leeds, on November 22 last, Mr. F. W. Richardson spoke very plainly to the Institute of Chemistry on the subject of unprofessional conduct and the ethics of expert evidence. He said that they needed some special permanent committee to deal with unprofessional conduct. He reminded his hearers of the low estimate in which expert evidence was held—particularly in the legal profession—and he pleaded for the oath, "The truth, the whole truth, and nothing but the truth," in giving expert evidence. Mr. Richardson is right, and I trust that a leader will arise to see the matter through.

It is granted that many chemists have been drawn into these disputes under conditions wholly alien to the spirit of their science. It is appreciated that they have been misunderstood, but it is their duty to make themselves understood. Technical things can be explained, and non-technical people can be made to understand them, but not when the superior "take it or leave it" attitude is adopted. So long as the legislature must deal in technical matters, and must appoint non-technical lawyers to deliver technical judgments, then it is the duty of the professional societies, as well as the individual chemists concerned, to appoint themselves advisers to the lay mind without fear or favour except for the truth. Too often the appearance of expert chemists for opposite sides in a dispute has been as unseemly and just about as useful as would be the spectacle of the Archbishops of Canterbury and York discussing the doctrine of transubstantiation at a meeting of the L.C.C. Is it surprising that the lay mind cancels them out? When chemists appear in public, above all things let them appear for chemistry.

To chemists it is obvious that there is much less between the views expressed by different chemists than is appreciated by the non-technical person who neither knows nor understands the subtlety of chemistry. But we ought not to air our petty differences except in debate in the privacy of our own societies. If there is uncertainty as to the meaning to be given to the terms which form the basis of the chemist's work, then surely the appropriate societies can do good work by initiating thought and discussions on the subject, if they do not go further and stabilise the views to be put forward for consumption by the public. Surely if quasi-scientific definitions of technical terms can evolve from a squabble between conflicting trade interests (and where interests clash opinions are bound to differ) before a non-technical lawyer, there is surely hope that chemistry may show a sufficiently united front to do a little better.

No one apparently can influence the present Act or its administration, but we ought at least to be prepared for the future. Why should not the Society of Chemical Industry, as being the appropriate Society to connect chemistry with the world of industry, develop functions akin to those of the British Engineering Standards Association, and have its precepts embodied as a glossary in the preamble to any future Acts of Parliament affecting chemistry. We should all, chemists and lawyers alike, know then that we were at least talking about the same thing.

Surely the Geneva Conference on Nomenclature did good work for academic chemistry and provided something of a parallel to the present need for precision in industrial chemistry.

However, such a suggestion may be too venturesome, but I do fervently hope that the societies may do something so that in the near future when British chemists have dealings with the outside world, whether it be the law or public generally, they may be helped to place their professional appearances on a higher plane than obtains to-day. The profession of chemistry is worthy of being respected and feared; its members should not be merely figures who have their say and cancel out.—
I am, Sir, etc., L. A. JORDAN.

Manningtree, Essex.
December 14, 1922.

LEGAL INTELLIGENCE

ARSENIC IN COCOA

On December 18, in the Richmond Police Court, the Home and Colonial Stores, Ltd., and Messrs. Rowntree and Co., York, were summoned by the Surrey County Council under the Sale of Foods and Drugs Act, 1875, for selling, and aiding and abetting the sale, respectively, of cocoa containing white arsenic to the extent of one-fortieth of a grain per pound. Both defendants pleaded guilty, and Messrs. Rowntree took absolute responsibility for the position in which the Home and Colonial Stores had been placed.

For Messrs. Rowntree it was stated that the most competent scientific opinion held that the cocoa in question would not endanger the health of those who drank it; and that the contamination was an accident which might have happened to any manufacturer of a foodstuff. Last July it was discovered that some of the cocoa the firm had been making contained faint traces of arsenic, which, after immediate and intensive search, was found to be present in the potassium carbonate used in the manufacture. Immediately the whole of the cocoa left in stock—some 300 tons, valued at £100—£250 a ton—was sacrificed, but it was held to be useless to attempt to get back what had already been sold to the trade. The Home and Colonial Stores had destroyed 85 tons of the material, worth about £1200. Sir William Willcox, medical adviser to the Home Office, stated that this was the first instance he had heard of in which arsenic had got into a food through potassium carbonate.

The Home and Colonial Stores, Ltd., was fined 40s. and Messrs. Rowntree £20, with 50 guineas costs.

NEWS AND NOTES

FRANCE

Industrial Notes

Chemical Industry.—The plant erected at Bully by the Compagnie des Mines de Béthune to produce synthetic ammonia by the Claude process is now working successfully. By this process 45 to 50 per cent. of the hydrogen in coke-oven gas is separated by liquefaction at the very low cost of 0·50 francs per cb. m. The synthetic ammonia produced is converted into ammonium sulphate and the coke-oven gas from which the hydrogen has been extracted is used as a source of heat and power. So good have been the results obtained that the Societés des Mines de Lens et d'Aniche have also decided to erect a plant. If the process comes into extended use, the increased output of ammonium sulphate will affect the fertiliser market, especially if the State powder factory at Toulouse is transformed into a large synthetic-ammonia plant, as is contemplated. Experiments are being conducted with the new fertiliser, "phosphazote" (*cf.* J., 1922, 390 R), which is expected to cost less to manufacture than superphosphate.

The paper industry is greatly concerned about the enormous increase of imports of paper and paper pulp from Canada, Scandinavia, Finland, Germany, Belgium and Switzerland. Imports of mechanical and chemical pulp during the first nine months of 1922 amounted to 1,680,459 metric tons, compared with 154,069 t. for the whole of 1921. The reason for this large increase lies in the shortage of timber in France, due to the destruction of forests during the war and the great consumption of timber for reconstruction in the devastated areas. Before long the Government will have to consider the question of re-afforestation, and there appears to be no reason why France should not become an important producer of paper, especially as she is as well supplied with water power as is Sweden.

The question of substituting alcohol for petrol as motor fuel still absorbs much attention. Recent work has shown that mixtures of alcohol and petrol are much more stable if the alcohol is practically anhydrous. Such a mixture has been used successfully as a motor fuel in the munition works at Sevran-Livry. But even such a mixture would not solve the problem; the question of quantity is equally important. At least 220 mill. galls. of alcohol would be required to replace the 132 million galls. of petrol consumed yearly in France; the annual output is only 22 mill. galls. Production from wood-cellulose, *e.g.*, by the Prodor process (*cf.* J., 1922, 435 R) appears to be the most promising.

Prices in the chemical market are firm, owing to the appreciation of the pound sterling and the dollar. Following a rise in the prices of Italian and Spanish pyrites, and also in freights, there has been a marked increase in the cost of sulphuric acid.

"Synthetic" Mother-of-Pearl

In the October issue of *Chimie et Industrie*, MM. L. Clément and C. Rivière describe their researches into the formation of "synthetic" mother-of-pearl. Natural mother-of-pearl consists of a cellular skeleton of "conchyoline," an albuminoid material secreted by the oyster containing grains of calcium carbonate, and water. When calcium carbonate is precipitated in a colloidal medium, under certain conditions, it forms a network of particles which displays the optical phenomena of a grating. Similar but less pleasing effects can be obtained with salts of barium, lead, silver and copper, the superiority of calcium carbonate being apparently due to its fine grain. To reproduce this effect a solution is made of a calcium salt (preferably the lactate, glycocollate or other salt of an organic acid) 15 parts, gelatin (to replace the conchyoline) 5 parts, and water 80 parts. This solution is heated, filtered, spread over the object to be treated, and allowed to set. A solution containing sodium carbonate 10 parts, trisodium phosphate 2 parts, gelatin, albumin, or casein 8 parts and water 80 parts, is then poured over the object to precipitate the calcium as carbonate. The characteristic iridescence appears after 30—60 minutes, and the object is then carefully washed, hardened with formaldehyde, and dried. The character of the nacreous appearance depends on the closeness with which the lines of cells containing calcium carbonate are packed, the most intense effects being obtained with 1000 to 1400 lines per mm. By varying the composition and rate of application of the precipitating solution, effects are obtained which vary from the weak lustre of oystershell to the iridescence of true mother-of-pearl. If a celluloid cast is taken of the surface of an object thus treated, the resulting film is also iridescent, thus showing that the effect is due to refraction from the fine reliefs reproducing the contours of the original. Films produced in this way may find application in decorative work. The mechanism of the precipitation of calcium carbonate in a colloidal medium is described as periodic or rhythmic precipitation (Liesegang, Leduc) and is of interest in the investigation of biological phenomena.

UNITED STATES

A News Edition of "Industrial and Engineering Chemistry"

Industrial and Engineering Chemistry, the technical journal of the American Chemical Society, announces an extension of its service in 1923. Besides the present journal, which will not be changed in form, there will be issued twice a month, on the tenth and twentieth, a chemical newspaper to be known as the "News Edition of Industrial and Engineering Chemistry."

The News Edition is designed to provide current information, much of it non-technical in character, supplied to a large extent by staff correspondents. There will be a leading short article written in non-technical language on some phase of chemistry. Industrial developments, items on foreign and domestic commerce, digests of both Federal and State legislative action, tariff decisions, personal items, happenings in various local sections, announcements and preliminary programmes of the semi-annual meetings of the Society, and of local sections, will constitute the bulk of the material. A maximum of four pages will be devoted to employment service information under regulations soon to be announced.

With this publication available, the "Clip Sheet" of the News Service will be discontinued, and newspapers will be invited to use as much material as they please from the News Edition.

The News Edition will be issued under the joint auspices of *Industrial and Engineering Chemistry* and the A.C.S. News Service, in co-operation with corresponding editors in the various chemical centres and representatives of other chemical societies. The first issue will appear on January 10, 1923.

Production of Acids in 1921

Preliminary statistics issued by the U.S. Department of Commerce show that the output of factories manufacturing chiefly sulphuric, nitric, and mixed acids in the United States declined considerably in 1921. Of the 35 factories that reported, 5 were located in New Jersey, 5 in Pennsylvania, 4 in Ohio, 3 each in California and New York, 2 each in Maryland and Virginia, and 1 each in 11 other States. New Jersey was the leading producer, its output representing 27 per cent. by value of the total production. The statistics for 1921 and 1919 are summarised in the following table:—

		1921	1919	Decrease %
o. of factories		35	39	—
rsons employed		3,139	5,860	46·4
Salaried employees		450	899	49·9
Wage earners (average)		2,684	4,961	45·9
Salaries and wages	$	5,243,000	10,096,000	48·1
Salaries	$	1,317,000	2,179,500	39·6
Wages	$	3,926,000	7,916,500	50·4
Cost of materials	$	9,714,000	15,857,000	38·7
Value of products	$	20,529,000	31,470,000	34·8
Sulphuric acid (50° Bé.)	Short tons	1,457,500	1,685,300	13·5
"	$	15,332,700	18,113,000	15·3
Nitric acid	Short tons	2,110	3,150	33·0
"	$	363,700	536,700	32·2
Mixed acid	Short tons	16,400	28,200	41·8
"	$	1,316,000	2,671,500	50·7
Other products	$	3,516,500	10,149,300	65·4

—(*Oil, Paint and Drug Rep.*, *Nov.* 13, 1922.)

An Indicator of Static Electricity

The accumulation of static electricity where inflammable dust or vapours are handled is a great but often unsuspected fire hazard, and the Westinghouse Lamp Co. has recently converted a laboratory curiosity into a very practical test for this hidden danger. The discharge of electricity through the gas in a Geissler tube is used to show the presence of high voltage near by; the gas used is neon, which readily conducts the discharge and causes the lamp to emit a bright reddish glow as a danger signal. The tube, mounted in an insulating case, has a metallic contact-tip at one end and a small condenser-plate at the other, and the whole apparatus is small enough to be carried about by an inspector; but it may be mounted where electricity accumulates and the charge run off to earth. The indicator is sensitive enough to glow when the person holding it walks across a rug and connects its metallic tip to a radiator or other grounding device. A small neon-tube has also been marketed for use in testing sparking plugs on automobiles which may be running badly.

Fatigue of Metals

An investigation on the fatigue or progressive failure of metals has been carried out at the University of Illinois Experiment Station under the auspices of the Engineering Foundation and the National Research Council, with Prof. H. F. Moore in charge. The most probable explanation of such failure was found to lie in a progressive spread of microscopic fractures. A nucleus for damage may be a very small area of high localised stress, due to a groove, a scratch, or a crack. In other cases, failure may arise from internal inclusions or irregularities of structures, from internal stress remaining after heat treatment, or from a grain or group of grains being placed unfavourably to resist stress. Definite indications were found that tough steel possesses a specific endurance limit.

Cheap Furfural, a Substitute for Formaldehyde

As a result of more than six years' research work, the U.S. Bureau of Chemistry has devised a cheap method of producing furfural from corn (maize) cobs and farm waste. This method, it is expected, will eventually make possible the production of low-priced substitutes for a wide variety of hard rubber and synthetic-resin products, provide a good market for farm by-products now wasted, conserve the native supply of methanol and of forest products, particularly hardwoods, used in making methanol, and possibly provide a supply of motor fuel. When heated together furfural and phenol condense to form a solid resin, which is dissolved only with great difficulty; "tetralin" is said to be the only substance that will dissolve furfural resins. Three firms are now producing synthetic-resin products, using furfural instead of formaldehyde, and are obtaining satisfactory results. The furfural resins have a harder surface, and are naturally black or dark, rich brown in colour. They are somewhat flexible, and are better electrical insulators than hard rubber or other synthetic resin products. It has also been found that furfural is an excellent paint and varnish remover, and that it can be used in making fine dark varnishes. It is hoped, eventually, to obtain furfural from corn stalks, bagasse and rich hulls, as well as from corn cobs and oat hulls.

The process of manufacturing furfural, from corn cobs, etc., which was discovered by Dr. F. B. LaForge, of the Bureau of Chemistry, is rapidly being developed commercially. The present demand for furfural in the United States is said to be small. Two years ago it cost $30 per lb., but now the one company producing furfural on a commercial scale is selling it at 25 cts. per lb. Dr. LaForge says that eventually, with production on a large scale, the price should be as low as 6 cts. More than twenty other firms are considering the building of furfural plants.

Furfural can also be used as a motor fuel, with a specially designed carburetter, and if greater yields were obtainable from farm waste, a subject now being investigated, its use as a fuel would be practicable.

BRITISH INDIA

Nux-Vomica Industry in Madras

Although *Strychnos nux-vomica*, the tree from which commercial nux vomica is obtained, is widely distributed throughout the tropics, the world's supply of the drug is almost entirely derived from India; and two-thirds of the Indian supply is furnished by the Madras Presidency. Despite the value of nux vomica as the source of strychnine and brucine, the tree is not cultivated, and in certain areas has almost disappeared owing to careless exploitation. The fruits are gathered by forest tribes, the pulp is washed away, and the seeds, after drying in the sun, pass through various hands until they reach the exporters, usually in December. For export the seeds are washed, sorted, and sold in bags of 164 lb. or 182 lb. each; they will keep for long periods, but storage is not usual. In 1920-21 exports amounted to 2268 long tons, distributed as follows: United Kingdom 1820·4 t.; Ceylon 13·2 t.; rest of British Empire 0·05 t.; Belgium 190 t.; France 0·6 t.; Italy 5 t.; United States 737·2 t. It is stated that the export in 1921–22 declined to 2010 t., but lately prices and shipments have increased. This year's crop on the west coast promises to be poor, but that on the east coast is above the average.—(*U.S. Com. Rep., Nov.* 6, 1922.)

AUSTRALIA

Bounty on Shale-Oil Production

In 1917 the Federal Parliament passed an Act providing for the payment of a bounty on shale-oil produced in Australia. As this Act has expired, the House of Representatives has revived it for another year and increased the bounty from 2½d. to 3½d. per gallon, because the shale-oil company in New South Wales has been working at a loss. The increase in the bounty will involve an additional expenditure of £7000, the total cost for the year being about £74,000.—(*Ind. Austr., Oct.* 19, 1922.)

GERMANY

Chemically-resistant Iron

Articles made of a 15 per cent. aluminium-iron alloy develop, on being heated to redness, a thin but highly resistant surface layer of aluminium oxide which does not scale and prevents further oxidation of the metal, so that no appreciable alteration of the surface is noticeable after heating at a high temperature for one hour in a strongly oxidising atmosphere. The alloy gives good castings and may, with care, be forged. Similar results are obtained by treating soft-iron articles by the Alitier process, which consists in heating the metal for some time surrounded by a powder containing aluminium, whereby the latter penetrates the surface of the iron for a certain distance and forms a surface layer of iron-aluminium alloy that behaves in a similar manner to the 15 per cent. alloy described above. An iron crucible treated by this method was practically unattacked after heating to 1000° C. for 60 hours, whereas a similar untreated crucible was destroyed in 24 hours.

Filter for Industrial Dust

The Cottrell dust-precipitator has the disadvantage that the finest dust tends to form hard crusts on the precipitating walls, and in the case of metallic fumes, the crust has to be chiselled away owing to the metal in the fume welding itself to the walls. Cloth filters are rapidly clogged by the dust and cannot be used with hot gases. On the other hand filters consisting of metal vessels packed with small ring-shaped pieces of metal or wire nets of fine mesh have none of these drawbacks and work very efficiently. For temperatures below 80° C. the filters are treated with a special oil, having a viscosity of 3·8 at 50° C., a solidifying point of −20° C., a flash-point of 155° C., and an evaporation loss of 0·02 per cent. in 5 hours, in such a manner that the surface of each wire is coated with a thin layer of oil. For higher temperatures oil is not used. In the collecting chamber for coarse dust, which is provided in front of the filter, 60 per cent. of the total dust is precipitated, and another 35 per cent. is collected on the filter. In each case the dust is readily removed either by mechanical shaking or by pneumatic means.

The Potash Industry, Jan.–June, 1922

According to official statistics the German output of potash during the first half of 1922 was 5,893,711 metric tons of potash salts, equivalent to 682,787 t. of pure potash (K_2O). Details of the production and inland sales of potash salts (calculated as K_2O) are given as follows:—

	Production Jan.—June, 1922 1000 t. K_2O	Inland sales
Carnallite	22,739	1·34
Crude salts	139,710	137·92
Manure salts (18-22%)	39·20	18·61
,, ,, (28-32%)	19·35	16·02
,, ,, (38-42%)	241·34	245·47
Potassium chloride (50-60%)	90·78	102·91
,, ,, (over 60%)	37·80	
Potassium sulphate (over 42%)	17·11	3·98
Potassium-magnesium sulphate, calcined	6·25	0·46

Inland sales during the first six months of 1922 increased by 58 per cent. compared with the same period of 1921, largely owing to improved transport facilities and rebates granted on orders. Roughly 490,000 t. of potash, equivalent to 93 per cent. of the total inland sales, was consumed by agriculture, and 7 per cent. was sold for industrial purposes Sales on foreign account were below expectation.

Following the increased consumption inland, the potash works have been fully occupied. From January to June, 1922, the number of workers rose from 39,594 to 42,139, or inclusive of subsidiary workers, from 44,244 to 47,577. However, pre-war conditions have by no means been re-established. Of the 206 works which were authorised to make deliveries, 76 were idle at the end of June.

The Welfare of Chemical Workers

The following observations on the influences affecting the health of workers in chemical factories were made in 1921, and have been published recently.

The advisability of having long pauses for meals and rest has been established; when these are cut down to a minimum, production by manual workers falls off, and brain-workers suffer from nervous exhaustion, sleeplessness, and gastric complaints. Among industrial poisons, lead still takes first place, although this danger has been much exaggerated, lead-poisoning being frequently suspected where the symptoms really arise from other causes; it now appears, too, that the only really reliable indication of lead poisoning is obtained from the blood-test. In many places changes in the methods of winning and working the metal have reduced the danger. Chromium also acts prejudicially to health. Other causes of poisoning have been phosphine (from moist ferro-silicon), sulphur dioxide, hydrogen sulphide, cyanogen, chlorine, nitrous gases, blast-furnace gases, illuminating gas, nitro- and amido-compounds, picric acid, trichloro-ethylene, and tetrahydronaphthalene. Numerous cases of poisoning by dinitrobenzene were observed in the breaking up of ammunition. Various skin diseases were caused by chemicals and impure oils.

Hygienic conditions in the factories have generally improved, especially in the large works. The installation of improved ventilating and dust-removing apparatus has been very difficult owing to the exceptionally high cost; and the provision of cloak-rooms and rooms for rest and refreshments still leaves much to be desired. Washing conveniences, especially bathrooms, are often badly treated by the workers, and in many cases not used at all. Among special installations for the benefit of workers may be mentioned a mechanical remover of ashes and slack from boilers. The neglect and ill-treatment by workers of protective devices introduced for their benefit was regrettable. Members of industrial councils and foremen seem to have a far greater appreciation of measures developed to protect health than measures to prevent accidents, and in respect of the former, there is frequently successful co-operation with the workers; in many districts lectures and special courses are held for their instruction.

GENERAL

Pasteur Celebrations

Prior to the celebration of Pasteur's centenary in May, 1923 (*cf.* J., 1922, 111 R), meetings in his honour will be held in this country from February 2 to 19, 1923, under the auspices of the Federated Committees of the Alliance Française in the United Kingdom. The hon. secretary of the Federated Committees, Mlle. Yvonne Salmo, of 14, Morgan Road, Reading, informs us that Dr. Pasteur Vallery-Radot, the grandson of Pasteur, will deliver a lecture on his grandfather's life and work in the rooms of the Royal Society of Medicine, London, and this will be followed by a banquet which will be attended by members of that Society and of the Institute of Brewing, and to which it is proposed to invite members of the various chemical societies. M. René Vallery-Radot will come to London, but his health will not permit him to go to the provinces, where Dr. P. Vallery-Radot will visit Manchester, Newcastle, Bradford, Liverpool, Cardiff, Reading, Leicester, Wolverhampton, Southampton, and Portsmouth (Feb. 19). In each of these towns the local branch of the Alliance Française is inviting the medical and chemical societies to take part in the proceedings. The Lord Mayor of Cardiff will extend a civic welcome to the visitors, and at Newcastle-on-Tyne Sir Theodore Morison will offer the hospitality of Armstrong College.

Glasses for Flame Safety-Lamps

The report of the sub-committee appointed to compare flame safety-lamp outer glasses made in Great Britain, Germany, Austria, and Czechoslovakia from the standpoints of safety, transparency, and price has recently been issued by the Mines Department (H.M. Stationery Office. 2d.). Tests carried out at the Mines Department Experimental Station have shown that there is no difference in quality between British- and foreign-made glasses; the former are more transparent, free from flaws, and uniform in surface, but the latter are usually more uniform in dimensions. All the British glasses and most of the foreign glasses passed the heating and mechanical tests satisfactorily. In the absence of reliable data, no conclusion was reached concerning the price of foreign glasses, but information was received that, apart from import duty levied in this country, Czech glassware is now more expensive than British glassware, and that the cost of production in Germany and Austria is less than in this country. It is recommended that the difference between the prices of British glasses to lamp makers and to colliery companies, viz., 8s. 6d. and 10s. 9d. per dozen, respectively, be investigated. No approved glasses have been imported from the United States for some time and no glasses of French or Belgian manufacture have been submitted for approval for use in this country.

New Oil-nuts from South America

Nuts from a palm growing abundantly in the Magdalena Valley, Colombia, and known locally as "Mamarrón," have been examined at the Imperial Institute, and found to belong to a species of *Attalea*, allied to the corozo and cohune nuts. Analysis showed the kernels to contain 3·8 per cent. of moisture, and 69·9 per cent. of fat, or 72·7 per cent. calculated on dry material. The percentage of shell (79·3 per cent.) is too high to allow the export of whole nuts, but commercial quantities of the kernels should realise about the same price as palm kernels (£17 10s. per ton in June, 1922). The kernel oil, which is cream-coloured, hard, and has an odour like that of coconut oil, should be suitable for use in manufacturing edible fats, and as the residual meal is free from alkaloids or cyanogenetic glucosides, it might be used as a cattle-food.

"Fruta de conejo" (rabbits' fruit) nuts belonging to a species of *Heisteria*, were also sent from the same district for examination. The kernels, which constitute 66 per cent. of the nut, contained 5·4 per cent. of moisture and 61·2 per cent. of a clear, golden-brown viscous oil, equal to a yield of 64·7 per cent., from the dry material. Although the oil has a high iodine value (140 per cent.), it does not possess good drying properties, and is unsuitable for paint manufacture. On heating it polymerises, yielding a product like polymerised tung oil, and therefore might be used in making rubber substitutes, etc. The residual meal is of high nutritive value, but as a trace of alkaloid is present, feeding trials would be necessary before using the meal for feeding cattle.—(*Bull. Imp. Inst., XX, No.* 2, 1922.)

Power Alcohol in Cuba

H.M. *Chargé d'Affaires* at Havana reports that increasing attention is being paid to the production of fuel alcohol in Cuba. As the alcohol distillery can easily be made part of the sugar factory, a great part of the lower grade material may in future be converted into alcohol instead of sugar. At present only two mills distil alcohol from the final molasses or waste material. Under proper conditions a gallon of alcohol can be produced from 2 galls. of molasses containing 56 per cent. of fermentable sugars, but with the inefficient methods generally used 3 galls. of molasses yield only 1 gall. of 95 per cent. alcohol. In 1919–20, when the sugar crop reached 3·75 milion t., the output of molasses was over 185 mill. galls., an amount which could yield from 60 to 90 mill. galls. of alcohol. It is estimated that, with a plant capable of producing 7200 galls. of fuel alcohol per 24 hrs., *i.e.*, able to utilise the daily output of molasses from a 3000-ton raw sugar plant, the alcohol could be produced at 12·55 cents and sold at 20 cents per gall. Production of alcohol is most important in the province of Matanzas, where there are 3 distilleries with storage capacities for 2,880,000, 2,660,000 and 1,200,000 galls., respectively, and two distilleries each capable of storing 175,000 galls. Local consumption, formerly less than the production, has now risen owing to the increasing use of fuel alcohol for automobiles, and there is a large export trade, chiefly with the United Kingdom, South America, Morocco and, latterly, Germany. Efforts are being made to increase the consumption of power alcohol.—(*Bd. of Trade J., Nov.* 16, 1922.)

Artificial Silk in Italy

The Italian artificial-silk industry, founded about 15 years ago, has an invested capital of 420 million lire, and comprises five large factories at Pavia, Padua, Venaria Reale, and Cesano Maderno, which produce nearly 11 metric tons of silk per day; it employs 12,000 workers now, and will probably employ 20,000 a year hence. Some of the necessary raw materials, *i.e.*, soda, carbon bisulphide, and sulphuric acid, are produced locally and it is hoped that in time wood pulp will be obtainable in the country. At present, the production is below the home demand, and there is both an import and export trade.

	Imports		Exports
		Metric tons	
1919	78·6	..	230·4
1920	374·1	..	396·4
1921	254·9	..	906·1

Belgium, Switzerland, and the United States are the chief sources of the imported artificial silk, and the United States, France, and Switzerland the destinations of the exports. Exportation has naturally been directed to countries possessing a relatively high rate of monetary exchange (*cf.* J., 1922, 314 **R**).—(*U.S. Com. Rep., Sept.* 25, 1922.)

Kaolin Deposits in Dobruja, Rumania

Kaolin was known to occur in the hill-country between Balcic and Cavarna prior to the war, but recently large deposits of this mineral have been discovered. The Rumanian Government has decided to erect a large porcelain factory at Balcic, and to use skilled labour, mainly from Czechoslovakia and Austria.

Method of Renovating Old Corks

Old cork stoppers can be cleaned and softened by boiling them, suitably weighted, in a 5 per cent. solution of sulphuric acid for 15 minutes. After rinsing several times in water, the corks are boiled in clean water for 15 minutes, and when cold they are placed in a 5 per cent. solution of alum for 6 hours, and then dried in the sun for 2 or 3 days. —(*Chem.-Z., Sept.* 28, 1922.)

PARLIAMENTARY NEWS

HOUSE OF COMMONS

Imports and Output of Beet Sugar

Answering Major T. Hay, Sir P. Lloyd-Greame said that importations of unrefined beet sugar into the United Kingdom in 1921 amounted to 13,685 tons, compared with a home production of 6363 t. The trade returns did not distinguish between refined sugar manufactured from beet or from cane.—(Dec. 11.)

British Dyestuffs Corporation

Sir P. Lloyd-Greame, in reply to Major M. Wood, stated that during the three months ended November 30, commission paid to the Corporation amounted to £4600, and the proceeds of sales of "reparation" dyestuffs was approximately £66,000. The sterling value of the dyestuffs received during that period was, according to the Reparation Commission, about £107,000.—(Dec. 11.)

Trade Information Register

In answer to Sir H. Brittain, Sir W. Joynson-Hicks said that 2766 firms were enrolled on the special register of the Department of Overseas Trade for the purpose of receiving information from abroad. The Department was in touch with many more firms, but prompt distribution of commercial information would be facilitated if firms desiring such information would enrol on the special register. —(Dec. 11.)

Scotch Shale-Oil Industry

Replying to Mr. Shinwell, Mr. Baldwin stated that sale of the Government holding in the Anglo-Persian Oil Co. was not contemplated, but if it ever were, the Scotch shale-oil industry and other relevant considerations would be taken into account.—(Dec. 11.)

Australian Zinc Concentrates

Viscount Wolmer informed Mr. Collison that, owing to the improvement in the market price of spelter, probably no loss would result from the operation of the contract for the supply of Australian zinc concentrates.—(Dec. 12.)

Imports of Petroleum

In a written answer to Lieut.-Col. James, Mr. Ormsby-Gore gave the following statistics of the imports of petroleum from Empire territories enjoying Imperial Preference and of the output of those countries:—

	Output 1921	Imports into U.K. 1921	Output Jan.–June 1922	Imports into U.K. Jan.-June, 1922
		Tons.		
Canada	25,000	nil	12,000	nil
Australia	8,000	nil	4,000	nil
Trinidad	334,000	108,205	161,000	60,076
British India ..	1,285,000	11,170	575,000	7,318
Sarawak	199,000	13,955	178,000	nil

—(Dec. 13.)

Insulin Treatment for Diabetes

Answering Sir W. Bull, Sir W. Barlow said that the Medical Research Council was doing all it could to accelerate the production and use of insulin for treating diabetes. It was not true that the remedy had passed the experimental stage, there was no question of any Government monopoly, and the suggestion that the Medical Research Council should grant licences for manufacture was on the lines of the practice actually followed.—(Dec. 13.)

Safeguarding of Industries Act

The following are summaries of answers given by the President of the Board of Trade to questions relating to the operation of the Act:—

Duties.—Up to and including December 8 the duties collected in Great Britain and Ireland under Parts I and II amount to £445,324. Since the Act was passed the expenditure of the Customs has decreased.—(Dec. 11.)

Domestic Glassware.—Imports of domestic and fancy glassware during the first half of 1922 included 2052 tons from Germany and 4334 t. from Belgium.—(Dec. 11.)

COMPANY NEWS

MAGADI SODA CO., LTD.

Addressing the eleventh ordinary general meeting of this company on December 11, in London, Mr. S. Samuel, the chairman, said that the very unsatisfactory position of the company had been brought about by causes beyond the control of the directors. Production had been hindered throughout by the failing of machinery, and the fixing of the rate of exchange at 2s. to the rupee had seriously interfered with all industries in East Africa. The directors were still confident of ultimate success, and he personally had guaranteed the advances made by the bank to the company; in 1921 no less than £72,500 was advanced. The defects in the new bucket-dredger which had been sent to Magadi had now been made good, and the dredger had been restarted; in a few weeks there would be a minimum production of soda at the rate of 100,000 tons a year. It would be necessary to write down drastically the existing capital and to raise further capital; if the shareholders would find a further £500,000, he would contribute £50,000; if a million of new money were found, he would put up £100,000.

MAYPOLE DAIRY CO., LTD.

Sir W. G. Watson, presiding at the annual general meeting in London on December 15, discussed the difficulties confronting the company owing to the fiscal policy of foreign countries. During 1921, over 1000 tons of margarine had been imported each week, the result being unemployment and unprofitable prices in this country. Abroad, imports of oil and margarine were dutiable, but the raw materials used in manufacturing edible fats were duty-free; in consequence the factories could work at full capacity, thereby reducing working costs. This state of affairs gave an advantage of at least 1s. per cwt. to the foreign manufacturer competing in the free British market. The large Continental companies controlling both Continental and British factories had already adopted the policy of transfering manufacturing operations from England to the Continent, but the Maypole Company would do this only under pressure of necessity, as it would lead to increased unemployment, reduce supplies of British-made cattle cakes, and render the country dependent in war-time on foreign supplies of essential food. The amounts paid in dividends were not quite covered by the year's profits, as it was expected that the Company's claims against the Government would have been settled before the accounts were presented.

THE PEACHEY PROCESS CO., LTD.

At the second annual meeting held recently in London, Sir J. P. Hewett, chairman of the company, said that the expectation of improved industrial conditions during the past year had not been realised, and the uncertain political and economic situation both at home and abroad had delayed the manufacture of a number of raw products by the Peachey process. Licences had been issued in this country for the vulcanisation of crude rubber articles, such as boot soles and mats, and for surfacing leather with rubber. The production of moulded goods by the two-solution method had been perfected, and manufacture should begin in the spring. Licences had also been granted for manufacture in Belgium, Ceylon and Malaya, and as soon as the appeal against the decision of the United States Patent Office in favour of the company's application had been heard, manufacture would begin in the United States. The prime aim of the company was to secure the manufacture of its products on a commercial scale in the United Kingdom, and success in this direction would materially assist negotiations abroad. There was reason to be confident that in the coming year Peachey products would be manufactured on a large scale by substantial undertakings in this country. The sum paid up for preference and ordinary shares amounted to £79,006.

REPORTS

Report on the Economic Conditions in South Africa, Dated July, 1922. *By* W. G. Wickham, *H.M. Senior Trade Commissioner in South Africa. Department of Overseas Trade. Pp.* 49. *H.M. Stationery Office*, 1922. *Price* 1s. 6d.

Several new industrial enterprises have been initiated during the past two years, among which may be mentioned a rubber factory at Howick Falls (Natal), a blast furnace at Newcastle, the manufacture of sheep-dips and fertilisers in the explosives factory at Somerset West, a paper factory, and an additional cement works. Experiments on the distillation of coal have been continued, and the production of power alcohol is being investigated. Difficulties still confront the winning of natural soda, and a steady output has not yet been attained. The mining industry has suffered from high costs of production and the low prices of metals, the diamond and gold mines being particularly affected. There was a short boom in the coal-mining industry, due to the coal stoppage in the United Kingdom; and it is hoped that with the provision of improved facilities for handling coal at the ports and on rail, the output will steadily increase. The Government has decided to encourage the production of iron and steel and copper by paying bounties on production. (For the mineral production of 1921, *cf.* J., 1922, 199 R). The Government is assisting agriculture with legislation designed to ensure that only produce of uniform grade and best quality shall be exported; and methods of preventing drought are being investigated by a commission.

Excluding imports for the Government valued at £7,922,024, the value of the imports in 1921 was £49,878,292 (£93,404,962 in 1920); among the chief items were: Iron and steel £1,266,384; leather, unmanufactured, £115,561; wax, paraffin, stearin, £249,931; glass, glassware £428,667; oils £2,777,465; paints, etc., £333,384; drugs, chemicals, medicines, £1,063,648; rubber goods £338,605; paper, all kinds, £1,119,318. The imports originated as follows, per cent.: United Kingdom 54·8; rest of British Empire 11·4; United States 16; Germany 2·3; Sweden 2; Japan 1·4. Competition from Japan and the United States has decreased, but German competition was severe in aluminium ware, enamelware, glassware, earthenware, china, and cement. The United Kingdom gained a larger proportion of the trade in glass and glassware, but lost ground as a source of fertilisers, basic slag being supplied by Holland and Belgium and superhosphate by Holland. Exports were valued at 57,960,154 (£77,799,172 in 1920), and included: ark, wattle and extract, £570,127; hides and kins £1,226,876; sugar £2,065,359; coal (except unker coal) £1,949,014; diamonds £1,355,487; old, crude, £34,453,586; oil, whale, £25,191; soap 19,957; fertilisers £31,317. Of the total exports he United Kingdom took 79·8, Germany 4·1, and he United States 2·6 per cent.

RAPPORT SUR LE COMMERCE ET L'INDUSTRIE DE LA SUISSE EN 1921. *Pp.* 438. *Zürich: Union Suisse du Commerce et de l'Industrie*, 1922. *Price* 9 *francs* (*Swiss*).

In the section of this report that is devoted to chemical industry it is stated that during 1921 there was little demand for hydrochloric and nitric acids, and that after a long stoppage the soda factory at Zurzach was sold to the Solvay company. Sales of nitric acid made by the arc process were also limited, but improved towards winter, when the demand for sulphuric acid also improved. The new sulphuric-acid factory at Martigny began to produce in the autumn, but that at Schweizerhall has not yet made any sales. Heavy losses were made by the fertiliser industry, owing to the small demand and foreign, especially Belgian, competition. At the close of the year prospects for the Swiss heavy-chemical industry were unfavourable, and it was felt that relief could only come when home prices approximated to foreign prices.

The electrochemical and electrometallurgical industries depreciated further during the year and several factories began to utilise their power for other purposes. Most of the carbide factories remained closed, and though the export was the same as in 1920, viz., 9890 metric tons, the average value fell from 44·9 fr. to 35·93 fr. per quintal. About 2000 t. of acetaldehyde, metaldehyde, acetic acid, etc. was prepared from carbide, and cyanamide was made only in one factory, that of the Société des Produits Azotés at Martigny, which also manufactures sulphuric acid for use in making ammonium sulphate and a new fertiliser, "phosphazote" (*cf.* J., 1922, 390 R). The output of ferrosilicon was at most 3000 t., and that of ferro-alloys fell to 200 t., exports of abrasives practically ceasing. Manufacture of "synthetic" iron was continued with difficulty, owing to German competition, and the factory at Bex is now making cement as well as electric iron; many factories, however, consume their own production of electric iron. No progress was made by the aluminium industry and supplies of raw materials did not permit production at full capacity, but exports increased by 2490 t. to 8610 t. Nitrate of lime had difficulty in meeting competition from Chilean nitrate.

Electrolytic products suffered from the small demand and low prices, but there was a steady sale of electrolytic soda lye; the demand for potassium chlorate improved towards the close of the year; the consumption of bleaching powder decreased by one-half. Production of hydrogen peroxide increased slightly, but high prices limited the demand for percarbonates, perborates, and persulphates. Production of copper sulphate and salts of various metals proceeded normally at Bex throughout the year.

Unfavourable conditions prevailed in the manufacture of dyestuffs, photographic chemicals and synthetic perfumes, the colour, lake and varnish industry being severely affected by the economic crisis. The explosives industry, already suffering, was still further depressed by the abolition of import prohibitions on explosives; no advances were made by the industry and the trials of liquid air as an explosive gave unsatisfactory results. The position of the manufacturers of pharmaceutical products would have been most serious had not the Germans begun to quote prices in foreign currency in October, and had not the quality of their products been unsatisfactory. Slightly better conditions prevailed in the soap industry, although soap for industrial purposes was in small demand. Many of the match factories reduced their output until relief was obtained by restrictions on the heavy imports from Czechoslovakia in December. Stagnation prevailed in the ceramic and glass industries generally and despite reductions in the cost of fuel, prices were still above the foreign level.

THE BACTERIOLOGY OF CANNED MEAT AND FISH. *By* W. G. SAVAGE, R. F. HANWICKE *and* R. B. CALDER. *Food Investigation Board, Special Report No.* 11. *Pp.* 72. *Department of Scientific and Industrial Research. H.M. Stationery Office*, 1922. *Price* 2*s.* 6*d.*

The objects of the investigations, described in the report, were as follows:—(*a*) To study how far canned foods contain living bacteria or poisonous products thereof. (*b*) To ascertain to what extent canned foods passed for consumption are sterile and if not sterile, the significance of the organisms found in them. (*c*) To study the bacteria associated with the spoilage of canned foods with a view to diminishing waste from such causes. The report deals only with canned meat and fish.

Methods of Examination.—Every precaution was taken to avoid outside contamination, and in doubtful cases the organism isolated was rejected. Reliance was mainly placed on liquid media. Egg-meat-broth, nutrient broth, and nutrient Agar were the primary media most employed, and a general reaction of $p_H = 7{\cdot}2$ was found suitable.

For anærobic cultivations palladium-hydrogen jars[*] were used, but as the complete removal of oxygen by this method is doubtful, or uncertain, additional precautions were taken in certain cases. The incubation period sometimes extended to three or four months, and the temperatures adopted were 21°, 37°, and 55° C.

---

[*] Med. Research Committee, Special Report, No. 12

The characters of the organisms isolated were all studied in pure cultures, and special stress was laid on the following:—

(1) Spore formation; (2) oxygen requirements; (3) optimum temperature for growth; (4) ability to decompose proteins, as indicated by liquefaction of blood serum; and (5) ability to decompose carbohydrates with gas production. In all, 116 tins of meat and 207 of marine products were fully examined, the larger number being tins which had been rejected at the port of entry and the remainder sound tins purchased from shops. A few other tins were used for inoculation experiments and in other ways. The organisms isolated come under the following groups:—

(1) *Moulds.* These were only found in 8 samples, and there was no evidence that they could cause either "blowing" or extensive decomposition, though their presence rendered the meat unsaleable. Their presence indicates access of air.

(2) *Obligate anærobes.* Found in 27 tins. Most of the strains isolated were proved to be capable of producing "blowing" as well as extensive putrefaction.

(3) *Sporting anærobes.* Owing to their wide prevalence in both sound and unsound samples, to their power of resisting heat and to their proteolytic activity, this group is of great importance.

Of the five sub-groups of organisms isolated the majority liquefied blood serum, and were therefore potential causes of decomposition. Absence of sufficient air would prevent their growth in sound tins. Long incubation of tins inoculated with the non-proteolytic strains left the contents quite unaltered. Some strains were found to grow well under the severest anærobic conditions which could be obtained, without, however, any decomposition being observed, possibly because the proteolytic enzymes are produced under strict anærobic conditions.

No strains of pathogenic type were found.

(4) *Thermophylic Bacteria.* These were widely distributed in both sound and unsound tins. Some could only grow above 37° C. Few of them liquefied blood serum, and none produced gas from carbohydrates. They were non-pathogenic, and their presence has little significance.

(5) *Non-sporing ærobes.* Of these 78 varieties were isolated. Some of the proteolytic strains could also produce gas from carbohydrates. Some of *B. Proteus type* were markedly pathogenic.

(6) *Micrococci.* These occurred in 23 per cent. of the tins of which the majority were sound. None was gas-producing, and only three were proteolytic. They are not a cause of spoilage, and were not found to be pathogenic.

The results as a whole inculcate that the aim of manufacturers should be to obtain their raw material as fresh as possible, can it as quickly as possible at the right temperature and under the cleanest conditions, and by the use of good quality tinplate and efficient closing methods, to ensure the presence and the *maintenance* of a vacuum in the tins.

The report closes with a review of previous work on the subject and an excellent bibliography.

OFFICIAL TRADE INTELLIGENCE

(From the Board of Trade Journal for December 7 and 14)

OPENINGS FOR BRITISH TRADE

The following inquiries have been received at the Department of Overseas Trade (Development and Intelligence, 35, Old Queen Street, London, S.W.1), from firms, agents or individuals who desire to represent U.K. Manufacturers or exporters of the goods specified. British firms may obtain the names and addresses of the persons or firms referred to by applying to the Department and quoting the specific reference number.

Locality of firm or agent	Materials	Reference number
Austria	Manganese ore with 70-92 per cent. manganese and little iron	628
Canada	Metals	625
,,	Celluloid articles	645
,,	Rubber manufactures	646
Cuba	Leather	6131 F.L./M.C.
Egypt	Soap (tender for)	9482 F.E./T.C.
,,	Soap, perfumery	638
Norway	Pig iron, galvanised iron, tinplate	632
Portugal	Lard, margarine	654
Switzerland	Iron and steel	637
Trinidad	Tinplate, solder	627
United States	Oils, pigments for making artists' colours	639
,,	"Stainless" steel and iron	658
Uruguay, Argentina	Glassware	661

TARIFF CUSTOMS EXCISE

Australia.—Definitions have been issued in connexion with the application of "dumping" duties. A special anti-dumping" duty has been applied to gold paint from Germany. The method of assessing *ad valorem* duties has been revised.

Costa Rica.—An additional tax of 0·25 centimo (gold) per kg. is leviable on all imported goods that are dutiable.

China.—The revised schedule of duties leviable under the revised import tariff is set out in the issue for December 14. Many chemicals, dyes, pigments, fats, waxes, oils, etc. are affected.

Egypt.—A list of revised tariff valuations for non-ferrous metals is given in the issue for December 7.

France and Algeria.—Recent modifications of the customs tariff affect animal wax, olive oil, vaseline, aluminium, copper and bronze foil, ammonium compounds, iodine and its compounds, tanning extracts, chloral hydrate, monochloroacetic acid, glycerin, tartaric acid, colours, soap.

France and Italy.—A complete translation of the commercial arrangement between France and Italy is published in the issue for December 7.

Grenada.—Rules have been issued controlling the importation of matches.

Mozambique.—The export duties on oilseeds have been modified. Building materials and material for sugar factories may be imported duty-free.

Poland.—The export duty on crude petroleum has been raised from 15 to 50 Polish marks per kg.

San Salvador.—Insecticides may now be imported free of duty.

Sudan.—The importation of alcoholic liquors is prohibited, save under licence.

United States.—All imported goods must be marked with English words indicating the country of origin. Certain goods not so marked may be marked after arrival under customs supervision and delivered after payment of an additional duty of 10 per cent. *ad valorem.*

TRADE NOTES

BRITISH

New Zealand in 1921

According to the report issued by the Department of Overseas Trade on commercial conditions in New Zealand (H.M. Stationery Office. Price 1s. 9d.), imports were valued at £42,942,443 and exports at £44,828,827 during 1921, compared with £61,595,828 and £46,441,946 in the previous year. The apparently favourable balance of trade in 1921 is misleading, as the customs valuations of imports are below the trade value and the amount of interest payable on foreign loans is not included. During the early part of the year, deliveries under old orders were heavy, but very few new orders were placed, and not till later in the year did buying improve. Some of the chief imports and countries of origin are given below:—

	£		Origin, per cent
Oils, fats, waxes ..	2,948,636	..	U.S. 81, U.K. 5·5
Paint, varnish ..	393,648	..	U.K. 60, Australia 24, U.S. 12
Metals, crude or partly manufactured, and ores..	538,288	..	U.K. 52, Austr. 37
Rubber and manufactures of (excluding tyres)	87,807	..	Austr. 64, U.K. 24, U.S. 9
Leather and manufactures of	440,168	..	U.K. 52, Austr. 31, U.S. 14
Ceramic wares, cement	1,113,719	..	U.K. 56, Austr. 13, U.S. 10
Paper	1,286,932	..	Canada 42, U.K. 36, U.S. 9
Drugs, chemicals, etc..	1,082,436	..	U.K. 47, U.S. 22, Austr. 20
Fertilisers	367,074	..	Austr. 24, U.S. 8, Japan 6, U.K.2

Per head of population, New Zealand is now the largest importing country in the world, and also the largest importer of British goods. Imports of dyes in 1921 were valued at £98,257, of which the United Kingdom supplied £47,835 and the United States £17,690; imports of German dyes rose from £28 to £14,820, but these were largely "reparation" dyes sent from Great Britain. The United Kingdom maintained its position as the chief source of medicinal preparations, drugs, perfumery, etc., but lost ground in the trade in basic slag and superphosphates, which were derived mainly from Belgium. The exports included 452,231 bales of wool, large quantities of dairy produce and meat, 329,113 hides and 8,336,702 sheep skins.

Kenya in 1920–21

The official report on the Colony and Protectorate of Kenya during 1920–21 states that although agricultural development proceeded actively during the early part of the year, the subsequent fall in prices caused a decline in production. The fertility, favourable climate, and cheap labour supply of the Colony suggest that it will eventually become an exporter of coffee, maize, sisal, flax, and certain oilseeds. The natives cultivate 24,280,000 acres of very fertile soil, whereas the Europeans cultivate only 3,157,000 acres; in addition there is 9 million acres under pasture. Sisal was grown on 30,698 acres in June, 1920; there were 21 sisal factories, with a daily capacity of 52·5 tons of fibre, and the industry seems fairly profitable. Native coconut plantations cover a large area, and the output of copra should increase considerably when the plantations on European estates come into bearing. An area of 6000 acres near Kibos has been alienated for the cultivation of sugar-cane, and a factory is to be erected to supply the requirements of the Colony and adjacent territories in sugar. An attempt to prepare limejuice has failed, but efforts are now being made to manufacture concentrated citric acid for export. Apart from a small quantity of graphite no minerals have been produced except for assay, but 974 prospecting licences were issued and 322 claims were registered, of which 166 were for gold and 93 for precious stones.

Imports increased in value by 48 per cent. to the record figure of £6,911,858, of which £3,516,075 represented goods from the United Kingdom. The value of the combined exports from Kenya and Uganda rose by 4 per cent. to £4,699,498; they included: cotton 1926 tons (Kenya 81 t.); coffee 7913 t.; grain and oilseeds 22,446 t.; fibre 5702 t.; carbonate of soda 12,829 t.; copra 468 t. The percentage distribution of the sodium carbonate was as follows: United Kingdom 7, India 26, Norway and Sweden 37, and Japan 19.—(*Col. Rep.—Ann., No.* 1122, 1922.)

Zanzibar in 1921

Although no cloves have been planted in Zanzibar for 20 years and many trees have died, the production has not diminished, and in 1920-21 the crop increased to 8555 tons. Government nurseries of clove trees and coconut palms have been established to assist planters. Exports of copra amounted to 6942 t., but the quality will not improve until drying-plant can be obtained. The export of chillies was 48,432 lb. The total imports increased by 21·5 per cent. to 72,611 t., valued at Rs. 3,22,32,946, gains being shown by cotton textiles, motor-spirit, petroleum, etc. Exports amounted to 45,036 t. (Rs. 3,24,64,049), the increase of 15·9 per cent. compared with 1920 being due to the heavy clove crop and to re-exports of motor-spirit and petroleum. The foreign trade of the Colony was distributed as follows (per cent.):—India and Burma 26, Tanganyika Territory 19, United Kingdom 16, Kenya 8, France 6, the order of importance being the same as in 1920.—(*Col. Rep.-Ann., No.* 1125, 1922.)

FOREIGN

Fertiliser Prices in Germany in October, 1922.

During the period July to September, prices of fertilisers in Germany increased by 210 per cent. Figures showing the prices at the works in marks per 100 kg. in 1913 and in July and October, 1922, are given below:—

Average prices of fertilisers in Germany

	1913		July, 1922		Oct. 11, 1922		Inc. over price in 1913
							Per cent
Carnallite	0·765	..	32	..	114	..	148·8
Kainite	1·20	..	51	..	182	..	151·9
Manure salts (20%) ..	2·80	..	110	..	412	..	147·1
" " (30%) ..	4·35	..	120	..	767	..	176·2
" " (40%) ..	6·20	..	317	..	1,310	..	210·2
Potassium chloride (50%)	13·50	..	442	..	1,787	..	132·4
Potassium sulphate ..	16·80	..	573	..	2,855	..	169·9
Potassium magnesium sulphate	8·06	..	341	..	1,699	..	210·8
Basic slag	3·75	..	278	..	1,200	..	320
Superphosphate ..	5·95	..	572	..	2,295	..	385·7
Cyanamide	21·28	..	1,135	..	4,904	..	230·5
Ammonium sulphate—							
Ord..	27·78	..	1,415	..	6,131	..	220·7
Dry	28·08	..	1,464		6,344	..	225·9
Sodium nitrate ..	22·40	..	1,324	..	5,749	..	256·6.

Italian Trade in Sulphur

Exports of sulphur from Italy are now confined almost entirely to Europe and countries on the eastern Mediterranean, as many markets have been lost entirely or in part to American producers owing to the high cost of production in Sicily, which is due to antiquated methods of extraction and the high cost of labour. The export of sulphur during the nine months ended March, 1922, was 54,402 metric tons, valued at 44,666,740 lire, and during the first quarter of 1922, 36,434 t., worth 29,493,350 lire, of which 16,280 t. was taken by Greece, 4344 t. by France, and 2860 t. by Germany.—(*U.S. Com. Rep., Nov.* 27, 1922.)

REVIEWS

THE CHEMISTRY AND TECHNOLOGY OF GELATIN AND GLUE. *By* DR. R. H. BOGUE. *Mellon Institute Technical Series. Pp. xi.*+644. *London: McGraw-Hill Book Co., Ltd.*, 1922. *Price* 30*s. net.*

The aim of the author has been to supply a want, long felt by students and investigators, of an up-to-date account of the principles of the manufacture, testing and general applications of gelatin and glue. No book has appeared before which has treated these matters purely from a scientific point of view. The subject is a very complex one, like all others depending upon colloidal chemistry, and the fact that the method of treatment is new increases the difficulty of producing a standard work. Nevertheless, in spite of these difficulties, the author has produced an excellent book which will be of value to both the chemist and manufacturer. It should be stated that the latter is only catered for indirectly, and that the details of practical manufacture are too scanty to be of much use to him. What he can learn is the scientific principles underlying the various operations.

The book is divided into two parts, viz. (1) Theoretical Aspects, and (2) Technological Aspects. An appendix contains details of the measurement and expression of hydrogen-ion concentration, p_H values and various tables. In the first part, the chemistry of gelatin is dealt with fully, the work of all recent investigations of its colloidal properties being clearly described under the following heads:—(1) The constitution of the proteins; (2) the chemistry of gelatin and its congeners; (3) the physicochemical properties and structure of gelatin; (4) gelatin as a lyophilic colloid; (5) gelatin as an amphoteric colloid. Chemical equations and mathematical expressions are used freely. Good descriptions are given of the cleavage products of proteins and of the determination of amino-acids and the Hausmann numbers.

Among the details of manufacturing processes is a suggestive description of the application of the determination of the specific conductivity of a glue liquor as a means of controlling its clarification. But the author appears to have limited his experiments to determining the point at which the soluble salts are at a minimum. He states, quite rightly, that indicator colour changes are of little use in controlling glue liquors. Seventy-five pages are devoted to the testing of glue and gelatin. A large number of physical and chemical methods is described and a useful attempt is made to divide the tests into "fundamental" and "secondary." As the result of work previously published by himself, the author concludes that the jelly strength of a glue depends upon the percentage of the total nitrogen present as unhydrolysed protein and that "amino" nitrogen is of little value as a factor for analytical purposes. This is in agreement with the conclusions published recently by the Adhesives Research Committee. Stress is laid on the importance of determining the p_H value of a one per cent. solution of the glue, though it is doubtful if the indications given by the test are so clear as the author thinks. The properties of a glue or gelatin are largely determined by the washing and boiling processes, and no subsequent adjustment of its p_H value could make good mistakes made in these operations.

The book concludes with a description of some of the uses and application of glue and, in dealing with glue as an adhesive, the factors affecting the strength of a glued joint are fully dealt with. The book is excellently printed and the bibliography full and generous.

S. R. TROTMAN.

(1) THE GENERAL PRINCIPLES OF CHEMICAL ENGINEERING DESIGN, *by* H. GRIFFITHS. *Pp.* 63.
(2) THE WEIGHING AND MEASURING OF CHEMICAL SUBSTANCES, *by* H. L. MALAN *and* A. T. ROBINSON. *Pp.* 63.
(3) MATERIALS OF CHEMICAL PLANT CONSTRUCTION: NON-METALS, *by* H. GRIFFITHS. *Pp.* 64.
(4) THE FLOW OF LIQUIDS IN PIPES, *by* N. SWINDIN. *Pp.* 64.
(5) PUMPING IN THE CHEMICAL WORKS, *by* N. SWINDIN. *Pp.* 80.
Chemical Engineering Library. London: Benn Brothers, Ltd. 1922. *Price per volume* 3*s. net.*

Messrs. Benn Bros. have published a set of five booklets on various sections of chemical engineering, which, although quite useful compilations, hardly justify the claim made on the printed wrapper that they will form a complete and authoritative reference library.

(1) In this volume the need is pointed out of breeding chemical engineers, of whom so few yet exist. Much has been written on the subject, but events are now moving and the position of the chemical engineer at the moment is somewhat similar to that of the electrical engineer in the 'eighties. The monograph gives a brief but good outline of the subject indicated by its title, showing the necessity for the pure chemist to be well up in *all* branches of science as well as his own, and to have a good knowledge of physics. The writer urges the necessity for an intelligent use of formulæ, many of which are necessarily empirical, and regards too much "common sense" as a sign of ignorance and rule-of-thumb. He emphasises the need for research in chemical engineering and the preliminary study of the ground before any plant is designed. A chapter is devoted to many details, small and large, which go to make up a plant, and the whole monograph is one that will be read with pleasure by any practical chemical engineer.

(2) The writer gives a general survey of the methods of intermittent measurements of liquids by filling tanks or eggs, with a polar diagram for the calibration of large cylindrical tanks, but entirely

omits the gauged-flow method for this operation, which is by far the quickest and most accurate. He describes the various types of water-meters in use, viz., reciprocating and turbine meters, and gives a good description of the Venturi-meter and weir-recorder. A short chapter is devoted to the outlines of automatic weighing machines and continuous volume-measurement of granular substances. The limits of space, no doubt, preclude the mention of many designs of apparatus of equal interest to that mentioned.

(3) This booklet devotes its first chapters to all general building materials and especially to their acid-resisting properties. There are some noticeable divergencies in the figures given for fire-bricks. On page 16 the writer states the porosity to be 7 per cent., and on page 19 gives a figure of 10—15 per cent. The crushing strength per square foot is given as 250 tons on page 16, and on page 19 as 110—128 tons. Specific gravity he quotes as 1·8 on page 25 and on page 16 as 2·16. Also, surely Volvic stone comes from the centre not the south of France? Stoneware and glass, artificial stones and "vitreosil" are mentioned with their good and bad points. The use and abuse of wood are discussed in very useful detail, and paints, cements and jointing materials described, but the acid-workers' old friend, "blackman," is not mentioned. This brochure is a useful one, and the few errors mentioned will, no doubt, be corrected in a subsequent edition.

(4) The author reviews the work of Reynolds, Poiseuille, D'Arcy, Stanton and Parry, gives a clear exposition of each, and makes a plea for a general standard of units in place of c. g. s; ft.-pd.-second; metre-kg.-second. He gives an account of the conditions governing the flow of liquids in pipes and channels with a wealth of diagrams and tables, including those for losses due to bends and cocks in pipes. He demonstrates the saving in power by the use of large pipes, which allow the rate of flow to be slow enough to keep within the stream-line limits; also the fact that the mean velocity is a definite function of the velocity at the centre of the pipe, so that only one reading with the pitou-tube is necessary. There are some gaps in the tables given yet to be filled up. He omits any use of the calculus and so provides a handbook that is quite suitable for popular consumption.

(5) In this volume are described most of the types of pumps and methods of pumping met with in chemical manufacture, special regard being had to the movement of corrosive liquids. The writer deals fairly with the different types, but the details are necessarily meagre owing to the small size of the book. His statements will not perhaps meet with universal agreement; for instance, he alleges that a theoretically-minded man would prefer mechanical pumps. This is quite contrary to the experience of the reviewer, who has frequently had to apply the brake to the ultra-theoretical man. In the section devoted to centrifugal pumps, the writer gives a list of makers' names with a digest of their statements, but it is rather noticeable that he omits the firm which has been longest in this field and whose experience must be as great as that of all the others put together. He mentions the difficulties in the making of pumps from iron alloys, due to the brittleness of this material, but omits the troubles due to variations in composition which have caused chemists much tribulation in the past. Rotary pumps are described shortly and receive all the attention they deserve, but no mention is made of wear, which in most cases is a serious item. Pumping by means of air pressure and eggs is very fully gone into, and the use of steam- and air-ejectors explained. The author reserves his approval for the air-lift, pure and simple, which he describes, and of which he explains the theory in detail, although it may perhaps be permitted to doubt the efficiencies he mentions. This small book is a good one, and within its limitations covers the ground in excellent fashion.

F. A. Greene.

Physical and Chemical Examination of Paints, Varnishes and Colours. *By* Henry A. Gardner, *Director, Scientific Section, Education Bureau of the Paint Manufacturers' Association of the United States, and the National Varnish Manufacturers' Association Incorporation. Pp.* 218, *and supplement of about* 150 *pages consisting of Circulars issued by the Interdepartmental Committee, Standard Specifications Board, U.S. Government. Washington: P. H. Butler,* 1845, *B Street, N.W.,* 1922. *Price* $9.

The name of the author of this volume is familiar to everyone acquainted with the scientific and technical literature of the Paint and Varnish Industry, for as Director of the Scientific Section of the Educational Bureau above named, Mr. Gardner is probably the most prolific contributor to the literature of the industry. The present work consists of a collection of methods for the physical and chemical examination of paints, varnishes and colours, together with copies of a number of Standard Specifications issued by the United States Government. In these days, when the mass of technical literature is so great, it is often difficult for those engaged in industry to read, let alone thoroughly digest, all the new work dealing with their own industry, and, viewed from this standpoint, the volume under review has a certain value; subsequent editions can, however, be considerably improved by careful revision.

Chapters I to XIV show clearly the rapid development which is taking place in the application of physical methods of investigation in the paint and varnish industry, and these chapters prove the most attractive, for therein the author deals with the most up-to-date work on such problems as oil absorption, viscosity, surface tension and interfacial tension of varnishes and paint liquids, and colour standards.

The chapter dealing with the testing of paint films, the Pfund Cryptometer, the colorimeter, and paint film gauge, is of particular interest, the construction and use of the instruments being carefully described. No attention is given to the microscopic examination and measurement of pigment particles, and this is a serious omission, because it is generally agreed that by no other means can the fineness of a pigment be determined. The chapter on the texture of pigments is an interesting but too discursive treatment of a difficult subject, and its value is not sensibly increased by the photomicrographs reproduced. The treatment of a most important subject, viz., exposure tests, is meagre and by no means sufficient for a work of this type, and in a new edition page 77 might be recast with advantage so as to secure uniformity of method of expression.

A number of chapters deal with the analysis of mixed driers, shellac, resins, bituminous paints, white paints, lead oxides, vermilions and other pigments, and it is only possible in a review of this description to draw attention to a few features which might with advantage be altered in a new edition. It is important to note that the composition of English basic sulphate of lead is not similar to that quoted by the author for the American product. In English brands, the zinc-oxide content is usually less than the 5·5 per cent. stated to be American standard.

Methods for the analysis of the new titanium pigments are given, but whilst mention is made of the use of antimony oxide as a pigment, the reader is referred to another publication for details of methods of analysis—an inconvenient feature in a work of this type.

Exception must be taken to the statement on page 183 that whilst the lead oxide pigments in the pure form are of the generally accepted formula Pb_3O_4, they are "probably mixtures of lead monoxide and lead dioxide" and further, that "in chemical composition they are the same, the proportions of lead monoxide and dioxide varying, however, but by their physical structure and colour they can be readily differentiated." The first statement is incorrect and the second is so involved that its meaning is not clear.

The remaining pages of the book consists of actual copies of 18 Circulars issued by the United States Government. These are excellent productions, each being a complete work in itself. This feature, however, involves much repetition, particularly of methods of testing and preparation of reagents. Thus, the same methods for the preparation of standard solutions of sodium thiosulphate, starch solution, standard iodine solution, alcoholic sodium hydroxide, etc. are described at least a dozen times, and similarly, the same laboratory methods for the examination of dry pigments are described time over again. Such repetition is unavoidable when the circulars are printed for sale as separate complete works, but it makes tedious reading in a work such as that under review. Further, each specification can be purchased at 5 cents per copy, so that 150 out of the 380 pages contained in the volume are purchasable for 90 cents, leaving less than 250 actually written by the author. In view of this, the price of 9 dollars for the work is excessive and will certainly militate against the free sale of the book, even though, as is always the case with the author's productions, the volume is well bound, clearly printed and free of printer's errors.

C. A. Klein.

With reference to the review of Die Lösungsmittel der Fette, Oele, Wachse und Harze, by Dr. H. Wolff, which appeared in our issue for October 16, the publishers, Die Wissenschaftliche Verlagsgesellschaft m.b.H., Stuttgart, write to say that the book is to be had bound as well as in brochure form; for reasons of economy the latter form is sent out for review. The price to purchasers in England has now been reduced to 5s., bound, whilst the price in Germany has been raised to 1600 marks.

PUBLICATIONS RECEIVED

A Dictionary of Applied Chemistry. Vol. IV. L—Oxydisilin. *By* Sir E. Thorpe, *assisted by eminent contributors. Revised and enlarged edition. Pp.* 740. *London: Longmans, Green and Co.*, 1922. *Price* 60*s.*

The Recovery of Volatile Solvents. *By* C. S. Robinson. *Pp.* 188. *New York: The Chemical Catalog Co., Inc.*, 1922. *Price* $2.50.

Bleaching Powder and its Action in Bleaching. *By* R. L. Taylor. *Pp.* 78. *Manchester and London: John Heywood, Ltd.*, 1922. *Price* 4*s.* 6*d.*

Scientific Papers of the United States Bureau of Standards. *Department of Commerce. Washington: Government Printing Office*, 1922:—

Specific Volume of Liquid Ammonia. *By* C. S. Cragoe *and* D. R. Harper. *No.* 420. *Price* 5 *cents.*

Studies in Colour Sensitive Photographic Plates and Methods of Sensitising by Bathing. *By* F. M. Walters *and* R. Davis. *No.* 422. *Price* 15 *cents.*

An Improved Method for Preparing Raffinose. *By* E. P. Clark. *No.* 432. *Price* 5 *cents.*

Thermal Expansion of a Few Steels. *By* W. Souder *and* P. Hidnert. *No.* 433. *Price* 5 *cents.*

Electromotive Force of Cells at Low Temperatures. *By* G. W. Vinal *and* F. W. Altrup. *No.* 434. *Price* 5 *cents.*

Metallographic Etching Reagents for Copper Alloys, Nickel and the Alpha Alloys of Nickel. *By* H. S. Rawdon *and* M. G. Lorentz. *No.* 435. *Price* 15 *cents.*

The Solubility of Dextrose in Water. *By* R. F. Jackson *and* C. G. Silsbee. *No.* 437. *Price* 5 *cents.*

Tests of Stellar Radiometers and Measurements of the Energy Distribution in the Spectra of 16 Stars. *By* W. W. Coblentz. *No.* 438. *Price* 10 *cents.*

The Spectral Transmissive Properties of Seven Permitted Food Dyes in the Visible, Ultraviolet and Near Infra-red. *By* K. S. Gibson, H. J. McNicholas, E. P. T. Tyndall, M. K. Frehafer, *and* W. E. Mathewson. *No.* 440. *Price* 15 *cents.*

Measurement of the Colour Temperature of the More Efficient Artificial Light Sources by the Method of Rotatory Dispersion. *By* I. G. Priest. *No.* 443. *Price* 5 *cents.*

Reprints from the Smithsonian Report for 1920. *Washington: Government Printing Office*, 1922:—

The Determination of the Structure of Crystals. *By* R. W. G. Wyckoff. *Publication* 2627. *Pp.* 199—222.

The Chemistry of the Earth's Crust. *By* H. S. Washington. *Publication* 2631. *Pp.* 269—320.

Dr. Aston's Experiments on the Mass Spectra of the Chemical Elements. *Introduction by* C. G. Abbot. *Publication* 2628. *Pp.* 223-240.

PROCEEDINGS OF THE

FORTY-FIRST ANNUAL GENERAL MEETING

Glasgow, July 4th to 11th, 1922.

The forty-first annual general meeting was held at the Institute of Engineers and Shipbuilders, Glasgow, on July 4, under the Presidency of Prof. R. F. Ruttan.

The Lord Provost of Glasgow (Mr. Thomas Paxton), in extending to the Society a very cordial welcome to Glasgow, congratulated the Society on the great progress it had made since it had last met in Glasgow in 1910, both in the increase in its membership and in the contributions it had made to our knowledge of the scientific and practical applications of chemistry. It was recognised that the Glasgow district owed much to its chemical industries, and in the interval that had elapsed since the Society had last come to Glasgow the City had not stood still in its efforts to show its appreciation of the furtherance of science in all its aspects. The Corporation of Glasgow was largely interested, in a corporate capacity, in chemical industry. They had established highly specialised chemical sections in connexion with the health, the gas, and the sewage departments; he believed Glasgow had some of the best organised gas works in the country. Alluding to the manner in which the University of Glasgow appreciated the place of chemical science in its organisation, he referred to the fact that during the past few months the chemistry department had been very considerably strengthened by the addition of new chairs. As showing the interest the University took in the work of the Society, he referred to the presence of Sir Donald Macalister, the Principal of Glasgow University, at that meeting. He expressed the hope that the result of the meeting in Glasgow would be to increase interest in the objects of the Society. He concluded by again extending a hearty welcome to the Society on behalf of all the citizens of Glasgow.

The President expressed the sincere thanks of the Society for the welcome to Glasgow that had been so courteously and heartily offered. He considered it his good fortune that during his term of office the meeting should have been held in Glasgow, for he knew of no other city in Great Britain better fitted for a meeting of the Society of Chemical Industry than Glasgow. Not only had it a most interesting and historical environment, but it was a city known throughout the Empire as a great seat of chemical industry, one of the great centres at any rate of the coal and the iron and steel industries. It had been a pioneer in the establishment of the bichromate industry, sugar refining, and the distillation of shale, and, above all, in the manufacture of chemical plant. It was of interest to note that the first great plant for the distillation of wood which had been sent to America had come from Glasgow. The process was known as the Scotch process, and it had only been slightly modified since that time except in the direction of making the plant very much larger and of greater capacity. The Empire associated the City of Glasgow with the great pioneers of chemistry and the industry of chemistry; the names of Joseph Black, and Tennant, and later on of Kelvin and Ramsay, were indissolubly connected with the City of Glasgow. The influence of Kelvin and Ramsay had extended to the outermost quarters of the British Empire and beyond that, throughout the whole realm of civilisation and had advanced the development of science. Therefore, the citizens of Glasgow might well be proud of their city, which had taken such a very prominent part in the past in chemistry, and to-day was playing such a very important part in chemical industry. He again thanked the Lord Provost for his very cordial welcome.

The **Lord Provost** having briefly expressed his thanks, the President took the chair.

Messrs. D. A. McCallum and J. McGregor were appointed scrutineers for the ballot, which was declared closed.

The minutes of the fortieth Annual General Meeting, held in Montreal, were taken as read.

Report of Council.

During the past year the Council has held 12 Ordinary Meetings, and the following Committee Meetings have been held:—Finance 4; Publications 25; and General Purposes 8.

The number of members on the Register at July 4, 1922, was 5270, as compared with 5654 last year.

Since the last Annual Meeting 260 members have been elected, 22 former members have been restored to membership, and the losses have been 665.

The Council regrets to record the deaths of 37 members (of whom 10 were original members).—J. R. Appleyard, H. J. Barnes, Dr. Chas. Baskerville, E. J. Bevan, Dr. J. F. Bottomley, T. Lynton Briggs, Wm. C. Carnell, John V. Casey, W. B. Cogswell, George H. Coy, W. S. Curphey, Fred P. Dewey, T. W. Dukes, Charles Estcourt, F. L. Gallup, W. B. Giles, Gustave Gillman, George Golding, W. Gowland, E. W. T. Jones, W. Arthur Kershaw, Dr. E. J. Lederle, James Lyle, John S. Macarthur, Dr. Andrew McWilliam, E. Kennard Mitting, Dr. F. W. Passmore, Arthur F. Price, A. E. Sadler, Irwin J. Smith, John W. Smith, J. Spiller, Frederick C. Weld, R. Lloyd Whiteley, Frank Wilson, Louis S. Winsloe, John W. R. Youll.

Mr. John Spiller was an Honorary Life Member of the Society.

Sir William J. Pope, F.R.S., was appointed Chairman of the Council during Prof. Ruttan's year of office as President.

Professor R. F. Ruttan retires from the office of President of the Society at the close of the Annual General Meeting, and the Council has nominated Dr. E. Frankland Armstrong, F.R.S., of Warrington, as his successor in office.

Mr. E. V. Evans and Prof. Henry Louis have been re-elected Hon. Treasurer and Hon. Foreign Secretary respectively.

Professor Ruttan has been nominated a Vice-President and to the other vacancies caused by the retirement of four Vice-Presidents Dr. H. Levinstein, Prof. G. T. Morgan, F.R.S., and Mr. S. J. Pentecost have been nominated.

The Council accepted with deep regret the resignation, owing to illness, of Dr. C. A. Keane as an Ordinary Member of Council, and chairman of the Publications Committee.

Three ordinary members retire from the Council, and to fill the vacancies thus created, and that caused by the resignation of Dr. Keane, six nominations have been received. A ballot will therefore be taken.

Mr. W. T. H. Williamson has been appointed Hon. Secretary and Treasurer of the Edinburgh Section in place of Dr. Lauder resigned.

The following Chairmen of Local Sections retire: Mr. S. R. Church (American), Dr. H. W. Brownsdon (Birmingham), Mr. Noble W. Pirrie (Canadian Pacific), Mr. J. H. Young (Glasgow), Mr. H. W. Matheson (Montreal), Dr. J. H. Paterson (Newcastle), Mr. J. H. Dunford (Nottingham), and Mr. S. H. Davies (Yorkshire). The following have been elected to succeed them respectively:—Professor R. H. McKee, Dr. E. B. Maxted, Professor E. H. Archibald, Mr. W. E. Moodie, Dr. A. R. M. MacLean, Mr. A. Trobridge, Mr. S. H. Burford, and Dr. L. L. Lloyd.

The following Honorary Secretaries of Local Sections retire:—Mr. F. R. O'Shaughnessy (Birmingham), and Mr. W. P. Dickson (Montreal). The following have been elected to succeed them respectively:—Mr. George King and Mr. W. B. Woodland.

The Council desires to express its cordial thanks to the retiring officers for their services to the Society.

The Council has approved proposals from the Edinburgh and Nottingham Sections to admit "Associates" to meetings of the Sections at a nominal annual subscription, on the same conditions as were laid down in the case of the Glasgow Section (see Report of Council 1921).

A new Section of the Society has been formed for South Wales with headquarters at Cardiff. Meetings will be held alternately at Swansea and Cardiff and it is hoped that a considerable accession of new members to the Society will result. The area covered by the new Section has hitherto formed part of the Bristol and South Wales Section, which in future will be known as the Bristol Section.

Reference was made in the last Report of Council to a tentative proposal which had been submitted to the Council for the formation of another Subject Group. This matter is still under discussion.

The Annual Meeting of the Society for 1921, which was held in Montreal, was followed by visits to the Sections at Shawinigan Falls, Ottawa, Toronto and New York, as well as to other places of interest in Canada and the State of New York. A full account of the trip and the various functions will be found in the Journal.

The experiment which was made in October of holding a Dinner of the Society in London was most successful, and it is proposed to hold a similar function in London each year that the Annual Meeting takes place in the Provinces or in one of the Overseas Sections.

With regard to the proposal of the Chemical Society that papers intended for its Transactions might be read at provincial Sections of the Society of Chemical Industry, and that Fellows of the Chemical Society resident in the locality be invited to such meetings, the Committees of the Sections have now expressed their cordial approval of the scheme, and a working arrangement has been entered into between the two Societies for the purpose of giving effect to it.

The audited Balance Sheet and Statement of Income and Expenditure for the year ending December 31, 1921, which have already appeared in the Journal for June 30, will be laid before the Annual General Meeting.

The audited accounts of the Messel Fund have also appeared in the Journal for June 30 and will be laid before the Annual General Meeting.

The whole of the income from this Fund has been invested—partly in 5% War Loan and partly in 3½% Conversion Loan, and there is a small balance on deposit account with the Society's Bankers.

Dr. H. E. Armstrong, F.R.S., is to deliver the first Messel Memorial Lecture in Glasgow on July 4 on the occasion of the Annual Meeting of the Society, and the first award of the Messel Medal will be made to him on that occasion.

The Council decided not to re-elect the large number of Committees which have been in existence for the past three years, but has continued the Publications Committee and the General Purposes Committee. The membership of these Committees is given in the Journal, 1922, page 5 R.

Mr. E. V. Evans has been elected chairman of the Publications Committee, until the end of the Annual Meeting, 1922, in succession to Dr. C. A. Keane resigned. Dr. W. R. Ormandy resigned his membership of the Committee.

The Journal for 1921 contained 1698 pages of text (Review 480, Transactions 310, Abstracts 908) compared with 1636 pages in 1920. Advertisements:—1160 pages in 1921, 1246 in 1920.

Volume VI. of the Society's Annual Reports of the Progress of Applied Chemistry has been published this year.

The Council approved the establishment of a General Council to look after the interests of the Society as a whole in Canada and to deal with questions which may arise with regard to Federal and Provincial Legislation. The names of the members of this Committee are given in the Journal, 1922, page 94 R.

A second joint meeting of the Society and of the Institution of Mechanical Engineers was held on January 6, 1922, when a paper was read by Mr. G. M. Gill, Chief Engineer of the South Metropolitan Gas Co. (see Journal, 1922, p. 5 R).

The new scheme for the Latham Research Fellowship, proposed by Mr. C. F. Cross, F.R.S., and approved by the Council, is now in operation. Full particulars will be found in the Journal, 1921, page 384 R.

The Council has renewed for 1922 its donation towards the expenses incurred in connexion with the extension scheme of the Chemical Society's Library.

In response to the application which the Council made to the Government through the Conjoint Board of Scientific Societies for financial assistance in defraying the cost of a Collective Index to the Journal for the years 1906 to 1920 the Chancellor of the Exchequer regretted that in view of the paramount importance of reducing public expenditure he is unable to contemplate any increase of existing grants. The Committee of the Conjoint Board considered that in the circumstances it would be useless to press the matter further, and the Council concurred in this view.

A list of the Society's representatives on outside bodies is given in the Journal, 1922, page 5 R. Owing to the resignation of Dr. C. A. Keane, Mr. W. J. U. Woolcock, M.P., has been elected to the Federal Council for Pure and Applied Chemistry and Mr. Julian L. Baker to the Conjoint Board of Scientific Societies.

Mr. Julian L. Baker and Mr. F. H. Carr were appointed representatives upon a Standing Committee to be set up by the National Physical Laboratory to deal with the standardisation of scientific glassware and kindred problems.

The President of the Society was invited to join the General Committee of the British Empire Exhibition, 1924.

Mr. E. V. Evans and Mr. R. H. Clayton represented the Society on a deputation which was received by Sir Alfred Mond, Bart., Minister of Health, on March 20, to urge the Government to take immediate steps to deal with the subject of Smoke Abatement.

The Council of the Association of British Chemical Manufacturers has expressed its willingness to co-operate with the Council of the Society in a scheme of chemical propaganda in connexion with the British Empire Exhibition, 1924.

Mr. J. H. Young moved the adoption of the report.

Mr. E. Grant Hooper, in seconding, said that he was sure they would all wish to welcome their President from Canada. They might congratulate themselves that the report of the Council represented, on the whole, distinct progress—not, he was sorry to say, in the matter of members, because they had to lament a slight diminution in the number; but there had been an increase in the number of Sections, and he thought they might reasonably look forward to an increase in the membership as a result. The members owed a great debt of gratitude to the Council for the work it had done during the past year, and of which the report so eloquently spoke.

The report was unanimously adopted.

Hon. Treasurer's Report.

The Hon. Treasurer, Mr. E. V. Evans, said that he was pleased to be able to report that the balance-sheet for 1921 showed that the Society's financial position had continued to improve, and it might be truly claimed that there was an excess of income over expenditure of £3747 11s. In addition to that the Society's stocks had appreciated in value; whereas the depreciation from cost price reported last year had been 36·5%, this had been reduced to 29·8% in December last; this difference represented an increase in the valuation of the stocks to the extent of £1214 18s. That was a very satisfactory state of affairs, but he asked the members not to become too optimistic from this general survey. The income of the Society was not a stabilised one, and examination of the balance sheet would show the important contribution made last year by the Advertising Department to the revenue of the Society. In fact, whereas the expenses of the Society (which related mainly to the costs of producing the Journal and to Sectional expenses) amounted to approximately £5 7s. per member, this figure was reduced to £2 16s. as the result of the revenue received from Advertisements. These figures illustrated the important part played by the Advertising Department, and he was sorry to have to report that owing to the slump in trade, which appeared to have been accentuated in the case of the chemical trade, it was not now so easy to secure advertisements as had been the case last year. This would without doubt affect adversely the finances of the current year, and it was for that reason that it was necessary to curb undue optimism.

Since the last Annual Meeting the Council had given considerable attention to certain ideas and schemes which had been formulated with a view of extending the activities of the Society and of increasing its usefulness to members. Although expenditure had been increased in certain directions, none of these schemes had yet been put into operation owing to the fact that the Council had strictly adhered to its decision to re-establish the financial position of the Society before incurring further responsibilities. It was owing to the continuance of the trade slump that the Council had to continue in a state of strict economy, its main object being to strive to attain a sound financial backing in order that the activities of the Society might be extended beyond those of to-day.

In regard to the Messel Fund, it would be seen that not only had this been kept intact during the first year, but all dividends had been re-invested. The initial expenditure involved in the creation of the Messel Medal represented the first outlay under this Fund, and he felt confident that the members of the Society would be in full accord with the steps taken by the Council to perpetuate the memory of Dr. Messel.

In conclusion he expressed his indebtedness to the Council for the detailed consideration and advice that they had given in matters relating to the finance of the Society.

Dr. Stephen Miall, moving the adoption of the accounts, said the satisfactory position that had been reported was in no small measure due to the great care and trouble and immense amount of time which the Hon. Treasurer had devoted to the well-being of the Society. He had watched over the expenditure in a most exemplary manner.

Mr. F. H. Carr seconded the motion and supported all that Dr. Miall had said with regard to the work of the Hon. Treasurer. Two years ago, the duty of taking on the treasurership of the Society had been by no means an easy task. Mr. Evans, however, had accepted that task and had carried it out in a remarkably successful manner, and his work had been a really great achievement during two such troublous years as those which had just passed.

The financial statement was then adopted.

President's Address.

The President then delivered his address, as follows:—

By selecting a Canadian chemist as your President for this year, you have conferred upon Canada the highest honour in your gift. On behalf, then, of the Canadian Sections of the Society and myself, I wish to express my deep appreciation of this recognition.

The year 1921 was recognised in Canada as a most inconvenient one for the British chemists to hold an annual meeting across the Atlantic, as it was a period of great anxiety to all interested in chemical industry. Difficulties in connexion with conditions of foreign trade, labour and transportation were calling for the closest attention, and new legislation of vital interest to the chemical industries was pending or being applied. We appreciated, therefore, all the more the sacrifices made in the interests of chemistry by those who did us the honour of accepting our invitation to hold the Annual Meeting of the Society in Canada in that year.

Members of the Society in the British Isles, not in intimate touch with conditions in America, can scarcely understand how far-reaching was the influence of that meeting in Montreal and the congress of chemists in New York to which it gave rise. It has not only greatly strengthened the Society itself, but it has done a greater service by stimulating public interest in the science of chemistry and its applications throughout Canada and the United States. The Society fully realised its objective by bringing into closer relations with one another the far-flung Sections of the North American continent. At this meeting was organised the Canadian Executive Committee, composed of the Chairman of the various Canadian Sections, which will act as a medium of communication with the parent Society and organise annual meetings of all the Sections in the Dominion. The first of these "all-Canada" meetings was held recently in Ottawa, and was attended by more than one hundred chemists. It was felt that some such nucleus, around which to crystallise and develop, was necessary for Sections extending over a distance of more than three thousand miles.

The Annual Meeting of the Society in Montreal also served as a means of recognising and promoting the interest shown by the Canadian Sections in the parent Society, and, by bringing the officers and members of the Canadian Sections into personal relations with the executive of the Society, went far towards harmonising and unifying the aims and ideals of the new and scattered Canadian Sections with those of the older ones in England and Scotland. This meeting further served to accentuate the imperial character of the Society: to bring home to chemists both in England and Canada the fact that this great Society has for its object the advancement of chemistry and its application to industries beyond the confines of the British Isles.

It is to be hoped that as a result of this overseas meeting not only, with the revival of industry, will the number of Sections in Canada be increased and each Section strengthened, but that in the near future Sections will be established wherever centres of industry exist throughout the whole Empire.

Incidentally, the voyage to Canada of the representatives of the Society played an important part in the great movement in progress last year for consolidating and strengthening the various interests of the British Commonwealth. During the year a congress of Premiers and other representatives of the Dominion was held in London; university and public school teachers from almost every part of the Empire met in Canada during July; and at the same time a congress of the Universities of the Empire was held in the several great universities of England and Scotland. This desire for unity and co-operation among the countries in the British Empire is that which makes it a real and substantial League of Nations.

The large and representative Congress of Chemists held in New York was the direct outcome of the visit of the Society to Canada. British and Canadian members of the Society were the guests of our American Section, who arranged for a meeting of the American Chemical Society during the same week. This Congress, following the Canadian meeting, directed public attention to the international character of the Society. No scientific meeting in America has received wider publicity or created greater interest among the chemists, in the industries, and among the people at large. Our common interest in chemical science and the opportunities of informal meetings between ourselves and the chemists of the United States undoubtedly served to add another bond to those of a common national origin and a common language to link England more closely with the Anglo-Saxons of the American continent.

It will then be seen that, although you accepted our invitation to cross the Atlantic for your Annual Meeting last year at considerable inconvenience to yourselves, the Council was fully justified in the course it took. The results, in enhancing the prestige of the Society, in consolidating its membership, and in creating a new interest in chemistry among those in America who should make use of its applications, will prove no small satisfaction to the executive of our Society.

I have ventured to select as the chief topic of my address some aspects of the war-worn subject of scientific and industrial research. It must not be forgotten that the most obvious of truths are those which require the most frequently to be recalled. They are so obvious that they cease to attract attention. It is to be hoped, therefore, that the active propaganda carried on some years ago to arouse the general public to a realisation of the national importance of science and scientific education will not be allowed to fade into a painless death.

I propose to discuss the present general trend of the development of scientific and industrial research, to refer to international organisation of science, to trace in outline the post-war efforts of the overseas Dominions to apply scientific methods to their industrial and economic problems, and, based upon our experiences of the last five years, to draw some tentative conclusions regarding the relation of the State to this vital problem.

We are living in the age of a second renaissance, one which will leave an impression on the civilised world as indelible as that left by the great revival of literature and art in the fifteenth and sixteenth centuries. It is a renaissance in which the attention of the civilised world is concentrated upon science, its outstanding achievements and its power to enhance our intellectual pleasure and our material welfare.

At the close of the war the world was ringing with appreciation of what science had achieved in the great struggle. How best to develop this great power and use its forces in times of peace became an international, as well as a national, problem of the first magnitude. So profoundly was the world impressed by the efficiency of co-operation and organisation in the conduct of the war, that extraordinary emphasis was laid on these as guiding principles in all activities of national life.

The general recognition of the value of co-operation may be truthfully described as the best positive product of the great war. Its impression on the organisation of science has been a permanent one. It has also penetrated and influenced the political, industrial, and scientific activities of all the allied nations. It has given birth to what has been called "Internationalism," the moving spring of which is the idea of a world-wide community of the human race and a desire for its realisation. This has taken definite form in the League of Nations—an effort at world-wide political and national co-operation—a unification of the whole human race into a single organised group or community. This high ideal of the internationalist may be difficult of realisation, as it comes into almost fatal collision with the principle of nationality, of patriotism, everywhere active and powerful.

Among the international movements resulting from this appreciation, the beginning of an attempt to organise the world of science is of conspicuous interest. This has taken the form of an International Research Council established in 1919 at Brussels. The second meeting of this organisation, which embodies the concept of international co-operation in science, has been called for the end of this month in Brussels.

This International Research Council is composed of delegates nominated by the representative councils and scientific national academies of the Allies and of the neutral nations. It has definitely refused to admit the nationalities which formed the central Powers during the war. Affiliated with this Council are a number of unions representing all branches of science, among which the International Union of Pure and Applied Chemistry is one of the most active, influential, and thoroughly organised. The constitution of the Council is drafted so carefully that there is no clashing of interests or infringements on the rights of the older international societies existing before the war. The Council, with Dr. Schuster of London as its Honorary Secretary, has been launched with the active sympathy and loyalty of nearly all the national scientific associations among the allies and neutral nations. It is obviously the beginning of a human enterprise much vaster than is indicated by its present form. It has been carried to its present stage of development by the momentum imparted to scientific investigation by the activities of the war, but it is as yet little more than a nucleus around which may gather the scientific organisations of the neutral and allied countries with their various unions. It has great possibilities in future years.

The ultimate goal at which the Council seems to aim would make it a veritable parliament of science composed of delegates from all countries and of affiliated unions. It would become the express image of the science of the world. At its triennial sessions would be enacted legislation governing the formation of new unions of scientists, as well as plans for the inter-relation and development of international unions already in existence. The unions in turn, meeting at more frequent intervals, would be made up of representatives of organisations of special sciences from every country of the civilised world. They would thus serve to develop and integrate for international purposes investigations carried out in different parts of the world, as well as to stimulate research and provide for scientific discussion and publication. Behind these International Unions stand, in every nation, the National Research Councils, National Departments or Advisory Councils of Research, whose activities are devoted to the national development of science and its applications. These National Councils in turn have as subsidiary organisations the various scientific societies, such as physical, astronomical, and chemical societies, the scientific departments of the universities, of the government and research institutes. A world-wide scientific effort would become organised, of which co-operation would be the nervous system carrying afferent and efferent impulses in all directions from the centre to the periphery.

Such a world-wide organisation of pure science is a type of internationalism strictly democratic and free from the semblance of super-national authority, which is one of the sources of danger in the League of Nations. It is a type of community interest which seems especially adapted to world-wide development, and if so developed should bring us nearer to the unification of mankind than any form of internationalism hitherto suggested. In pure science, communism is a natural law; race, religion, nationality should count for nothing. The underlying principle here is the universalism of science and the catholicity of truth. The plan merits hearty recognition among the nations, it is full of possibilities.

The successful development of science in each ation taking part in this international movement es at the very foundation of the edifice designed y the International Research Council. As obrved by Sir Ronald Ross, it should be regarded as duty by every country to participate in the disoveries of the laws of nature, and thus to enhance e powers of man and widen the range of his vision. his is a national duty to humanity and should be dequately supported by national endowment. The cultivation of pure science yields results which re more lasting than the Pyramids, of world-wide ecessity and which increase in value with every eneration of workers."

While we should regard the support and development of fundamental science as a national obligaion to the civilised world, it is also of supreme nportance to the individual nation, in order that s findings may be utilised to create national ealth through the development of its natural esources and increasing the efficiency of its ndustries.

When the war was giving us such a convincing emonstration of the dependence of modern nations pon scientific achievement, the nations of the mpire were looking forward to post-war reorganiation through the scientific method of scientific rganisation.

The prompt establishment by Great Britain of an dvisory Council for industrial and scientific reearch under a committee of the Privy Council in 915, and its subsequent organisation as a separate tate Department of Scientific and Industrial Reearch, furnished a model of organisation which the ther portions of the Empire quickly utilised. It was not only an early recognition of the fact that he development of national resources in time of var is dependent upon scientific methods and reearch, but it also indicated the path to be followed n organising the industries of the nation to meet the post-war conditions.

Of the many useful activities of this Department, the most outstanding is its co-operation with the industries of the country in the foundation and maintenance of approved associations for research, for which the Government placed one million pounds at its disposal. These associations, now twenty-nine in number, have encountered criticism and possibly are not perfect in detail, but their influence has been felt throughout the English-speaking world. The general acceptance by manufacturers of this principle of industrial unions indicates that the policy of industrial secrecy, which has so greatly hampered the application of science to industry, is now almost obsolete. Manufacturers of Great Britain by their action demonstrated their belief in the statement that for most industries "the closed door shuts out more than it shuts in."

This pooling of the expenses and proceeds of scientific research may to some have an objectionable Teutonic flavour, but its effect is to transform isolated crafts into highly developed industries, eliminate needless duplication of effort, and, what is of the highest importance, it has prevented at the present critical period incalculable loss through arrested development. This courageous and original method of organising and developing research has spread to Canada and the United States and has there helped to eliminate unnecessary trade secrecy and promote co-operation in technical and scientific investigation.

The plan in its present form is not easily adapted to conditions in the overseas Dominions, where it will take time and a great controlling motive to bring into effective co-operation the large number of scattered, isolated, and sometimes conflicting industries. The absence of available laboratories and the consequent necessity of constructing laboratory buildings for each association have also had a strong deterring influence. It is, however, as generally recognised overseas as it is here, that co-operation and organisation are the most efficient means of capitalising science—of making it commercially useful.

This general conclusion was reached as each of the large units of the Empire recognised that the creation of new industries and increased production were required to restore material prosperity and to meet its enormous national debt. It is interesting to note, however, the lines along which the overseas Dominions have been working to develop scientific method and research. All followed the lead of England in 1916 by establishing something analogous to a scientific advisory body for the Government.

In Australia an Advisory Council of Science and Industry was called into existence by the Prime Minister, the Right Honourable W. H. Hughes. This was considered to be a preliminary step towards the centralisation of scientific work in that country. The work of the Advisory Council covers similar ground to that investigated by the Advisory Councils of the other Dominions. The same order of procedure is to be found in each of the Dominions; first, a census was made of the problems of special importance to the Dominion; then a census of the industrial activities of all the laboratories for scientific research, their personnel and the character of the work in progress. The result of this preliminary work was to disclose a great shortage everywhere in the supply of trained investigators necessary to carry on the researches.

To remedy this an investigation was made of the training afforded by the universities and technical institutes, with a view to increasing the future supply of scientific investigators. Students were encouraged to enter a course of research by the establishment of Fellowships. Those who had demonstrated capacity for investigation were granted assistance for researches in contemplation or partially completed. Not only were these researches encouraged in this way, but the attempt was almost invariably to bring about co-ordination of researches already in progress, as well as stimulate the initiation of new ones. This stage in the development of research work in Australia was completed by the end of 1918, and we find India, New Zealand, South Africa, and Canada had developed efficient schemes for Fellowship and assisted researches by the end of 1918.

Australia met with the same experience as did the other Dominions when attempting to utilise existing laboratories, scattered in the universities and Government departments, for the purpose of carrying out the work of the Institute. The experience of a year or two convinced the Council that it was impracticable for its research work to be carried out efficiently and economically solely in existing laboratories. They found that Government laboratories were manned and equipped for work of a routine nature, laboratories in works were small and inefficiently equipped both as to men and facilities, while the staffs in university laboratories were too fully occupied with instructional and executive duties to give the prolonged attention necessary for the successful and speedy solution of industrial and scientific problems. None of these classes of laboratories were equipped for conducting large-scale experiments of semi-commercial magnitude, hence, in Australia, the Council submitted resolutions to the effect that the immediate establishment of a permanent research institute was a matter of urgency, as the financial and executive powers of the temporary organisation were wholly inadequate for the purposes in view. This Institute was planned to work in co-operation between the Commonwealth and the six State Governments. Steps have also been taken with a view to evolve a suitable scheme for the establishment of industrial research associations among the industries themselves, similar to those in existence in the United Kingdom.

The establishment of a Bureau of Information and a technical and scientific library in connexion with the Institute is also decided upon. This met with the general approval of the Government.

The hopes of bringing about efficient organisation and co-operation of scientific work in Australia are centred around a National Institute of Science and Industry.

Scientific development in the Union of South Africa took its origin in a Board called the Industries Advisory Board, established by Act of Parliament also in the year 1916. This Board, consisting of eleven representatives chiefly of commerce and industry, had to deal with statistics of production and make recommendations regarding scientific and industrial research, factory legislation, encouragement of industries, development and utilisation of natural resources. At about the same time the various scientific societies in the Union formed a committee for industrial research with an executive head, and a committee, styled the Scientific and Technical Committee of the Board, was then appointed by the Government. This committee had to deal with all scientific or technical questions and with research work referred to it by the Government or the Industries Advisory Board. The original Board and the scientific and technical committee were later amalgamated under the title of "The Advisory Board of Industry and Science," which has strongly recommended the establishment of a central Research Institute for the whole Union of South Africa. In the meantime it has established a State Laboratory in connexion with University College, Johannesburg, for the study and development of a ceramic industry in the Transvaal. "In taking this step," its report states, "the Board desires to make it clear that the establishment of the ceramic laboratory or other laboratories of a similar character in connexion with existing scientific institutions, while affording a ready and very economic means of prosecuting industrial research, must not be regarded as in any degree prejudicing the eventual establishment of a central Research Institute."

Unlike the other Dominions, action was taken in New Zealand by the Government through the influence of a learned society, the New Zealand Institute. The Institute, like the British Science Guild in England, has for years pleaded with the New Zealand Government for some definite policy in aid of research.

In June, 1917, the Government endeavoured to find a scheme for providing a proper system of scientific investigation for the Dominion. With the assistance of the New Zealand Institute, a committee, representing the industries and the scientific men of the Government and University, submitted a carefully studied plan of organisation for co-ordinating scientific and industrial research. This scheme, involving a cost of £20,000 per annum for five years, has not yet been submitted to Parliament by the Cabinet, and it seems very unlikely that it will be revived even in a modified form.

New Zealand is essentially an agricultural country, not a wealthy one, and spends half a million pounds annually on national defence, hence the Government naturally felt that the addition of £20,000 to the annual sum required to meet their heavy war debt was not justifiable. It was also found that the University was understaffed and that the graduates were not well trained in science. Men trained for scientific research could not be found in the country. There is, however, a privately endowed institute called "The Cawthron Institute for Scientific Research," which at present practically confines itself to agriculture and fruit growing.

The Indian Industrial Commission, appointed by the Government of India in May, 1916, which sat from 1916 to 1918 under the chairmanship of Sir Thomas Holland, made a most thorough study of the industrial conditions in the whole of the Indian Empire. The results were embodied in an able report issued in 1918. The constructive proposals made by the Commission were (1) that Government must play an active part in the industrial development of the country with the aim of making India more self-contained in respect of men and material, and (2) that it is impossible for Government to undertake that part unless provided with adequate administration equipment and forearmed with reliable scientific and technical advice.

The Government had resigned itself for so many years to the tradition of "laissez faire" in industrial matters, that when in recent years it attempted to play a more active part, its efforts were rendered futile by the absence of scientific and technical advice to assist it in estimating the value of industrial propositions and by the lack of any suitable agency to carry out approved proposals. To remedy the first of these defects a reorganisation of the existing scientific services was advocated.

In February, 1921, an Imperial Department of Industries was constituted on a permanent basis, and again Sir Thomas Holland was placed in charge.

The Imperial Department of Industries has undertaken under its direct control three important projects, viz., an Imperial School of Mining and Geology; a Central Chemical Research Institute; and an Imperial Tanning Institute and Demonstration Leather Factory. Progress in the case of each of these three schemes has been hampered, owing partly to financial stringency and partly to political unrest. The organisation of the All-Indian Industrial and Chemical Services of further complicated by the recent constitutional changes in the Indian Government.

At a conference of the Indian departments held last year much opposition to an All-India

Chemical Service appeared from the local Governments, through distrust of departmentalism and doubt of the necessity of adding another specialised Indian service to the large number now in existence. No decision was reached and the question was postponed for a year, with the prospect of a compromise satisfactory to the provinces and with a certain amount of regard to efficiency of the service in India as a whole.

It is obvious that conditions in India are fundamentally different from those found in the self-governing Dominions, such as Australia and Canada. The development of scientific and industrial research by the State must be linked up with the Indian Civil Service and be largely bureaucratic. Support from the Indian people seems unlikely until the intelligentsia of the native races with their great wealth lose their prejudice against all forms of business.

In Canada our original organisation was modelled more closely on that of Great Britain than perhaps in any of the other dominions. A sub-committee of the Privy Council was constituted in June, 1916, and later an Honorary Advisory Council for Scientific and Industrial Research. This Council was omposed of eleven representatives of the scientific, technical, and industrial interests of Canada. An administrative chairman was selected from mong its members who gave his whole time to he work and received a salary of £2000 per nnum. The work of the other ten members was purely honorary.

It is noteworthy that at this critical period of our history every Government in the Empire had at its command the disinterested and gratuitous services of men whose training and experience qualified them to act as advisors along scientific, echnical and industrial lines.

The Council made a careful survey of the researches carried on in Canada; it successfully directed attention to the value of scientific method and research, obtaining the support of public opinion throughout the whole dominion; by means of a system of fellowships, it encouraged university graduates of special ability to enter the field of research. This year the Council are thus helping over fifty of our most brilliant graduates to obtain training in research methods in the graduate schools of Canadian and English universities. The majority of these graduates are chemists or chemical engineers.

The possibility of utilising existing laboratories in the Government departments and universities received careful consideration, but it was found to be enormously expensive, without the prospect of compensating efficiency, and it was decided to assist the Government departments by advice and by recommendations for special research grants. Substantial financial assistance was given to researches both academic and industrial, on the whole with very satisfactory results.

It was recognised that a permanent and really efficient linking up of science with its application could only be effected by some central organisation which would bring about an intimate co-operation between those who could set the industrial problems and those whose training and knowledge would aid in their solution. A similar conclusion was independently reached by all the self-governing dominions. It was decided in 1917 upon the policy of establishing a Central Research Institute for both scientific and industrial research. As the result of a nation-wide propaganda, the scheme was submitted to the Government, supported by all the Boards of Trade, Canadian Clubs and scientific organisations from the Atlantic to the Pacific. The approval voiced by the Canadian press was equally unanimous. As this plan embodies the experience of many countries and seems to be designed along the lines of the natural evolution of the problem, I shall refer to some details of its organisation and possible advantages.

As finally developed and outlined in a Bill presented before last year's Parliament, a National Canadian Research Institute was practically unanimously approved of by the Cabinet and passed the House of Commons without division, but, owing to an unexpected attack of economy on the part of the Senate, the Bill was not confirmed but was postponed until next session. Notwithstanding the vote of the Senate, the Government gave a special grant of £20,000.

The building which will house the Institute will be erected near Ottawa, the capital city of Canada, on a site large enough to give ample room for expansion, at an estimated cost of over £100,000. This first unit, with a power plant attached, is so designed as to permit of a flexible organisation to enable its activities to be adapted to the varying requirements of a rapidly growing country like Canada. It will be the Bureau of Standards for Canada, and in this respect its work will be similar to that of the Bureau of Standards at Washington or that of the National Physical Laboratory. The unification of standards will be carried on in association with the Canadian branch of the International Committee on Engineering Standards, now doing excellent work in Canada. Closely associated with its function as a Bureau of Standards, it will carry on fundamental research in chemistry, physics, and related fields, investigations in abstract science similar to those carried on in the scientific laboratories of the universities and by the same type of workers.

The activities of the Institute will include investigations in biochemistry and bacteriology, both fundamental and as applied to such industries as the fisheries, the canning, cellulose, and packing industries, as well as investigations undertaken on recommendation of the Research Council from time to time, to promote the utilisation of the natural resources and valuable waste materials of the country.

The permanent staff will consist of a director and eight or ten highly qualified heads of departments, who will carry on independent research and form an advisory body for industrial specialists who may be engaged by the Research Council to promote the utilisation of the natural resources and neglected waste products of the country, or for those who may be employed by industries to improve their technical processes or manufactured products. The heads of departments will be chemists, physicists, engineers, and other scientists who have already shown high capacity for investigation. They will be allowed trained assistants and all facilities and freedom to carry on abstract research, each along his own line. The importance of the individual in research is recognised. The director, in consultation with the Research Council or a committee of the Council, will have the power of deciding on the technical processes and methods which require and would justify investigation, and the conditions under which they should be undertaken.

We are establishing in Canada a number of associations for research in the industries, similar to those in England. These trade guilds for research, as we call them, will pay their own specialists, will be housed in the Institute, which will provide the laboratory accommodation and facilities available in its building without rental, a charge being made only for power and materials at cost price. Several of these guilds for research are now being organised. Under conditions to be determined in each case, laboratories will be placed at the disposal of individual industrial firms for study of improvements in processes and products. Regulations regarding the length of time the laboratories may be occupied, the right to secrecy regarding the work, etc., etc., will be similar to those enforced in the Mellon Institute of Pittsburg, which has so effectively demonstrated to manufacturers in the United States the value of industrial research.

The Canadian Research Institute will parallel the Mellon Institute, but with this difference, that instead of the institute being maintained by private endowment it will be endowed by the Government of the country. It is also a form of State endowment similar to the industrial association for research, but more centralised, permanent, and better adapted to the requirements of the Dominion of Canada.

The Institute will not be under a department of the Government, and will, therefore, be free from political influence and party patronage. The director and the group of scientific and technical officers are appointed by the Research Council, who will prescribe their remuneration and tenure of office, subject to the approval of the Governor in Council. The director will be given a very free hand in organising and directing the Institute, and will receive a salary commensurate with his responsibilities. The responsibility for the success or failure of this whole venture is, therefore, placed upon the shoulders of the Research Council and the director in charge.

The organisation of the institute is based upon the following general principles: First, a recognition of the claims of abstract science for permanent State endowment apart from universities; secondly, the development equally in the institute of fundamental and industrial research, thus bringing into constant and profitable contact men interested and skilled in academic or abstract science with those engaged in its application to industry; thirdly, the encouragement of special workers employed by the industries to solve their specific problems in association with a permanent staff of highly-trained investigators. The last feature involves the endowment by the State of an organisation similar to the Mellon Institute. It is applicable particularly to conditions as they exist in Canada.

What are the advantages of such a plan for developing research? The idea of Government endowment of abstract scientific research is not a new one in England. Sir David Brewster, seventy years ago, in a presidential address to the British Association, advocated the establishment of a State Bureau of Research. The Science Commission of 1870 reported that one of the most efficient methods by which the Government could further research in this country was by the establishment of public laboratories for the pursuit of investigations in connexion with the varying and ever-multiplying departments of physics, chemistry, biology, and other branches of science. The view then taken, and not altogether unknown even at the present time, was that "the more science was left to itself the better for it." Mr. Gladstone, indeed, termed the intervention of the State as "interference" with science, calculated to discourage individual exertion, and so obstruct discovery and progress.

There is now a growing conviction throughout the Empire that the rapid advancement of abstract scientific knowledge, and the efficient applications of science, will not be the outcome of any State policy which leaves industrial research to be developed only in works and fundamental research only in the universities.

The Department of Scientific and Industrial Research has obtained from the State a liberal support of its plan to develop industrial research among the great groups of industries. The value of this experiment in State aid to research has been established, but will this plan provide for the future? Will the associations, after the Government bonuses are withdrawn, continue research on those problems which have no direct and immediate application to the industries but which are of superlative value to the nation?

Let us consider a little more closely the value of research in works and in universities to national progress. Scientific progress in industries is no less an expression of the spirit of research which has permeated the Empire than the scientific activities of the Government and the universities. The advances and improvements made in any commercial organisation add to the volume of knowledge and so, indirectly, to the wealth of the nation. Further, it is generally recognised on both sides of the Atlantic that the permanent success of an industry, especially a chemical industry, depends upon its ability to command a sufficient supply of knowledge especially directed towards the improvement of its methods and products.

Laboratories for routine testing in some form or other are equipped in all industries, exercising analytical control over output and processes, but the class of works research laboratories, which have done so much to introduce scientific methods, are those designed to lessen cost of production by improved processes and products. The success which followed their installation was highly appreciated because of the immediate returns through improved scientific control of operations. They have come to be recognised as permanent departments in the industries but subject to control on purely business lines. A few quotations from a recent article by F. A. Wardenburgh, Assistant Chief Engineer of the Du Pont Company of America, frankly puts research in its place among the activities of an industry. "Industrial research must justify itself in economies." "Research chemists cannot be employed if results do not show a profit." "The prime object of business is the making of money and, if research work is to maintain its proper place in business, it must be conducted so that it will more than pay its way." His plan of directing research lays continual stress on the commercial outcome. At every angle the question is asked: "Is the cost of this particular step justified by the results to be obtained from it?" The author admits there are many problems which should be studied but which are not receiving the attention they deserve because they do not offer sufficient probability of making a satisfactory monetary return to justify the company proceeding with the work. Further, that there is a great deal of research work of high importance to the industry, but it is not done because it is seldom that any one company can justify conducting a scientific research with the hope that the result can be profitably applied in some indefinite way. This is a clear business statement of a firm spending over £40,000 per annum in their various works laboratories. It cannot be expected that any firm will jeopardise its financial standing for the attainment of an academic ideal.

To obtain permanent and outstanding results it is now generally conceded that investigations must be directed chiefly to the theories underlying the operations of the industry; for example, it was the study of chemistry in high vacua which indirectly led to the production of the tungsten nitrogen lamp by the General Electric Company at Schenectady.

As Dr. Mees has pointed out, the value of a research laboratory, working on pure theory and on the fundamental sciences associated with the industry, is esentially cumulative. The results, at first nebulous and suggestive, later became definite and more and more available. The time factor in this type of research is a most serious obstacle in the way of its general introduction by commercial organisations. He states, as the result of his experience in the organisation of industrial research: "Most men acquainted with fundamental industrial research work consider that five years is the earliest date at which any considerable results can be expected from a newly-established research laboratory and that the development of really new material in considerable quantities, so that it will have an effect upon the industry as a whole, cannot be looked for in less than ten years' consecutive work."

This type of industrial research could not be seriously considered by individuals or firms from a business point of view. The industrialist as a rule works for the profits of to-day and not for the preservation of national wealth of the future.

The relation of the scientific departments of the universities to the industries of the country is a very complex and much discussed problem. It is as varied in its aspects as are the types of universities and the varieties of industries.

The value of the association of the university men engaged in abstract science with those interested in its application was so obvious during the war that, to develop and make permanent this relation in times of peace became the first problem before the national scientific organisations of the Empire. The attempts to obtain satisfactory co-operation between industries and universities since the war have proven a very qualified success; many schemes have been suggested and tried on the American continent as well as in the Empire, and, except in isolated cases, the universities have not proven of any great or permanent assistance to the manufacturer. Successful collaboration occurs when the problem is one quickly solved and which can be handed over to the factory in a completed form ready for commercial development. Such conditions are rare. Most industrial problems require continuity of study by the same investigators and along the same line of research extending over a long period. Such conditions in university laboratories are undesirable, rarely possible, and call for special apparatus, often of a kind unsuitable to a university building. It is further recognised in factory practice that the inventor of a process or substance should himself carry it through the semi-commercial stage and be able, by his experience, to meet the new conditions and difficulties of large-scale operations.

The larger new universities and institutes of technology recognise the importance of the technical section in their departments of science to the manufacturer. The staff of the technical colleges are usually men of research ability, who at all times are available in a consulting capacity and are able to attack problems of manufacturers which could with advantage be studied on a laboratory scale, thus keeping in constant and intimate touch with the industrial interests of the country.

Many of the universities of England, Canada, and the United States are situated in industrial centres, in very intimate relations with the industries of the place, and naturally identify themselves with the needs of these industries. They find on the spot the subjects for research and also frequently an opportunity of trying out their ideas in factory practice. Co-operation between the factory and the university in this way is highly desirable and decidedly to the advantage of the university. The universities should feel that, in a sense, they hold their costly laboratories and technical equipment in trust for the community. Every successful research in industrial economic problems is an advance in knowledge and should be regarded as a part of the realisation of the ideals of a university, viz., to add to the sum total of human knowledge. Yet this is not the essential function of the university.

It has been stated that utilitarian motives, arising from war experience and accentuated by the requirements of the present period of reconstruction, largely dominate the scientific life of the world to-day. Investigations along fundamental lines suffered during the war, especially in the universities, from the transference of attention to more urgent needs and the absence of a junior staff with capacity for research. Many university men with high ideals fear what is described as a growing tendency to exaggerate the utilitarian motive in university investigation; as Dr. Schuster expresses it: "Beating the utilitarian drum too loudly."

Research in the abstract sciences and the study of their applications are, however, not incompatible, and they can often be carried out in the same university with advantage to both. There is, however, especially on the American continent, a danger of the essential university function being less developed than the subsidiary function.

The universities should be chiefly the training ground for research men, where those set apart as research instructors should not be overburdened by administrative work, and where ample time, remuneration, facilities, and assistants are available for graduate schools of research and training in the more abstract fields of science.

The undergraduate, let us say in chemistry, is so fully occupied during his regular course in acquiring a knowledge of the essentials of his science that he cannot acquire originality in meeting new conditions or that independence of thought and intellectual dexterity which comes from the experience of being thrown on his own resources. University researches are specially designed for training these advanced students and junior members of the staff in those principles and habits of work which underlie all research, and these are not usually of a type the results of which can be directly carried into the industries.

The high privilege of the universities is the preservation of real knowledge, not only to see that such knowledge, once acquired, should not be lost, but also to extend its boundaries.

Research and the development of initiative in scientific investigation among its graduate students distinguish the university from the mere college. Capacity for research is the valuable product the countries of the Empire expect from the scientific departments of its universities. It is therefore essential that any State system designed to develop the industrial research of the country should especially consider the needs of the universities in order to ensure a supply of men capable of taking positions of higher command in industrial research.

Investigations in the so-called "pure" sciences have hitherto been largely confined to the universities. They claim, however, no proprietary rights to the domain of fundamental research; indeed, they can offer little inducement to a research career.

Scientific work in universities is often hampered by tradition, lack of financial support and proper equipment. A more stimulating and congenial environment for research would be the natural atmosphere of a large State-endowed research institute. The stimulus afforded each other by a group of scientific investigators in daily contact with each other should make for increased efficiency and establish an *esprit de corps* which would be inspiring to themselves and bring about a wholesome rivalry with the laboratories of the universities. The positions of higher command in an institute would be prizes worthy of the best efforts of those with capacity for research. It would thus offer an attractive career for the research worker and be a powerful stimulus to the graduate schools of science throughout the country. It would further aid British science by encouraging research along the border lines between the sciences, where progress in recent years has been so remarkable, and would be particularly well organised to attain the highest results, which come from co-operative work calling for the resources of different sciences to solve some great problem of national importance.

The associated development in the same organisation of abstract and applied science in closest contact with each other is the most recent stage in the evolution of the problem. We find a movement on all sides towards this end. A few of the more advanced type of industrial laboratories in England and America retain men gifted with vision and scientific imagination, who are advancing our knowledge, for instance, of such an academic problem as the ultimate constitution of matter. We find papers on the constitution of the atom and on molecular structure coming from the laboratories of the General Electric Company, and papers on higher mathematics and mathematical physics from the Eastman Kodak Company.

The laboratories of the Bureau of Standards at Washington and the National Physical Laboratory have for many years given numerous contributions to our knowledge of physics and physical chemistry of the highest value.

The Bureau of Standards at Washington is not only conducting, on an increasing scale, fundamental researches in almost every field of physics, engineering physics, and chemistry, but is now carrying on purely industrial research on a very large scale. They have taken over extensive buildings erected during the war and have converted them into industrial laboratories. In these buildings are installed plants and machinery on a commercial or semi-commercial scale to study improvements in methods of production and quality of the output. Only industrial problems of national importance are studied, chiefly to obtain value from waste raw materials and neglected by-products. These are studied in close association with their very exact work on standards of measurement, quality and performance.

The National Physical Laboratory has recently largely extended its field of usefulness to the country. In addition to the accurate maintenance and reproduction of all the primary standards of measurement for the Empire and exact researches in physics, it has now been called upon to enter the field of industrial work. It not only co-operates in researches with many of the industrial research associations, but it is responding to an ever-increasing demand for investigations on the part of manufacturers and private firms, for which the laboratory receives payment of the full cost. An extension of its present activities in the industrial applications of science would in the near future enable it to take over with advantage many of the greater and more basic problems which cannot be completely solved by the research associations during the period of five years allotted to them.

To ensure permanence and inspire confidence among men of science a national Research Institute should be administered by a single responsible body, incorporated if possible so as to encourage private benefaction and with an assured endowment.

The difficulties in equipping and manning any single institute capable of carrying on more than a fraction of the researches required for the manifold industries of such industrial nations as the United States or Great Britain are almost insuperable. These difficulties are largely eliminated if the work of the institute be confined to questions which are of basic importance to the nation, and not directed to problems individual or incidental in their character.

Is it beyond the practical to hope that much of the future scientific and industrial research in Great Britain may be carried out in a State institute where both abstract and fundamental industrial research could be blended?

The industries will conduct research in works because they have found it to be a good business investment, but only along those lines of investigation that obviously and immediately yield a return for their investment. They are not unreasonable in looking to the State to conduct investigations in abstract science and on problems remote from their own particular operations, but basic to the production of national wealth.

A plan of co-operation of the various branches of abstract science with industrial research in a Government Institute and a recognition of the purely commercial side of research may appear to many to be a compromise with scientific ideals. It must be remembered, however, that an institute of a national character, if it is to be permanent, must have popular support, and to obtain and hold such support a certain amount of its work must be understood and appreciated by the majority of the public. Public opinion should be strongly felt by Parliament to ensure favourable legislation and permanent financial support.

The extent and character of the compromise is a difficult question, but with the more general appreciation of science among the unintelligent, as well as the intelligent, public, the development of fundamental and abstract science will in time receive an increased measure of popular support.

"The more enlightened the people, the more general and permanent will be their support of science."

While centres of research in works and in universities must always have a place, and play an important part in fostering scientific advancement and in adding to the wealth of the nation, research in abstract science and its material applications seem now to call for a larger measure of direct State support throughout the Empire.

As scientific research, like education, is subject to social control, it should become one of the accepted responsibilities of the State in a progressive democratic country. The financial support of the abstract sciences as well as of their material application should be as certain, permanent, and free from party politics as is the grant to national education, for, as Sir Ronald Ross expresses it, "Science has become our premier national industry, and governs every other industry, as the work of the architect governs that of the bricklayer."

Dr. E. F. **Armstrong**, President-elect, proposing a vote of thanks to the President for his address, said that Dr. Ruttan had given them much food for serious thought, and he asked him, on behalf of the Society, to allow the address to be printed in the Transactions. They had all often heard of the neglect of science, but this was almost the first time they had heard something about the other side of the picture, of the steps that were being taken throughout the Empire and in the Mother Country to promote science. It would be some years before these steps materialised, but they must be all to the good. Dr. Ruttan had given a picture of what was being done throughout the Empire in this very necessary direction. He could not help feeling that there was going to be a good deal of bureaucratic control about research in the future. If bureaucratic control was the best way to do research all would be well, but he wondered! It was, however, with very great pleasure that he proposed a hearty vote of thanks to Dr. Ruttan for his address.

The vote of thanks was carried with acclamation.

On the motion of Mr. R. H. **Clayton**, seconded by Mr. **McArthur**, Messrs. Price, Waterhouse, and Co. were re-elected auditors.

The **President** expressed the high appreciation and sincere thanks of the Society to the Council of the Institute of Engineers and Shipbuilders for the hospitality afforded in allowing the use of their building in connexion with the meetings. The vote of thanks was carried with acclamation.

Subsequently the **President** announced that as the result of the ballot Prof. W. R. Hodgkinson, Dr. Alfred Holt, Mr. W. A. Williams, and Mr. J. H. Young had been elected Ordinary Members of Council.

Nottingham Section.

Meeting held at University College on May 17, 1922.

MR. J. H. DUNFORD IN THE CHAIR.

THE CHLORINATION OF WOOL.

BY S. R. TROTMAN.

The chlorination of wool for the purpose of making it unshrinkable has been carried out entirely as an empirical process, with little attempt at scientific control or critical examination of the product. It is hardly surprising, therefore, that the results are irregular and complaints not infrequent. These complaints are commonly that (1) the material is not unshrinkable, (2) though unshrinkable it wears badly, and (3) much weight is lost during the process. These faults do not as a rule occur together, though (2) and (3) often do. In trying to avoid the first fault the manufacturer often commits the remaining two. He is, in fact, on the horns of a dilemma. If he does not carry the process far enough the goods are not really unshrinkable, while if he does make them unshrinkable they are liable to lose too much weight and wear badly.

The experiments described in this paper were instituted with the view of trying to solve these difficulties. Though not yet complete, sufficient progress has been made to indicate the lines upon which the problem must be solved, and, incidentally, to emphasize the importance of and urgent necessity for carefully planned and patient research. The subject will be dealt with under three heads: (1) The properties of chlorinated wool. (2) Analytical standards for a satisfactory product. (3) The manufacturing process and its control.

The properties of chlorinated wool.

There is a very important difference between the microscopic appearance of ordinary and chlorinated wool. In the former the free edges of the epithelial scales can always be seen distinctly. In chlorinated wool these are no longer visible; the scales appear to adhere to the cortex throughout. This is seen in Figs. 1 and 2. In a well chlorinated sample the outline of the epithelial scales is still perfectly plain. Their surface is smooth and opaque as in natural wool. Incipient damage is indicated by the outline of the scales becoming difficult to observe and their surface rough. Sometimes they become so thin that the underlying cortex can be seen (Fig. 3). Actual damage is denoted by the complete disappearance of the epithelial scales exposing the cortex of the fibre. This gives the fibre a rough surface marked with longitudinal streaks as seen in Fig. 4. This damage may be either local or general. In can be estimated quantitatively by counting the percentage of damaged fibres present. Samples of commercial unshrinkable fabrics contain from 5 to over 50% of damaged fibres. Complaints of bad wearing properties are invariably found to be associated with the presence of large numbers of such fibres.

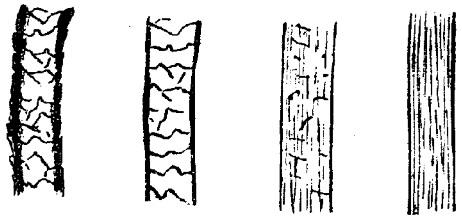

1. 2. 3. 4.

FIG. 1.—Untreated wool fibre.
FIG. 2.—First stage of chlorination.
FIG. 3.—Second stage showing incipient damage.
FIG. 4.—Third stage showing complete destruction of epithelial scales.

The properties of chlorinated wool are generally stated to be: (1) Decreased tensile strength and elasticity. (2) Increased affinity for dyes. (3) More readily wetted down than ordinary wool. (4) Has a scroop, particularly when wet. (5) Has different electrical properties to ordinary wool. Some of these properties I have proved to be those of over-chlorinated or damaged wool. Other important properties must be added, viz., altered solubility in water, alkalis, acids, etc., and an increased affinity for water.

Tensile strength and elasticity.—I find from many experiments that there is no loss of either tensile strength or elasticity during careful chlorination. Even when a considerable percentage of damaged fibres is present the loss is not immediately apparent, though it may be developed gradually owing to causes to be explained later. It is not until over 50% of the fibres are badly damaged that any marked diminution of either tensile strength or elasticity can be observed. Thus, for example, the breaking strength of an undamaged yarn was 2·6 lb. The same yarn when hardly any epithelial scales were left had a breaking strength of 2·4 lb. Very similar results were obtained in tests for elasticity. In a typical set of experiments the following results were obtained, on six-inch lengths:—

Elasticity of original untreated yarn	1·50
„ „ undamaged chlorinated yarn ..	1·60
„ „ slightly damaged chlorinated yarn ..	1·52
„ „ damaged chlorinated yarn	1·375
„ „ badly damaged chlorinated yarn ..	1·296

Another set of experiments with the same yarn but using a different method of chlorination gave:—

Elasticity of undamaged chlorinated yarn ..	1·620
„ „ damaged „ „ ..	1·475

Apparently, therefore, chlorination, in the absence of damage, actually increases the elasticity slightly, and considerable destruction of the epithelium is required sensibly to reduce it. The results are not surprising. The strength of the wool fibre is a function of the cortex. The epithelial scales have little to do with it. Possibly when large numbers of them are destroyed their cumulative effect becomes apparent, but it is more probable that it is damage to the cortical cells which is being measured. It is obvious that tensile strength cannot be used as a test to check the process, or even as an indication of serious damage. The weakness which is sometimes developed in wear is, in part, due to the gradual wearing away by friction and other causes of the exposed cortex of the damaged fibres.

Increased affinity for dyes.—This is generally described as though it were a valuable property of chlorinated wool. My experiments show that this is quite wrong. If the process of chlorination is carried out properly the increased affinity for dyes is extremely slight, in fact negligible. It only becomes marked as the epithelial scales begin to be attacked and destroyed. In fact, one may say that if an unshrinkable fabric has a marked affinity for dyes it is a bad sign and indicates extensive damage and bad wearing properties. In one experiment four samples of yarn containing 0, 5, 20, and 50% of damaged fibres respectively were dyed in the same bath. It was found that the depth of colour was roughly proportional to the percentage of damage and that the affinity for dyes of the sample free from damaged fibres was but little greater than that of natural wool. In a comparative test on a good commercial fabric containing 4% of damaged fibres and a sample of the same make but containing a much larger percentage, the same difference was again noticeable. Good and bad samples can be sorted by simply dyeing them under exactly the same conditions. Further experiments are in progress upon these points.

Wetting power.—The wetting power of chlorinated wool is actually not much greater than that of ordinary scoured wool. It is, like the increased affinity for dyes, only marked when the fibre is damaged. In fact, the wetting power varies directly with the percentage of damaged fibres. In one experiment, fibres of (*a*) untreated wool, (*b*) undamaged chlorinated wool, (*c*) chlorinated wool containing respectively 5, 20, and 50% of damaged fibres, were suspended with their lower ends dipping in a weak solution of an acid dye. The height to which the solution rose in the fibres was in the order of the percentage of damaged fibres, and there was very little difference between the action of the natural and undamaged chlorinated wool. If a piece of badly damaged fabric is worked in water it wets immediately and becomes soft and almost slimy. This, however, is not noticed in an undamaged sample. This rapid softening doubtless has some bearing upon the breaking down of damaged goods in wearing and washing. When dried again the fibre appears to regain its strength. This peculiarity on wetting is very similar in the case of certain varieties of artificial silk. It is still more noticeable if dilute sodium carbonate or sodium hydroxide is used. Loss of tensile strength is very marked, while with undamaged fibres no such loss is observed. This is illustrated by the following example:—

	Good sample.		Bad sample.
Strength of dry yarn	2·59	..	2·52
Strength after soaking in *N*/10 sodium carbonate	2·58	..	1·80

Closely connected with wetting power is the property of attracting and retaining atmospheric moisture. The standard "regain" depends upon this factor. The regain for wool is 18¼%. For properly chlorinated wool it is the same. For damaged chlorinated wool it is higher and increases with the extent of the damage. A regain of 19% is quite common, and in one case it has reached 21·5%. Untreated wool regained 16·07% under the same conditions. A large number of samples of wool and chlorinated wool have been exposed to the same atmospheric conditions till equilibrium was established and the moisture present then estimated. It was found that in every case (1) the moisture content of untreated and chlorinated wool (when undamaged) was practically the same, and (2) as the fibre became damaged the water content increased gradually.

An interesting experiment was carried out in which a commercial garment—one of the best I have examined, containing only 4% of damaged fibre—was cut in two and one portion treated with chlorine water (3 g. per litre) and washed as usual. The dry weight of each portion was then found in an ordinary conditioning oven. The two dry pieces were exposed, side by side, under exactly similar conditions, to the action of the air and re-weighed at intervals of 24 hours and the regain calculated. The results are given in the following table:—

		Good sample. Regain.		Bad sample. Regain.
After 1 day	.. .. ..	9·76	..	12·40
,, 2 days	.. .. ..	16·84	..	19·59
,, 3 days	.. .. ..	16·16	..	18·04
,, 4 days	.. .. ..	16·49	..	19·07
,, 5 days	.. .. ..	16·49	..	19·07
,, 6 days	.. .. ..	16·80	..	19·07

The atmosphere became dryer on the third day. This is reflected in the regains. Under all conditions the regain of the bad sample is nearly 3% higher than that of the other. This point has, of course, some bearing upon the weight of commercial unshrinkable garments. Another set of experiments was made with commercial garments from different sources. They were again dried and exposed to air, under identical conditions, and weighed every 24 hours. Samples 1 and 4 were badly damaged during chlorination. Nos. 2 and 3 were of fair quality. The results of the tests are given in the following table:—

	No. 1		No. 4		No. 2		No. 3
Regain 1st day	11·11	..	13·04	..	9·54	..	9·00
,, 2nd day	10·92	..	13·52	..	9·81	..	9·89
,, 3rd day	13·81	..	14·10	..	10·88	..	11·01
,, 4th day	13·56	..	14·49	..	11·45	..	11·31
,, 5th day	14·31	..	15·00	..	11·98	..	11·59
,, 6th day	14·88	..	15·46	..	12·26	..	11·98
,, 7th day	15·82	..	15·94	..	12·81	..	13·28

The difference between the good and damaged samples is again very marked. It seems to be quite clear that the capacity for absorbing moisture from the atmosphere is a function of the damage.

These four samples were next wetted out with water, wrung, and hung out to dry in a warm room, the rate of drying being determined by weighing the garments at intervals. The following results were obtained:—

	Percentage of water in sample.						
	1.		2.		3.		4.
After 24 hours	37·14	..	14·44	..	14·10	..	16·91
,, 36 hours	23·27	..	11·72	..	12·08	..	15·07
,, 48 hours	16·90	..	11·72	..	12·08	..	15·07

It will be noted that the bad samples retain more water than the good ones, and that the amount retained is in accordance with the regains in the former experiments.

Solubility of chlorinated wool.—Natural wool and chlorinated wool, both undamaged and damaged, have been treated side by side with (*a*) water, (*b*) *N*/10 sodium hydroxide, (*c*) *N*/10 sodium carbonate, (*d*) dilute acetic acid and salt solution (*i.e.*, artificial perspiration). The dissolved wool substance was estimated colorimetrically by the biuret reaction, and also directly by weighing the sample before and after treatment. The results of these experiments prove that (1) well prepared chlorinated wool, containing no damaged fibres, is not more soluble than ordinary wool; (2) damaged chlorinated wool is, on the other hand, distinctly soluble, and the solubility increases in direct proportion to the percentage of damaged fibres present. This is, no doubt, explained by the fact that the cortical scales are less resistant than the epithelial scales, the latter when present protecting the former from the action of the solvent. The following figures illustrate the percentages soluble in *N*/10 alkali of good and bad commercial samples:—No. 1, 5% damaged, 3·51%; No. 2, 5% damaged, 4·08%; No. 3, 25% damaged, 9·00%; No. 4, 50% damaged, 14·50%. Good and bad samples behave quite differently when placed in *N*/10 alkali. The former tend to swell and the fibre retains its firmness. Damaged samples, on the contrary, wet down almost instantaneously by assuming a "fallen" appearance and aquiring a soft, slimy feel, and breaking unless carefully handled. The colour of both fibre and solution becomes yellowish.

This solubility and "falling" of damaged goods is, in my opinion, one of the chief causes of bad wearing. Every time the goods are washed they are soaked in dilute solutions of alkali. Gradually more and more of the wool substance is dissolved until, ultimately, the fibre breaks down. The solubility in artificial perspiration is of considerable importance as a factor affecting wearing properties. It is much less marked than the solubility in alkaline solutions, but still quite distinct. It is always greater in the case of damaged goods. Untreated and well-treated wool only lose traces of nitrogen even when soaked in dilute acetic acid and salt solution for long periods. Damaged chlorinated wool, on the contrary, gives a biuret reaction in a comparatively short time. This is illustrated by the figures obtained from two garments from yarn from the same source and of the same grade.

	Average sample.		Damaged sample.
Percentage soluble in *N*/10 alkali in 3 hours	6·29	..	16·52
Percentage soluble in dilute acetic acid and salt in 12 hours ..	0·90	..	4·05

The acetic acid extract gave a very strong biuret reaction in the case of the damaged sample, but practically none in the other.

Action of ozonised air on chlorinated wool. It seemed of interest to test the comparative action of ozonised air, under similar conditions, on wool and chlorinated wool. The tensile strength and elasticity of a natural wool and the same wool after different degrees of chlorination were carefully tested. The samples were then exposed to the action of ozonised air for 7 days, after which the elasticity and tensile strength were re-tested. The results of these tests indicate that (1) the elasticity and tensile strength of natural wool are unaffected by exposure to ozonised air; (2) the elasticity of chlorinated wool is also unaffected; (3) the tensile strength of chlorinated wool is distinctly less after exposure to ozonised air. The following table illustrates these points:—

	Tensile strength before exposure.		Tensile strength after exposure.
Natural wool	3·29	..	3·60
" "	3·40	..	3·50
" "	3·45	..	3·42
Chlorinated wool	3·70	..	3·35
" "	3·47	..	3·27
" "	3·93	..	3·50
" "	3·37	..	3·23
" "	3·53	..	3·45

The loss of tensile strength would probably increase with the time of exposure to the ozonised air. Time has not permitted me to complete the tests nor to find out whether the result varies with the degree of chlorination. There appears to be evidence that chlorinated wool does not withstand exposure to air so well as ordinary wool. This fact may have something to do with inferior wearing properties.

I have noticed also that when epithelial scales are damaged during chlorination the damage is increased during the process of boarding. Further experiments are, however, being carried out upon this point.

Treatment with formaldehyde in 2% solution before chlorination causes a considerable decrease in the solubility of even damaged goods, as well as, as will be noted later, a diminution in the loss of weight.

The analysis of chlorinated wool.

Natural, scoured wool contains only traces of chlorine. Chlorinated wool, if properly "dechlorinated" and washed, is also practically free from chlorine. If either of these processes is faulty the quantity of soluble or combined chlorine increases. Soluble chlorine indicates incomplete washing, while combined chlorine denotes over-chlorination or faulty dechlorinating. Soluble chlorine is estimated by a method similar to that used for rag flocks. Combined chlorine is determined in the residue, after removing soluble chlorine, by careful incineration with sodium carbonate and precipitating the chlorides with silver nitrate.

The following are examples of good and bad samples:—

	Good.		Bad.
Soluble chlorine	trace	..	0·033%
Combined chlorine	0·007%	..	0·079%

Solubility in *N*/10 sodium hydroxide, sodium carbonate, etc., artificial perspiration, and water are also tested, the dissolved wool substance being estimated by the biuret reaction.

Chemical analysis should always be accompanied by a careful microscopical examination. I count and examine 100 fibres taken from different portions of the sample. Good samples should fulfil the following conditions:—(1) Only traces of chlorides should be present. (2) Should not contain more than 5% of damaged fibres. (3) Should not have a marked affinity for dyes. (4) After soaking in cold decinormal alkalis the solvent should only give faint reaction for wool substance with the biuret test.

Alternatively, the loss of weight may be determined directly. The following illustrates the method. About 2 g. of the material is dried and weighed in a weighing bottle. It is then soaked for 3 hours in *N*/10 sodium hydroxide solution. At the end of this time it is washed with hot distilled water several times, then with very dilute acetic acid, followed by more water. It is then dried and weighed again in the weighing bottle.

The manufacturing process.

Damage of chlorinated wool may be produced in the following ways:—(1) During chlorination; (2) during finishing; (3) after finishing owing to incomplete removal of chlorine and the breaking down of damaged fibres.

In studying the "unshrinkable" process one is struck, at once, by the incompleteness of published information and often, as will be shown later, by its inaccuracy. The following examples, taken from standard text books, are typical of the unscientific nature of the process itself and of the incompleteness of published information. Yet they are quite typical of the methods of actual manufacture.

(1) "Treat the wool in a bath of 1¼ lb. hydrochloric acid in 10 gallons of water. Squeeze and wash in a bath of bleaching powder, made as follows. For 100 lb. of wool use 15 to 20 lb. of bleaching powder to 330 gallons for hard fibre wool and 20 to 25 lb. to 475 gallons for soft fibre wool. The bleaching powder solution should be 0·6° Tw. to 1° Tw. After half-an-hour add 3 oz. of hydrochloric acid to each 10 gallons and work 10 minutes longer. Wash and treat with bisulphite."

(2) "Prepare a solution of 160 lb. of bleaching powder at 14° Tw. Add 100 lb. of soda ash. Let the precipitate settle and decant. For each pound of fabric use from ¼ to 1 pint of acid."

(3) "Steep for 20 minutes in hydrochloric acid of 1·5° Tw., then for 10 minutes in bleaching powder solution of 3° Tw. Then pass into hydrochloric acid of 1·5° Tw. for 20 minutes."

The most striking point about these published processes, next to their general vagueness, is that in no case is the strength of the bleaching powder solution stated in terms of available chlorine. With regard to this, it should be noted that for such low strengths as 0·5°—1·5° Tw. the error of experiment is greater than the total amount of chlorine present. In process No. 1 the effect of adding hydrochloric acid at the end of half an hour would probably be to cause considerable damage to the goods.

We have but little definite knowledge of the chemistry of the process. Experiments are in progress, the results of which will be published later. When chlorine water acts upon wool the following changes may be observed. (1) Protein nitrogen is gradually dissolved. (2) Sulphur is dissolved as sulphuric acid. (3) The proportions of sulphur and nitrogen in the residual wool are changed. All these changes are directly proportional to the concentration of the chlorine water and the time of action. The dissolved nitrogen gives the biuret reaction. This, together with the fact that sulphuric acid is present, appears to indicate that the keratin molecule is broken down into simpler compounds, probably soluble chloramines, with the liberation of some loosely-combined sulphur atoms. Over-treatment of wool is accompanied by a rapid loss of sulphur. Thus a natural untreated yarn contained 3·74% of sulphur. Treatment with chlorine water (5 g. per litre) reduced this to 3·29%. At the same time the nitrogen content fell from 16·01% to 15·57%. Very similar results were given by fair and damaged commercial garments.

	Fair sample.	Bad sample.
Nitrogen %	15·21	14·90
Sulphur %	2·72	2·51

Bleaching powder solution is a complex mixture containing lime, calcium hypochlorite, calcium chloride, and hypochlorous acid. It owes its action to hypochlorous acid or chlorine separately or conjointly according to the conditions of the reaction. These conditions have been investigated by Taylor, Higgins, and others, and may be usefully recapitulated, as they are of much importance in the treatment of wool.

(1) When bleaching powder is treated with just enough of a strong acid (hydrochloric or sulphuric acid) to neutralise the free lime, hypochlorous acid is liberated by hydrolysis till the accumulation of lime inhibits the action. If more hydrochloric or sulphuric acid is added, the calcium hypochlorite is decomposed with the formation of more hypochlorous acid. This is, in turn, decomposed by the mineral acid giving rise to chlorine. With limited amounts of acid a mixture of hypochlorous acid and free chlorine is produced. If the quantity of acid is increased the proportion of chlorine rises till ultimately only chlorine is produced.

It will be seen that in the commercial processes no account is taken of these facts. It is entirely a matter of chance whether hypochlorous acid or chlorine is used, or both. It depends largely upon the quantity of acid carried into the bleaching powder bath by the soured wool. In any case, it is probable that the first effect is the liberation of chlorine, owing to the excess of acid when the chemick first enters the wool.

(2) Weaker acids, such as acetic and phosphoric acids, act similarly, except that the proportion of hypochlorous acid does not usually fall below 50%.

(3) Boric acid, according to Higgins, even when present in excess, gives only hypochlorous acid and no chlorine. Taylor, it should be noted, does not confirm this statement, though it is agreed that the proportion of hypochlorous acid is high. From experiments made in connexion with this paper, I am of opinion that for weak solutions of bleaching powder, such as would be used in the chlorination of wool, Higgins' view is correct, but that when strong solutions and an excess of boric acid are used free chlorine is also produced. For concentrations up to 3 grams of available chlorine per litre a mixture of bleaching powder and boric acid is practically hypochlorous acid.

(4) Carbonic acid, in the cold, gives a mixture of hypochlorous acid and chlorine, like a mineral acid. As the temperature rises the proportion of hypochlorous acid increases, till at 100° C. only hypochlorous acid is formed.

(5) Chlorine water contains small quantities of hypochlorous acid, but if a little hydrochloric acid is added it may be regarded as containing only chlorine.

By taking advantage of these reactions it is possible to investigate separately the action on wool of chlorine and hypochlorous acid. I may say that, from the study of many samples of damaged goods and of the actual processes used, I had formed the opinion that in all cases the damage was caused by chlorine and not by hypochlorous acid. My experiments were undertaken, in the first instance, to confirm or disprove this view.

In all cases the goods were carefully dechlorinated and washed. After drying, they were examined with the microscope and the percentage of damaged fibres estimated. In most cases the loss in weight was also determined. This is also a measure of the efficiency of the process.

The action of chlorine is shown in the following table:—

Chlorine water.

No. of exp.	Grms. Cl per litre.	% loss in weight.	% of damaged fibres.
1.	0·5	5·2	27
2.	1·0	8·0	46
3.	3·0	15·6	100

It may be mentioned that bleaching powder solution of 1° Tw. contains approximately 2·75 g. of chlorine per litre. The destructive effect of chlorine is very marked. A solution of hypochlorous acid containing excess of hydrochloric acid gave similar results.

The next table shows the effect of bleaching powder solution to which was added the quantity of hydrochloric acid required to liberate all the available chlorine.

Bleaching powder.

No. of exp.	Grms. Cl per litre.	% loss in weight.	% of damaged fibres.
1.	2·0	13·8	Scales nearly all gone.
2.	3·0	20·5	
3.	4·0	23·5	
4.	5·0	25·5	

Exp. 2 was repeated using only one-quarter of the acid, *i.e.*, decreasing the ratio of chlorine to hypochlorous acid. The loss in weight was reduced to 10·6%. A blank experiment with the yarn used, omitting only the chemick, gave 2·2%.

The next series of experiments was designed to test the effect of adding gradually increasing quantities of acid to a definite amount of bleaching powder solution. The latter had a strength of 4 g. per litre. The amount of acid necessary to liberate all its available chlorine was calculated. The same quantities of wool and bleach liquor were taken for each experiment. In the first experiment one-fourth of the total acid was used. In succeeding experiments the quantity was gradually increased till excess was reached. The wool was soured in the measured quantity of acid and the whole of the fraction added to the chemick.

The results are given in the following table:—

No. of exp.	Fraction of acid used.	% loss in weight.	% of damaged fibres.
1.	0·25	8·6	Very little damage.
2.	0·40	15·6	" " "
3.	0·50	13·0	" " "
4.	0·75	13·8	Damaged.
5.	1·00	15·5	Much damaged.
6.	1·20	17·0	" "

Here again the effect of increasing the quantity of chlorine is very marked, as is also the large percentage loss in weight caused by excess. Yet this frequently happens in commercial processes where no control of the acid used is exercised. Commercial liquors nearly always contain free acid after use.

The next series of experiments was carried out by an ordinary commercial process, except that the strength of the bleach liquor was carefully controlled by titration. Varying concentrations in grams per litre of chlorine were used. The process used was:—(1) Steep in hydrochloric acid at 1° Tw. and squeeze. (2) Steep in bleaching powder solution and wash. (3) Steep in bisulphite and wash. (4) Steep in soda ash, wash, and dry.

In every case the amount of acid carried over by the wool was in excess of that required, as it frequently is in practice, thus giving a large proportion of chlorine to hypochlorous acid.

The results of these experiments were:—

No. of exp.		Grms. Cl. per litre.		% loss in weight.		% of damaged fibres.
1.	..	0·3	..	2·26	..	Less than 5
2.	..	0·4	..	2·70	..	,, ,,
3.	..	0·5	..	3·80	..	,, ,,
4.	..	0·6	..	3·85	..	Over 10
5.	..	0·7	..	4·65	..	30
6.	..	1·0	..	6·90	..	Over 30
7.	..	2·0	..	—	..	50—60

These results indicate the danger of using unknown strengths of bleaching powder solution, and that the chlorine content must be estimated carefully and kept below 0·6 g. per litre.

A set of experiments with another make of yarn, on the same lines, gave very similar results, viz.:—

No. of exp.		Grms. Cl per litre.		% loss in weight.		% damaged fibres.
1.	..	0·3	..	1·90	..	Less than 5
2.	..	0·4	..	3·21	..	5
3.	..	0·5	..	3·30	..	5
4.	..	0·6	..	4·00	..	10
5.	..	0·7	..	5·04	..	Over 10

It seemed probable that previous treatment with formaldehyde would cause a decrease in the loss of weight. This proved to be the case, though little difference in the number of damaged fibres was noted. With 0·7 g. of chlorine per litre the loss in weight was reduced from 5·04% to 2·60%. I noticed here a point of some importance, namely, that different types of wool have different powers of resistance to chlorine. Thus in a set of experiments with a fresh variety no damage was observed till 1 g. of chlorine per litre was exceeded. This was particularly noticeable in the case of a coarse, unbleached woollen yarn where no damage was recorded below 3 g. of chlorine per litre. I noted, further, that when a yellow colour appears on the wool, it is indicative of serious damage. I have often been told by manufacturers that the object of the bisulphite or sulphurous acid bath is partly to remove the yellow colour produced by the chlorine. This should be quite unnecessary. The only object of its use should be to remove chlorine left in the wool.

Boarding goods containing traces of unremoved chlorine caused, as would be expected, a great increase in the number of damaged fibres.

Experiments were made next with sodium hypochlorite instead of bleaching powder solution. Rather stronger solutions can be used with safety and the loss in weight appears to be somewhat less.

Sodium hypochlorite.

No. of exp.		Grms. Cl per litre.		% loss in weight.		% of damaged fibres.
1.	..	1	..	6·7	..	10
2.	..	2	..	10·4	..	More than 10
3.	..	3	..	10·5	..	,, ,,

Further experiments are necessary for generalisation.

Hypochlorous acid was prepared by passing chlorine into water containing calcium carbonate in suspension. If, as the foregoing experiments seem to indicate, damage is caused by chlorine, less should be found when hypochlorous acid free from chlorine is used. That this is so is, I think, undoubtedly the case. It is shown in the following tables for some different kinds of yarns.

Hypochlorous acid.

No. of exp.		Grms. Cl per litre.		% of damaged fibres.
1.	..	1·0	..	No damage.
2.	..	3·0	..	Less than 5.
3.	..	5·0	..	30
4.	..	1·0	..	No damage.
5.	..	3·0	..	Scale intact but faint.

As already noted, hypochlorous acid may more readily be obtained by treating bleaching powder solution with boric acid. I give some results together with parallel experiments made simultaneously with other methods.

No. of		Grms Cl per litre.		Acid used.		% of damaged fibres.
1.	..	0·5	..	hydrochloric	..	no damage.
1a.	..	0·5	..	boric	..	no damage.
2.	..	1·0	..	hydrochloric	..	8
2a.	..	1·0	..	boric	..	no damage.
3.	..	3·0	..	hydrochloric	..	80
3a.	..	3·0	..	boric	..	scales intact but faint.
4.	..	5·0	..	hydrochloric	..	no scales left.
4a.	..	5·0	..	boric	..	80
Finer counts.						
1.	..	0·5	..	hydrochloric	..	no damage.
1a.	..	0·5	..	boric	..	no damage.
2.	..	1·0	..	hydrochloric	..	10
2a.	..	1·0	..	boric	..	5
3.	..	3·0	..	hydrochloric	..	20
3a.	..	3·0	..	boric	..	15
4.	..	5·0	..	hydrochloric	..	50
4a.	..	5·0	..	boric	..	40

It is clear that when boric acid is used as the sour a greater concentration of chlorine may be used without causing damage than when hydrochloric acid is employed. *Vice versâ*, less damage is produced at lower concentrations. Not only is the danger of damaging the fibre less, but the loss in weight is also much smaller. This is seen from the following experiments:—

No. of exp.		Grms. Cl per litre.		% loss in weight.
1.	.	2	..	2·6
2.	..	3	..	4·8
3.	..	4	..	5·7
4.	..	5	..	7·5

As before, damage only became visible at a concentration of 3 g. per litre. We may take it as a general rule that hypochlorous acid up to the strength corresponding to 2 g. of chlorine per litre will cause neither damage nor undue loss in weight. The latter is still further decreased by previous treatment of the wool with formaldehyde.

Summary.

(1) Wool is more easily damaged by chlorine than by hypochlorous acid. Hence bleaching powder solution should be used under conditions that minimise the quantity of chlorine present.

(2) Different grades of wool require rather different treatment, some being damaged more easily than others.

(3) For any particular type of wool the maximum strength of bleaching powder solution permissible should be determined by experiments and never exceeded.

(4) For this purpose the Twaddell hydrometer is worse than useless. It should be replaced by a chemical process.

(5) Using bleaching powder solution and a mineral acid, it is rarely safe to exceed a strength of 0·6 g. of available chlorine per litre. The practice of soaking in acid is dangerous, unless the quantity of acid is controlled, since excess of acid carried over into the bleach liquor causes evolution of chlorine.

(6) Excess of either hypochlorous acid or chlorine causes destruction of both epithelial scales and cortical cells, large loss of weight, high solubility, and bad wearing properties.

(7) If boric acid, or other weak acid, is used as the sour, excess is not so dangerous and less damage results since hypochlorous acid is chiefly produced.

(8) Loss in weight and also the solubility of the product can be reduced by means of formaldehyde.

(9) All goods should be required to conform to a standard of "good commercial quality."

(10) Many of the properties usually ascribed to chlorinated wool are those of over-chlorinated wool.

Many of the experiments in connexion with this paper were carried out by my assistant, Mr. H. W. Goodwin, F.I.C.

Communications.

NOTES ON THE COMPOSITION OF THE RESIDUE ON DISTILLATION OF CRUDE GLYCERIN.

BY ARCHIBALD RAYNER, B.SC., F.I.C.

In a paper on the above subject (J., 1922, 97 T) E. Lewis describes an investigation which partly duplicates work carried out by the writer several years ago, with the same objective in view, and although certain conclusions arrived at confirm this earlier work, there are several points raised which seem to need confirmation or amplification.

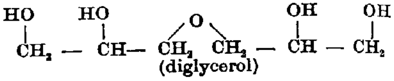
In the first place, it is stated that 25% of the residues consists of glycerol and polyglycerols, and 70% of inorganic matter, from which it follows that the organic soaps etc. can only amount to 5%. This statement seems to need some explanation since, as only negligible quantities of organic impurities pass away with the distillate, it follows that the proportion of inorganic to organic impurities in the residues should be substantially the same as that in the crude glycerin before distillation. It is well known, however, that the organic impurity in soap or saponification crudes is invariably much more than one-fourteenth of the inorganic matter. Examination of the more detailed analyses given later shows similar results which are difficult to reconcile.

In the writer's experience examination of various still residues from soap crudes from various sources has shown that the organic salts usually amount to about 40% of the inorganic salts, which is about what would be expected, since it is about the average proportion in which they occur in soap crude glycerin.

Further, the statement is made that polymerised glycerin is present in commercial crude to the extent of about 2%, and is highest in glycerin produced in autoclaves. Unless it is suggested that polyglycerols exist combined with fatty acids in the original fats, their presence in crude glycerins, and other than such glycerin as has had still residues worked back into it, cannot be explained. Many years' experience of glycerin produced largely by the autoclave process quite fails to support the suggestion that such glycerin contains polyglycerol at all, nor from theoretical considerations, having in view the dilution of the glycerin in the autoclave, can such a production of polyglycerols be considered in the least likely.

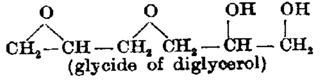
As regards the calculations by which the relative amounts of glycerol and diglycerol in the residues are estimated, as far as the writer is aware, there is no justification for assuming that the acetylisable impurities in the residues are wholly due to polyglycerols, since this would necessitate the assumption that the acetyl value of the residues of crude glycerin is similarly due wholly to polyglycerols in the crude, a suggestion which appears hardly possible of acceptance, since it is well known that various hydroxy-acids etc. are present, which give saponifiable products when boiled with acetic anhydride. Further, the writer has found that the only distillable polymerisation products which are produced from glycerin are also volatile under the conditions of the I.S.M. total residue test if the latter is carried to a correct finish. In any case, however, it does not appear that the chemistry of the polymerisation products of glycerol is so simple as to enable the composition of such products to be estimated in terms of glycerol and diglycerol from their hydroxyl value.

As a result of a long study and examination of these products, the writer was forced to the conclusion that the conversion of glycerol to volatile polymerisation products gives rise to substances of at least two different types, the one class appearing to consist of products obtained by intermolecular condensation of the ordinary diglycerol type, with the molecules linked together thus:—



(diglycerol)

and the other of the glycide type, in which not only is there intermolecular condensation, but also the original glycerol molecule itself has undergone internal condensation giving products of the type:



(glycide of diglycerol)

It is only by assuming the presence of these two types that the discrepant results of different observers of the properties of the volatile polymerisation products can be explained. As a typical instance of these variations in results the following figures may be quoted. In a certain laboratory by heating glycerol for 12 hours at 270°—280° C. and separating that proportion of the distillate boiling at 210°—250° C. at 3 mm., a product was obtained having a hydroxyl value 34·0% and a viscosity 5 times that of glycerol. On the other hand, in this laboratory by boiling glycerin alone for a somewhat longer time and distilling at 10 mm., a large fraction was obtained, boiling at 260°—265° C. at 10 mm., and having a hydroxyl value of 38·0% and a viscosity 13 times that of glycerol. The differences are quite outside any possible analytical errors, and as the product having the higher hydroxyl value has actually a much greater viscosity, it follows that there must be present, particularly in the case of the first distillate, another distinct class of compound, probably of the glycide type, possessing low viscosity and low hydroxyl values. Of this class of compound the glycides of glycerol, diglycerol, and triglycerol are known, the last-named being said to be produced when polyglycerols are distilled.

From their molecular structure it follows that the hydroxyl values are low, whilst they are known to be thin liquids having boiling points considerably lower than the parent glycerols. The presence of such substances in distilled glycerin recovered from residues, on a large scale by a special process worked out by the writer, has been very evident. A sample from a particular batch of distillate was redistilled in the laboratory at 10 mm., and that portion separated which boiled at 174°—176° C. at 10 mm. (b.p. of pure glycerol in same apparatus, 175°—176° C. at 10 mm.). As this distillate appeared to contain traces of bases, it was further purified by treatment with phosphotungstic acid, followed by another redistillation, collecting only the portion boiling within 1°. The resulting product was apparently pure glycerol, containing no moisture, and giving no total residue by the I.S.M. method. Its glycerol value, however, when determined by the I.S.M. method, standardising the solutions used against standard glycerin, gave 96·3% glycerol, and it had sp. gr. 1·2641 at 15·5° C. only, as against pure glycerin 1·26531. If in this case it were assumed that the product was a mixture of glycerol and diglycerol the proportions would be approximately 86% glycerol and 14% diglycerol, a composition which, in view of the boiling point, is impossible, and the low glycerol value can only be explained by the presence of smaller amounts of another compound of similar b.p. to glycerol, but having a much lower hydroxyl value, or possibly no hydroxyl value at all.

Such figures are characteristic of these distillates and other products derived from polyglycerols, and it is on this account that, in the writer's opinion, no information as to the relative amounts of diglycerol and glycerol can be obtained from the hydroxyl value of the mixed products.

If such information is required it is best obtained by submitting the volatile products to fractional distillation, whilst the total amount of volatile products can be estimated by the difference after determining the moisture content and total residue by the I.S.M. methods.

It should be mentioned that attempted polymerisation by 0·05% of iodine, as described, has quite failed to give anything like an 85% yield, very little polymerisation at all being obtained under the conditions described, and this method seems to suffer from the same defects as other methods having as their object the preparation of pure polyglycerols.

I am indebted to Mr. Charles Radburn, Chairman of Price's Patent Candle Co., Ltd., for kind permission to publish these notes.

The Laboratory,
Belmont Works, Battersea.

THE COEFFICIENT OF VULCANISATION OF RUBBER.

BY G. MARTIN, B.SC., A.I.C., AND F. L. ELLIOTT, A.I.C.

It has been shown by previous investigators that when rubber-sulphur mixings are vulcanised approximately to the same physical properties, there is a small variation in the percentage of sulphur "fixed" by the rubber. This variation does not generally amount to more than 1% of sulphur (Eaton, Agric. Bull. Fed. Malay States No. 27, 1918, p. 134: de Vries, India Rubber J., 1917, 101—103). Except for results showing that "quick-curing" rubbers generally have a high coefficient of vulcanisation at the standard cure, while "slow-curing" rubbers have a low coefficient, no experimental evidence has been published indicating the cause of these differences (Eaton, *loc. cit.*; de Vries, J. Ind. Eng. Chem., 1921, 13, 1133).

De Vries ("Estate Rubber," 1920, p. 489) sums up the position by stating: "Though the coefficient for a fixed cure shows small, though distinct variations, it has not yet been possible to connect these deviations with any property of the rubber in such a manner that, for instance, a coefficient higher than the average would be an indication of certain mechanical properties or of a certain special composition of the rubber."

The object of the present investigations was to determine to what extent, if any, the percentage of sulphur combined with the rubber at the standard cure adopted, is dependent upon the nature and the amount of the usual accessory substances present in raw rubber.

Twenty-four samples of rubber were selected for examination. They consisted of six samples of crêpe rubber and six samples of sheet rubber prepared on an estate in Ceylon from the latex of a group of trees approximately 10 years old, and also of six samples of sheet rubber and six samples of crêpe rubber prepared on the same estate from another group of trees approximately 20 years old. From each lot of latex were prepared one sample of sheet rubber and one sample of crêpe rubber.

Vulcanisation coefficient and resin content of Ceylon Rubbers.

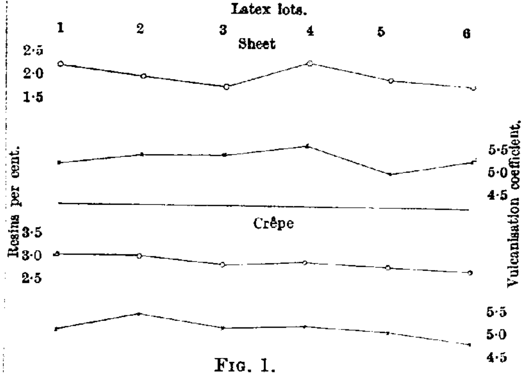


FIG. 1.

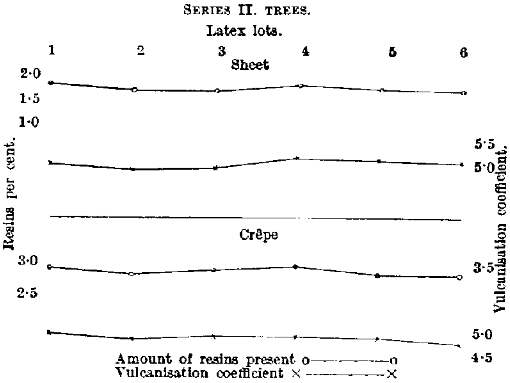


FIG. 2.

An interval of 14 days elapsed between the collection of each lot of latex from each group of trees. It has been found convenient to number the latex lots from each group of trees from 1 to 6, according to their order of collection. The samples were washed, dried, analysed, vulcanised, and tested in the usual way (Bull. Imp. Inst., 1916, 14, 499).

The "free sulphur" was determined by extracting 2 g. of the crumbed sample for 20 hours with acetone and oxidising the dry acetone extract with fuming nitric acid and potassium chlorate. In order to obtain the "combined sulphur," the "free sulphur" was subtracted from 10%, which was the amount of sulphur used in all these mixes. The accuracy of this method was checked by separate determinations of "free" and of "combined" sulphur. The combined sulphur was thus determined for two cures near the standard cure, and the coefficient of vulcanisation at the standard cure calculated from each result. Until nearly the whole of the sulphur has gone into combination with the rubber the rate of combination of rubber with sulphur is constant, so that as long as the two cures are close to the standard cure this calculation can be done with accuracy (De Vries, "Estate Rubber," 1920, p. 487; Eaton, *loc. cit.*; also Delft Comm., 6, 183). It will be seen in the tabulated results that the coefficients of vulcanisation calculated from two separate results are in close agreement. In those cases where only one cure is given the results were checked by repeating the determination.

The standard cure selected was that which gave a stress-strain curve which passed through 830% elongation under a load of 1·36 kg. per sq. mm. In the majority of cases the standard cure was calculated from the position of the stress-strain curve at a cure two to three minutes above or below the standard cure. This could be done with accuracy, since the alteration in the position of the stress-strain curve with time of cure was determined for each sample.

The results obtained in the examination of the rubbers are given in the following tables:—

Series I trees—about 10 *years old.*

Section 1. *Sheet-rubber.*

Sample no.	Latex lot.	Cure. mins.	Combined sulphur found. %	Calculated standard cure. mins.	Calculated vulcanisation coefficient at the standard cure.	Average vulcanisation coefficient at the standard cure.
496	1	60	4·64		5·32	5·28
		70	5·31	62	5·23	
497	2	60	4·62		5·57	5·55
		68	5·20	65	5·52	
498	3	55	4·84		5·66	5·59
		60	5·14	58	5·52	
499	4	48	4·85	52	5·84	5·84
500	5	60	4·43	62	5·09	5·09
501	6	64	4·64	68	5·48	5·48

The average vulcanisation coefficient at the standard cure is 5·47 with an average deviation of ± 0·19.

Section 2. *Crêpe-rubber.*

Sample no.	Latex lot.	Cure. mins.	Combined sulphur found. %	Calculated standard cure. mins.	Calculated vulcanisation coefficient at the standard cure.	Average vulcanisation coefficient at the standard cure.
508	1	95	4·64		5·16	5·13
		100	4·82	95	5·09	
509	2	110	4·98	111	5·58	5 58
510	3	100	4·21		5·16	5·23
		106	4·59	110	5·30	
511	4	110	4·55	115	5·29	5·29
512	5	95	4·44	99	5·14	5·14
513	6	108	4·13	114	4·84	4·84

The average vulcanisation coefficient at the standard cure is 5·20 ± 0·16.

The samples of crêpe rubber in section 2 were prepared from the same latex as corresponding samples of sheet rubber in section 1.

Series II trees—about 20 *years old.*

Section 3. *Sheet-rubber.*

Sample no.	Latex lot.	Cure. mins.	Combined sulphur found. %	Calculated standard cure. mins.	Calculated vulcanisation coefficient at the standard cure.	Average vulcanisation coefficient at the standard cure.
502	1	70	4·41		5·39	5·39
		75	4·71	77	5·38	
503	2	67	4·40		5·18	5·18
		70	4·59	71	5·18	
504	3	64	4·60	66	5·27	5·27
505	4	64	4·83		5·53	5·53
		68	5·13	66	5·53	
506	5	78	4·86	79	5·47	5·47
507	[illegible]	75	4·88	75	5·42	5·42

The average vulcanisation coefficient at the standard cure is 5·38 ± 0·10.

Section 4. *Crêpe-rubber.*

Sample no.	Latex lot.	Cure. mins.	Combined sulphur found. %	Calculated standard cure. mins.	Calculated vulcanisation coefficient at the standard cure.	Average vulcanisation coefficient at the standard cure.
514	1	108	4·49	111	5·13	5·13
515	2	126	4·29	131	4·96	4·96
516	3	125	4·40	129	5·04	5·04
517	4	120	4·31	126	5·03	5·03
518	5	120	4·07	132	4·98	4·98
519	6	125	4·25	128	4·83	4·83

The average vulcanisation coefficient at the standard cure is 5·00 ± 0·07.

The samples of crêpe rubber in section 4 were prepared from the same latex as corresponding samples of sheet rubber in section 3.

The average vulcanisation coefficients are collected below:—

	Series I. trees (about 10 years old).	Series II. trees (about 20 years old).
Sheet	5·47 ± 0·19	5·38 ± 0·10
Crêpe	5·20 ± 0·16	5·00 ± 0·07

The vulcanisation coefficient of crêpe at the standard cure is distinctly less than that of sheet. The vulcanisation coefficient of rubber from the older trees is slightly less than that of rubber from the younger trees and the results are distinctly more uniform.

It is an interesting and possibly significant fact that as the average time of the cure increases, so the average vulcanisation coefficient decreases.

Form.	Series I. trees. Time of cure.	Series I. trees. Vulcanisation coefficient.	Series II. trees. Time of cure.	Series II. trees. Vulcanisation coefficient.
Sheet ..	61	5·47	72	5·38
Crêpe ..	107	5·20	126	5·00

It should be noticed that there is no relation between the time of cure and the vulcanisation coefficient of individual rubbers. The relation is only found to exist when average results of a series of experiments are taken. It is possible therefore that the vulcanisation coefficient at the standard cure is dependent upon some factor indefinitely associated with the accelerator present in the dry rubber.

The average chemical composition of the rubbers is shown herewith:—

	Series I. trees—about 10 years old.				Series II. trees—about 20 years old.			
	Resin.	Protein.	Ash.	Caoutchouc.	Resin.	Protein.	Ash.	Caoutchouc.
Sheet	1·98	2·27	0·28	95·47	1·73	2·09	0·28	95·90
Crêpe	2·86	2·25	0·28	94·61	2·65	2·11	0·25	94·99

The fact that sheet and crêpe rubbers of Series I. trees contain more resin and protein than the sheet and crêpe rubbers of Series II. trees, suggests that possibly the less chemically pure is the rubber, the higher will be the vulcanisation coefficient at the standard cure. Evidence in favour of this can be quoted from the results of other workers. For example, rubber prepared from latex which has been evaporated to dryness and rubber prepared from the first clot in the partial coagulation of latex, both contain more of the accessory substances present in all natural rubbers than does rubber prepared in the usual way, and they both have a high coefficient of vulcanisation at the standard cure (de Vries, J. Ind. Eng. Chem., 1921, 13, 1134). However, the amount of the accessory substances in raw rubber is not the only factor which may affect the vulcanisation coefficient. The nature of these accessory substances, which varies with the form and origin of the rubber, possibly plays an important part.

us sheet rubber contains more caoutchouc than es crêpe rubber, yet it has generally a distinctly gher vulcanisation coefficient at the standard re. It will be shown that some of the accessory bstances in sheet rubber are of a nature fferent from those in crêpe rubber, and have a fferent effect on the vulcanisation coefficient.

Following up the presumption that some of the cessory substances in raw rubber increase the ount of combined sulphur at the standard re, the question arises as to which are sponsible. De Vries (*loc. cit.*) reasoning from e effect of artificial organic accelerators on the lcanisation coefficient, presumes that the natural celerators in raw rubber are chiefly responsible r variations in the vulcanisation coefficient, and es not correlate these variations with any of the her impurities.

With a view to finding which of the accessory bstances are chiefly responsible for variations the vulcanisation coefficient, attempts were made correlate the vulcanisation coefficient of each mple of rubber with the amounts present of ash, resin" (acetone-soluble substances), and protein mpounds, and also with the time of vulcanisation. e latter was taken as a measure of the amount natural vulcanisation accelerators present.

Only in the case of the "resins" could a distinct lation be found between the amount of this esent in each rubber and the corresponding lcanisation coefficient. Attention has already en called in this paper to the relation between e average time of vulcanisation and the average lcanisation coefficient, and it has been pointed t that this relation does not hold for individual bbers. In the case of the resins, however, a ference to the table below and to Figs. 1 and 2 will ow that, with one or two exceptions, there is a lation between the amount of the resin of individual rubbers and the vulcanisation coefficients at e standard cure.

		Latex lots.					
		1	2	3	4	5	6
eries I. trees—							
Sheet	Resin, %	2·21	1·95	1·72	2·33	1·92	1·77
	Vulcanisation coefficient	5·28	5·55	5·59	5·34	5·09	5·48
Crêpe	Resin, %	3·00	3·02	2·77	2·90	2·77	2·69
	Vulcanisation coefficient	5·13	5·58	5·23	5·29	5·14	4·84
eries II. trees—							
Sheet	Resin, %	1·83	1·67	1·66	1·84	1·72	1·67
	Vulcanisation coefficient	5·39	5·18	5·27	5·53	5·47	5·42
Crêpe	Resin, %	2·74	2·56	2·69	2·78	2·59	2·56
	Vulcanisation coefficient	5·13	4·96	5·04	5·03	4·98	4·83

It will be noticed that, with the exception of eet from Series I. trees, which has in previous xperiments displayed more variations than sheet om the older (Series II.) trees, the vulcanisation efficient at the standard cure generally rises and lls as the resin content increases and decreases. he sample which shows the biggest discrepancy eries 1 sheet rubber from Latex lot 3) unfortuately arrived in a wet condition, and had a ashing loss of 1·7%. Previous work has shown at moisture has an influence on the amount of esin present (Bull. Imp. Inst., 1916, 14, 549; 1918, , 435). It is probable that the chemical identity the resin is also affected. This may account for e sample in question being abnormal. There are at the most three other samples which give exceptional results (and this is to be expected in a natural product) so that the evidence in favour of a direct connexion between the acetone-soluble constituents and the variation in the vulcanisation coefficient is very strong.

In order to pursue still further the influence of the resin on the vulcanisation coefficient at the standard cure, samples of crêpe, sheet, and slab were extracted with cold acetone and these extracts each added in turn to the unextracted crêpe rubber in the following mix:—Crêpe rubber, 88; sulphur, 10; acetone extract, 2. The results are shown in the following table:—

Description.	Cure, mins.	Elongation 0·6 kg. sq. mm.	Elongation 1·04 kg. sq. mm.	Tensile strength. lb. per sq. in.	Combined sulphur found. %	Estimated standard cure, mins.	Calculated vulcanisation coefficient at standard cure.
pe	115	785	880	1690	3·24	135	4·2
pe + crêpe resin	115	796	891	1570	3·45	138	4·6
+ sheet resin	115	745	842	1760	4·45	125	5·4
+ slab resin	115	579	—	705	6·20	88	5·3

In columns 3 and 4 are found the elongations under the loads stated, as shown by the stress-strain curve. Taking for these 4 cures an elongation of 800% under a load of 1·04 kg. per sq. mm. as the standard cure, in the 8th column is found the estimated time of cure necessary to give this stretch. The vulcanisation times of the samples of crêpe, crêpe + crêpe resin, and crêpe + sheet resin are so near to each other that the estimated standard cure should be relatively accurate. The sample of crêpe + slab resin cures very much more quickly than the other samples. It is possible that the error in estimating the time of cure in this case may amount to a little more. Even when these errors are allowed for the results in the last column leave no room for doubt that the added crêpe resin increases a little the coefficient of vulcanisation at the standard cure, while the addition of sheet and slab resin has a very marked effect on the vulcanisation coefficient. It is also of interest (column 6) that the addition of crêpe resin increases the rate of combination of rubber with sulphur very slightly —hardly more than lies within the limits of experimental error—while the sheet resin markedly increases and slab resin almost doubles the rate at which rubber and sulphur combine. The sheet rubber resin was obtained from a sample requiring 50 minutes in which to vulcanise. This is much less than is usually required by sheet. The sample of slab took 66 minutes to vulcanise. This is longer than slab usually requires.

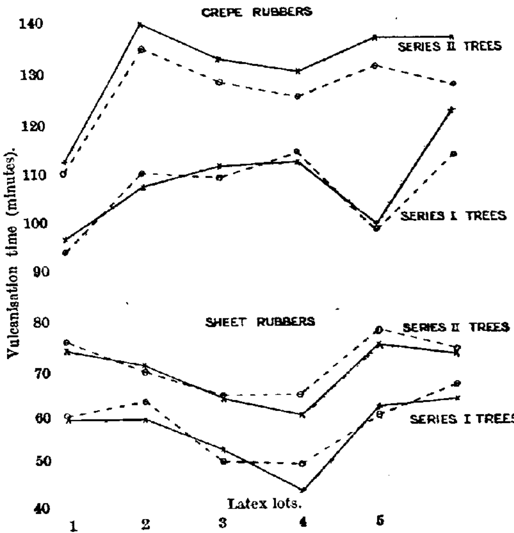
Numerous investigations at the Imperial Institute have shown that slab rubber and also rubbers which have been machined, and then kept in a wet state, usually have a higher amount of resin and a lower amount of protein than has sheet or crêpe; moreover, they generally vulcanise quickly (Bull. Imp. Inst., 1918, **16**, 435). It is evident from the above experiments that the resin constituents of slab rubber are responsible for its quick curing properties. This is confirmed by the fact that the acetone-extracted sample of slab required 90 minutes to vulcanise. It seems probable that part of the protein portion of raw rubber during the process of maturing is rendered soluble in acetone and this acts as a strong accelerator.

Spence (J. Ind. Eng. Chem., 1918, **10**, 116) states that Para rubber contains an "active principle," soluble in acetone, nitrogenous, and feebly basic in character, and acting essentially as a catalyst of vulcanisation. On the other hand, Stevens found that on one occasion the removal of resin had very little effect on the rate of combination of rubber and sulphur (Kolloid-Zeits., 1915, **14**,

91) while on another occasion the rate of combination was decreased by 25% (J., 1916, 874). In Spence's published experiments (Kolloid-Zeits., 1912, 11, 28) the "resins" were more completely removed than in those of Stevens, and it is possible that the last traces of "resin" may play an important part in vulcanisation. It seems probable, however, that the "resin" of Para rubber prepared in different ways and from different groups of trees will differ in quality as it does in quantity, and will have different effects on vulcanisation.

The increase in the vulcanisation coefficient at the standard cure on the addition of 2% of either slab resin or sheet resin is remarkable. In a preliminary investigation on the combination of crêpe resin with sulphur at 150° C. in a sealed tube in the presence of air, the resin was found to combine with 11·5% of its weight of sulphur in 2 hours. About half of this was insoluble in acetone. A fuller investigation of the combination of different rubbers with sulphur following the procedure advocated by Kelly might yield important results (J. Ind. Eng. Chem., 1922, 14, 196—197). For the present it should be borne in mind that the addition of 2% of either slab or sheet resin to crêpe rubber increased the vulcanisation coefficient by approximately 1% of combined sulphur. If the whole of this increase were due to a combination of resin and sulphur to form an acetone-insoluble compound, it would involve the conversion of the whole of the substances soluble in acetone into insoluble substances, and even then would give compounds containing on an average as much as 30% of sulphur. The increase in vulcanisation coefficient is so large that the combination of sulphur and resin to form an insoluble compound is unlikely to be the sole explanation.

Chemical and physical methods of determining time of vulcanisation.



Time of vulcanisation determined from the amount of combined sulphur x———x

Time of vulcanisation determined from the standard stress-strain curve o- - - - -o

FIG. 3.

The physical characteristics of the resins previous to vulcanisation are also unlikely to provide an explanation of this increased vulcanisation coefficient, since the crêpe resin was the softest and slab resin the hardest. The explanation may lie partly in the combination of resin with sulphur to form an insoluble product, partly in the physical properties of the compounds so formed, and partly in obscure physical and chemical relationships.

The influence of the resin constituents of rubber on the coefficient of vulcanisation at the standard cure raises the query as to whether the estimation of the correct time of cure by the determination of combined sulphur gives results similar to those obtained by physical methods. The average vulcanisation coefficient for the whole of the 24 samples described in the first part of this paper is 5·26. Assuming that a rubber which has been cured to a coefficient of 5·25 is correctly cured for the purpose of these experiments, the time of cure of each sample can be calculated and the results compared with those obtained by physical methods. The details are shown in Fig. 3. These results are in agreement with those of other workers and indicate that the chemical method of determining the time of cure does not give results materially different from the physical method (Eaton, *loc. cit.*; de Vries, *loc. cit.*). Rubbers from the same latx and prepared in the same way differ in cure roughly by the same amount whether their time of cure is estimated physically or chemically. There is not the same agreement between th physical and chemical methods of estimating the time of cure when rubbers of different form, such as crêpe and sheet, are concerned. These two types of rubber, however, differ in time of cure by an amount so large that these discrepancies are of little importance. We may definitely conclude that the relative times of cure of rubber-sulphur (90:10) mixes are approximately the same whether we adopt the chemical or physical method of determining the time of cure.

Conclusions.

(1) The amount of combined sulphur at the standard cure depends upon the way in which the rubber is prepared, upon the trees from which the latex is obtained, and also to a less extent upon unexplained variations in the finished rubber from time to time. In the samples tested the maximum variation did not reach 1% of combined sulphur.

(2) For a series of rubbers, as the average time of cure increases so the average amount of combined sulphur at the standard cure decreases.

(3) The amount of combined sulphur at the standard cure for rubber of the same form, and from the same trees, varies approximately as the amount of resin constituents of the rubber varies.

(4) The resin of crêpe rubber has little influence on the rate of combination of rubber with sulphur. The resin of sheet rubber acts as a mild accelerator, while the resin of slab rubber contains a strong accelerator. The resins of slab and sheet rubber increase the vulcanisation coefficient of crêpe rubber at the standard cure more than does the resin of crêpe rubber.

(5) Whether the time of cure of the rubber-sulphur mix (90:10) is estimated by chemical or physical means, the results are approximately the same, as long as similar forms of rubber are compared. The differences are larger when dissimilar forms such as sheet and crêpe are compared.

The experiments described in this paper have been carried out at the Imperial Institute in the course of investigations conducted in connexion with the Ceylon Rubber Research Scheme.

Imperial Institute, London, S.W.

Annual Meeting.

CHEMICAL ENGINEERING GROUP.

The papers by Messrs. Parrish and Hinchley, read before the sessions of the Chemical Engineering Group at Glasgow on July 6th, are printed below in abridged form. An account of Mr. Walmsley's paper will appear later. An abstract of the paper read by Mr. T. H. Gray will be found in the July 15th issue, p. 281 R. The full papers will appear in the Proceedings of the Group in due course.

OBSERVATIONS ON THE DESIGN AND WORKING OF AMMONIACAL LIQUOR STILLS.

BY P. PARRISH, A.I.C.

[*Abridged.*]

The quantity of gas liquor produced and distilled in the United Kingdom must be of the order of 1250 million gallons of 8 oz. (1·73 per cent.) NH_3 per annum. This quantity chiefly arises in the purification of crude coal gas derived from the carbonisation of coal at gas works and coke ovens, from blast-furnace gases, and the carbonisation of shale as conducted largely at the shale oil works in Scotland.

The following analyses give an indication of the average composition of ammoniacal liquors arising at various works:—

	Gas works. % w/v.	Coke oven. % w/v.	Blast furnace. % w/v.	Shale works. % w/v.
Volatile ammonia..	1·4 to 2·5	0·68 to 0·85	0·4	0·9
Fixed ammonia ..	0·1 to 0·4	0·3 to 0·10	0·01	0·3
Total ammonia ..	1·5 to 2·9	0·98 to 0·95	0·41	0·93
$(NH_4)_2S$	0·8 to 0·9	0·40	—	0·10
$(NH_4)_2CO_3$ ..	5·0 to 8·5	1·90	1·1	2·90
NH_4Cl.	0·5 to 1·0	0·20	0·006	0·015
NH_4CN	0·07 to 0·3	0·04	—	—

Broadly speaking, the arrangement of the stills and liming chamber can be divided into three categories, viz., (A) free still superposed on liming chamber, fixed still separate; (B) free still superposed on liming chamber and fixed still; (C) free still superposed on fixed still, liming chamber separate.

As to the arrangement which the plant should take, much depends on the provision made for cleaning the stills, on the fixed ammonia content of the gas liquor to be distilled, and on its freedom from tarry matter. By far the greater number of stills operating in the United Kingdom are stills built up of double-flanged sections, each of which, generally speaking, constitutes a chamber. The joints between the corresponding flanges of the chambers are made with boiled linseed oil and Vulcan cement, or with red and white lead and lead wire. Obviously these sections have to be provided with such a number of manholes, and of such a size, as will afford facilities for the cleansing of the overflow pipe or pipes and the removal and/or cleaning of the hoods, frogs, crocodiles, or whatever steam-distributing device is provided.

In this form of still the joints between the several sections are potential sources for the leakage of ammonia, and as it is unusual to insulate the covers of the manholes with non-conducting material, the loss of heat by radiation is not inconsiderable. Complete dismantling may become necessary owing to accumulations of lime sludge, either causing blockages which are difficult, if not impossible, to remove *in situ*, or the lime may form laminations on the bottom of the chambers to such an extent as seriously to impair the thermal efficiency and capacity of the plant.

Another arrangement of still which largely overcomes the disabilities to which reference has been made above comprises an outside shell free from a multiplicity of flanges, and without cleaning manholes. This design of still, for which Dr. Carpenter was responsible, contemplates the withdrawal of the internal elements, which comprise a hood, tray, and bubbler, as constituting a complete chamber for cleaning purposes.

These hoods, trays, and bubblers are provided with machined faces so that there is no possibility of the by-passing of steam on the outer part of the trays. Suitable lifting tackle is provided for facilitating the removal of the internal elements, which, in turn, are all provided with suitable lifting lugs.

It has been found in practice that, provided the accumulations of lime sludge at the foot of the liming chamber are removed every fortnight, and the top cover of the fixed still is lifted monthly for the cleaning of the perforations of the anti-priming device, the still will operate continuously for six months before cleaning is necessary. During this time approximately 5,000,000 galls. of gas liquor will have been distilled, still cleaning representing a charge of about 2d. per ton of sulphate made. With the shell type of still, involving as it does the withdrawal of the internal elements for cleaning purposes, it would be obviously unwise to arrange the plant according to category B. (*cf. supra*), as this would necessitate the removal of the liming chamber in order to afford access to the anti-priming arrangement, or first tray, of the fixed still.

Manifestly with gas liquor having a high content of fixed ammonia, particularly if such fixed ammonia is due to ammonium sulphate, the difficulty of keeping the distilling sections of the fixed still free from sludge, particularly the first and second fixed sections, is great. Special consideration should be given to the design of the liming chambers or the elements of large liming chambers, which admit of considerable time contact, in order to ensure active agitation. Easy means of a periodic discharge of the sludge from the foot of the liming chambers should also be provided. Failing this, an arrangement of plant with outside liming section specially designed as represented in category C. is necessary.

It is the author's view that mechanical considerations, such as facilities for cleaning, provision for the removal of bubbling hoods and initial capital cost, have been the factors largely governing the design and arrangement of gas liquor stills in the past. Had designers and makers of gas liquor stills been in a position to visualise the items which contribute to the cost of ammonium sulphate in so far as the still itself is concerned, it is not improbable that less attention would have been directed to this somewhat circumscribed aspect of design, and more attention given to the possibilities of designing a still which would be economic as regards steam consumption. In saying this, it is not overlooked that the ideals of the chemist and physicist have not infrequently to be compromised in order to ensure mechanical strength and practicability in the matter of production.

The data given below relative to the characteristics of several types of present-day stills lead to the conclusion that standardisation based on experimental data under varying conditions, and with due regard to the fundamental laws governing the distillation of gas liquor, would be fully warranted.

Characteristics of ammoniacal liquor stills as supplied by English makers.

Letter index.	Diameter of free still.	Height of free still.	Diameter of fixed still.	Height of fixed still.	No. of trays in free still.	No. of trays in fixed still.	Depth of liquor in trays.	Liquor capacity of trays (galls.).	Depth of liquor seal.	Heating surface per tray or element.	Capacity per hour (galls.).	lb. of NH_3 per hour.	Surface area occupied by hoods, crocodiles or other such devices.	Depth of chamber.	Arrangement of overflow device.	Arrangement for cleaning.	Arrangement at top of still to avoid entrainment.	Surface area for ascent of gases.	Surface area for descent of liquor.	Weight of fully equipped still.	Letter index.
	ft. in.	ft. in.	ft. in.	ft. in.			in.		in.	sq. ft.			sq. ft.	ft. in.				sq. in.	sq. in.	tons.	
A.	5 10	21 10	5 10	10 2	6	5	5	57·25	1	21·59	1250	250 (2% NH_3 liquor)	12·48	1 4½	Annular space round hood.	Still to be dis-sembled.	Anti-priming device.	71·6	278	41	A.
C.	4 0	16 2½	4 0	9 11	10	8	3½	17·62	1⅜	9·68	1050	182	4·9	11	Two semi-elliptical slots.	Large manholes.	Void.	183	224	22	C.
G.	7 6	18 8	7 6	11 5	9	8	2	43·44	1	41·7	1360	235 (1·73%)	11·6	1 0¾	Eight 4″ pipes.	Manholes	Void.	248	59·5	—	G.
I.	5 6 square.	17 7	5 6 square.	7 0½	12	8	2½	41·2	1½	29·15	—	—	3·9	9	One 8″×3″ opening.	Hand-holes.	Large void.	110	48	—	I.
J.	5 0	19 8	5 0	8 11	9	8	2¾	21·2	1	17·04	—	—	5·37	10	Two semi-elliptical slots.	Hand-holes.	Void.	174·7	180	—	J.
L.	4 6	7 6½	4 6	7 6½	13	8	1⅛	12·5	1½	12·54	400	70·2 (1·73%)	6·09	6	Six 4″ diameter pipes.	Six handholes 6″ — 3″ for each chamber.	Void.	217·5	73·75	15	L.
										Category "B."											
B.	5 0	12 6	Comprising a conical base with circular steps increasing in dia.	6 8	14	9 steps.	1¾	12·75	1½	19	650	141 (2·17%)	11	7½	Two 4″ pipes.	Manholes.	Anti-priming hood.	78·5	14	25	B.
F.	7 0	12 0	7 0	12 0 inclusive of liming chamber.	8	6	3½	58·1	1½	32	2016	437·4 (1¼%)	11·53	1 6	Two semi-elliptical slots.	Large manholes.	Void.	373	522	19	F.
H.	6 0	4 0	6 0	6 6	6	8	2	28·0	1	26·9	840	182·2 (2·17%)	12·2	7½	One 8″×4″ semi-elliptical pipe.	Hand-holes.	Void.	113	57	17½	H.
										Category "C."											
D.	5 4	9 0	5 4	12 8	5	7	5	49·5	2	18·96	1250	195 (1·56%)	5	1 2	Two semi-circular pipes.	Manholes.	Void.	213	204	—	D.
E.	5 6 square.	4 0	5 6	8 6	4	8	2½	39·3	1⅝	26·2	560	56 (1%)	11·6	9	Two 12″×4″ openings.	Manholes.	Void.	528	54	—	E.
K.	5 6 square.	8 0	5 6	13 0	10	15	2½	36·4	1½	28·0	860	126 (1½%)	11·6	9	Four 7″×3″ openings.	Manholes.	Void.	528	84	26	K.

Summarised heat balance of sulphate of ammonia manufacture.

Dr.	B.Th.U.'s	Cr.	B.Th.U.'s.
(a) Heat entering still—		Heat leaving still—	
I. Via steam	259,100	I. Via gas stream	241,000
II. ,, liquor	165,000	II. ,, effluent	192,000
III. ,, lime	12,000	III. Radiation loss (0·7%)	3,100
	436,100		436,100
(b) Saturator balance			
I. Heat entering	241,000	Heat entering preheaters	258,300
II. Ht. of dilution	7,900	Loss (radiation) via liquor whilst centrifuging, etc. (17·8%)	56,400
III. ,, ,, formation	65,800		
	314,700		314,700
(c) Interchange balance—			
Entering preheaters	258,300	Heat recovered via liquor	165,000
		,, lost via water (9·0%)	21,760
		,, ,, ,, gas (0·1%)	180
		Radiation losses (21·0%)	71,360
	258,300		258,300

Tho above figures show the heat expressed in terms of B.Th.U. entering and/or leaving the various parts of the plant constituting a complete sulphate of ammonia unit.

Not infrequently has the question been asked, What are the conditions governing the water balance of a saturator?

Owing to the heat of formation of ammonium sulphate by the combination of the ammonia with the acid of the saturator, the temperature of the bath is at least equal to the temperature of a boiling saturated solution of ammonium sulphate. A further increase of temperature accrues from the free sulphuric acid content of the bath. Indeed the temperature of the bath will be at least 15° C. higher than the temperature of the stream of steam and ammonia leaving the still. Hence there can be little possibility of the condensation of water in the saturator unless the heat of formation of ammonium sulphate is counterbalanced by heat losses *viâ* conduction, radiation, and the circulation of mother liquor outside the saturator.

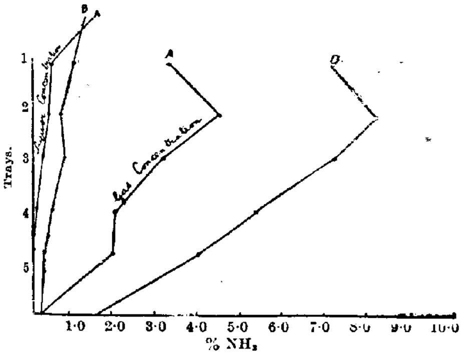


FIG. 1.

Diagram showing liquor and ammonia gas concentrations at two rates of speed.

3·7 *galls. per hour A* }
9·3 ,, ,, ,, *B* } *with identical steam consumption.*

The factors governing the water balance of a saturator are undoubtedly the strength of acid which is used and the quantity of extraneous water which is introduced thereto.

It is known that when using sulphuric acid of 70% H_2SO_4 content, 50 gallons of extraneous water can be introduced to the bath without creating redundant mother liquor.

From the thermal data afforded by the measurements under review a simple calculation will show that 55 gallons of water was being evaporated per ton of ammonium sulphate (of 25·74% strength) being made.

So far it will be seen that there is great uncertainty as to the form which the elements of an ammoniacal liquor still should take if the vital factor, namely, steam consumption within the still, is to be economised. Hitherto hypotheses have been deduced and indeed worked upon, but it is doubtful whether any satisfactory data have been arrived at, either experimentally or otherwise, to indicate the precise form which the elements should assume, and the conditions under which the stills should be operated if a minimum steam consumption is to be attained.

Having an experimental sulphate of ammonia plant available, experiments were conducted under varying conditions with a view of arriving at certain conclusions in the above connexion.

Fig. 1 is a diagram showing the liquor and gas concentrations at two rates of feed with identical steam consumption. It will be seen from this diagram that the rate of flow has been increased by about 250% at the sacrifice of 0·23% of free ammonia in the effluent. It is not inconceivable that an identical effluent to that of the lower rate of feed would have been obtained had the time contact been increased (say) to the extent represented by two additional trays. This experiment would appear to indicate that given a definite time contact, the steam consumption can be made to approach the theoretical minimum possible dependent upon the liquor feed concentration. The latter condition embodies the ideal at which designers of gas liquor stills should aim, and incidentally the one with which manufacturers should be conversant when contemplating the purchase of gas liquor stills.

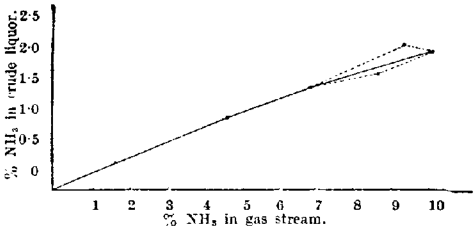


FIG. 2.

Diagram showing ammonia concentration of gas, with varying contents of ammonia.

A measure of the efficiency of the steam consumption of a gas liquor still is afforded by the concentration of the ammonia in the gas stream. A simple method of determining this factor under practical working conditions is to condense the stream of steam and ammonia leading to the saturator, and to make a determination for ammonia, carbonic acid, and hydrogen sulphide contents. From a series of analyses carried out in this manner, the graph shown in Fig. 2 has been prepared. By calculation from the foregoing graph the curve in Fig. 3, which affords an indication of the steam consumption per lb. of ammonia in relation to the ammonia concentration in the crude liquor, has been constructed.

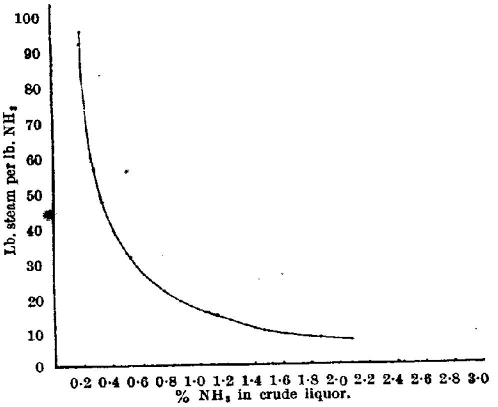


FIG. 3.

Curve showing steam consumption per pound of ammonia, with varying concentrations of ammonia in gas liquor.

Unfortunately little information appears to be available concerning the extent to which the concentration of ammonia in the gas stream is affected by varying concentrations of ammonia in the gas liquor. This obviously has an important bearing when fixing the price of gas liquor according to its ammonia content, and particularly so when purchasing concentrated gas liquor. As far as is known, the only recent work published on this aspect was an article appearing in *Chemical and Metallurgical Engineering* of February 15th last by Emil Piron, in which some of the fundamental laws governing the distillation of mixtures were discussed. This worker has shown the lines along which problems of this character can be studied, both experimentally and mathematically. Indeed the article is of such merit that diagrams, based on the experimental data furnished, have been embodied in this contribution. Fig. 4 is a graph which shows the relationship between the composition of the liquor being distilled and that of the distillate leaving the still. The particular experiment comes under the category of a discontinuous distillation, but the data so given can be correlated to the performance of a continuous still. This graph in conjunction with Fig. 5, which is compiled from data by the same author, is of importance as indicating the economic limit which should be looked for as representing the point at which further distillation is unprofitable. It also furnishes some idea as to the relative value of gas liquor of different concentrations from the point of view of the distiller.

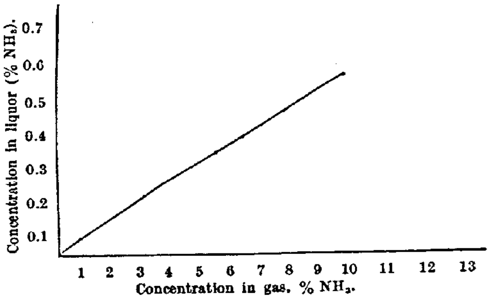


FIG. 4.

Diagram of Emil Piron's values, showing the variation of "K," with a variation of the strength of liquor.

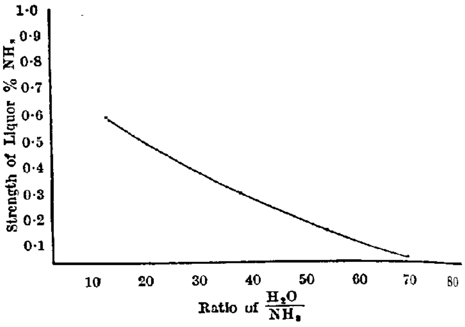


FIG. 5.

Steam consumption per unit of ammonia distilled from liquors of varying concentrations, plotted from data by Emil Piron (see Chem. and Met. Eng., Feb. 15, 1922).

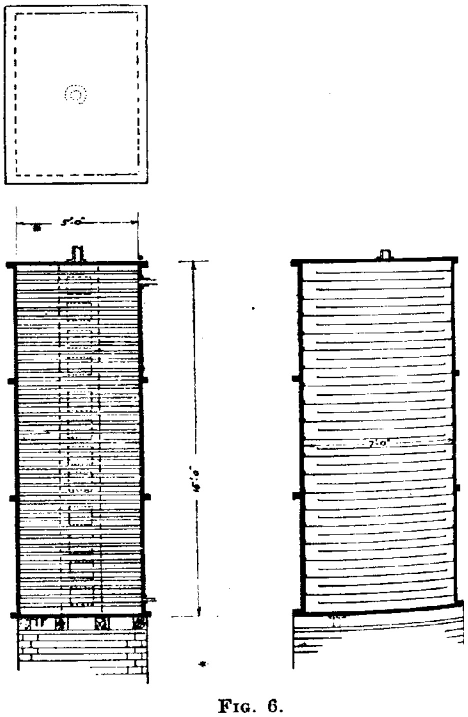


FIG. 6.

Hill's still.

It has been suspected by workers having technical and practical experience of gas liquor stills that there was no particular merit in the elements of the still being arranged with a deep seal, through which the ascending gases and steam were compelled to bubble. On the contrary, it has been suggested that the capacity of a gas liquor still can be fully maintained, and the steam consumption appreciably reduced, if the ascending gases and steam emerged on the liquor line in the trays.

Fig. 6 shows a continuous gas liquor still which was in operation in London in 1878, the design of which was based on the principle of a comparatively large surface area with a thin film of liquor, along which the gases and steam skirted by reason of the contiguity of the respective plates. It is known that a still 15 ft. high by 7 ft. x 5 ft. in section, having 38 plates, was capable of dealing with the free ammonia content of 10,000 galls. of gas liquor of 6—8 oz. strength per day.

It is clear from the experience afforded by the operation of the above still that heating surface is not alone the governing factor which should be aimed at in the design of gas liquor stills. Rather must attention be directed to ensuring the greatest intimacy of contact along with maximum time contact and heating surface. Attenuated bubbling of such a nature that maximum deformation and/or reformation of the bubbles is ensured, is the principal factor for promoting rapid equilibrium.

Experiments have been directed to the elucidation of the above view by varying the depth of seal for a given still design, and although the author is reluctant to draw premature conclusions, evidences are not wanting which support the theory advanced above.

It has to be remembered that the utilisation of exhaust steam is not confined to vacuum distillation plants alone. Many gas liquor stills operating under normal pressure conditions are worked to-day with exhaust steam. Moreover a consideration of the relative vapour pressure of ammonia and water in typical gas liquors at ranges of pressures between (say) 20 in. of mercury (absolute) and 35 in. (absolute) leads one to the conclusion that no great saving in steam consumption is likely to accrue, whereas an additional expenditure of steam will be required for the operation of the vacuum pump and the pump installed to withdraw the effluent liquor from the still.

Other considerations also operate when working a vacuum still. Some are advantageous, others have the contrary effect. The volume occupied by the steam at (say) 5·7 lb. per square inch (the absolute pressure at which the vacuum still at Hamilton is reported to have worked) is 68 cub. ft. per lb., as contrasted with 24·75 cub. ft. per lb. when operating under normal pressure distillation conditions. Thus, under vacuum conditions, the velocity of the steam through the still is appreciably increased and hence the time contact is reduced correspondingly for a given weight of steam. On the other hand, the greater volume of steam passing over, or bubbling through, the liquor on the several trays is clearly an advantage. Manifestly the elements constituting the chambers of a still operated under vacuum must have larger surface area provided for the ascent of the stream of steam and ammonia.

As uncertainty existed as to the intrinsic capacity of a still for dealing with gas liquor of varying concentrations, experiments were made to determine this aspect. Gas liquor of varying concentrations was fed to the experimental still under such conditions that the effluent liquor leaving the still had approximately a constant composition. From the rates of flow and the concentration, Fig. 7 has been constructed. In brief, this curve represents the amount of ammonia distilled in unit time expressed in relation to the concentration of the feed liquor.

Gas liquor storage tanks.

As to the form of the tanks and the general arrangement for the storage of gas liquor, practice varies considerably throughout the country. The shells of Lancashire boilers are used in many cases for the storage of gas liquor, and it is known that they have served quite well for this purpose. Experience suggests, however, that sectional plated cast-iron tanks are preferable, and are calculated to have a much longer life than second-hand steel boiler shells.

Preheaters and coolers.

With small units of plant it is usual to place the preheater inside the still house, where it is not subjected to extremes of temperature during operation. With larger units of plant the preheaters are almost invariably placed outside the still house building. This practice may be regarded as unsound from the point of view of heat conservation. The quantity of heat leaving the saturator, however, is appreciably greater than that required to raise the temperature of the feed liquor to boiling point. Indeed, cooling water has to be profusely used to reduce the waste gases at atmospheric temperature.

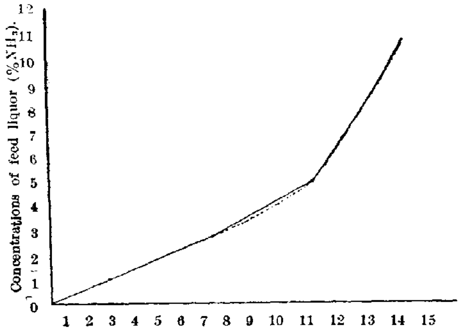


FIG. 7.

Diagram of the capacity of experimental still in relation to strength of feed liquor.

Devil liquor storage tank.

On account of the noxious character of the devil liquor, it is important that certain steps should be taken to ensure its collection and treatment. This is best effected in a sectional plated cast iron tank suitably lagged which will allow of 5 to 6 hours' accumulation. Opinions vary as to the best method of treatment. At many works the devil liquor is pumped along with the gas liquor and the mixed liquors are distilled. The only disadvantage is that expense is entailed in the matter of steam, and many of the impurities of the gas liquor which are arrested with the devil liquor, such as pyridine, creosote oil, naphthalene, etc., are again returned to the saturator. Obviously for the production of white salt it is essential that these impurities should be disposed of in another way, and not recirculated to the saturator.

Moreover, it must be remembered that the distillation of devil liquor represents approximately a 20% reduction of the capacity of the still, which is another important consideration.

Constituent parts of gas liquor stills.

Fig. 7 shows how the elements of the still designed by Dr. Carpenter (*v. supra*) are assembled. The bottom tray is supported on a circular webbed flange arranged within the still. Each succeeding tray is in turn supported by the one underneath. The first bubbler of the free still, placed immediately above the liming chamber, is supported by a vertical 9-in. cast iron pipe (which by a bend near the foot conducts the limed liquor to an outer annulus) placed centrally in the liming chamber and terminating with a suitable base. The first bubbler supports the hood which in turn supports the bubbler. Thus the whole weight of the bubblers and hoods is transmitted to the 9-in. pipe, and the complete weight of the trays is reflected on the webbed flange.

For the permanent machined joints a mixture of red and white lead is used. For the faced joints of the superimposed sections graphite paste is used. A packing of yarn is also employed between the trays and the outside shell of the still so as to prevent the admission of any rust which will interfere with the removal of the trays. The bubblers of the fixed section of this particular still are open, with serrated edges on the two circumferential peripheries.

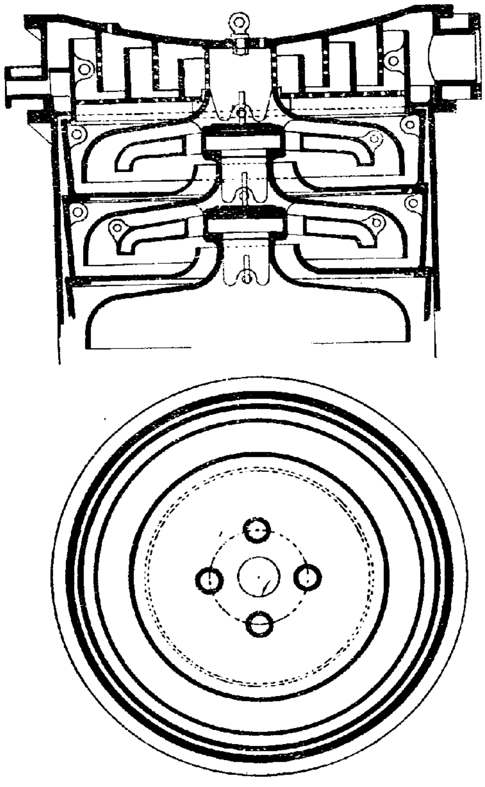


Fig. 7.

The merits of the design of this still are the size of the liquor overflows and the large area of wetted surface which the elements afford. Further, it is evident that the designer has appreciated two other important factors, viz., the great advantage of a high velocity of the vapours where they come in contact with the liquid, and the importance of time contact as between the vapour above the liquid and the liquid itself as aiding equilibrium.

Fig. 8 shows the elements of a still which was introduced to this country about 40 years ago. Some of the features of this still, particularly the liming section, possess definite merit, but it is believed that there are many directions in which the still can be improved, particularly in the matter of area of liquor overflows, time contact between the vapour and liquid, and velocity of the vapours through the liquid.

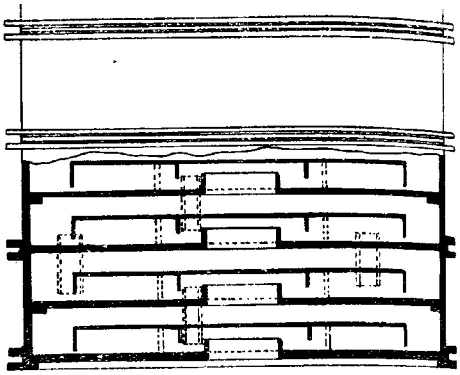


Fig. 8.

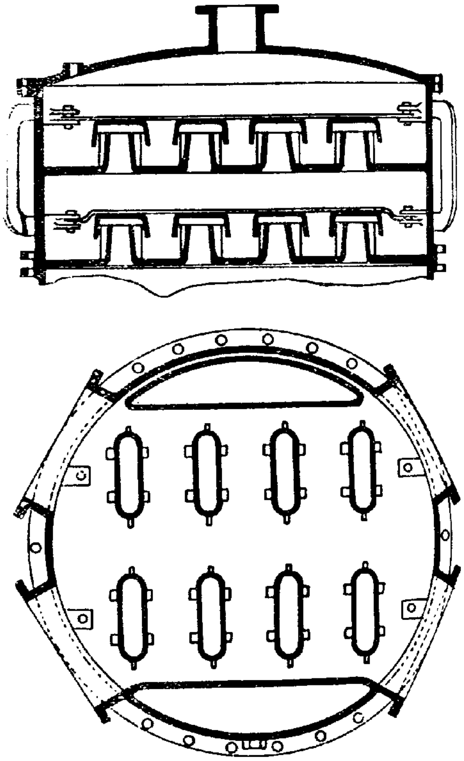


Fig. 9.

Fig. 9 represents the elements of a still of more recent design. Regard has obviously been paid to the removal of the hoods for cleaning purposes, and the possibility of blocked outlets would appear to be remote, in view of their size. The comparatively small diameter of the still in relation to the quantity of gas liquor with which it deals and the arrangement of hoods which clearly admit of the bubbles from one being thrown in contact with those created by the adjacent hood, must ensure considerable deformation, thus increasing the contact of liquid and vapour.

Fig. 10 represents a very simple form of element. If simplicity were the predominant factor in the efficiency of a gas liquor still, this particular design would certainly merit a premier place. The hoods in both the free and fixed stills are rectangular and the travel of the liquid is left to right and right to left alternately. The overflows are tolerably large and the designer has evidently had in mind the importance of avoiding blockages at this point. The hoods are capable of ready removal. One disadvantage appears to be that the arrangement of hood lends itself to localised bubbling. Moreover the area of the serrations is equal to, if not in excess of, the area of the gas slots, which area is too large for ensuring such a vapour velocity as to give anything approaching optimum bubbling.

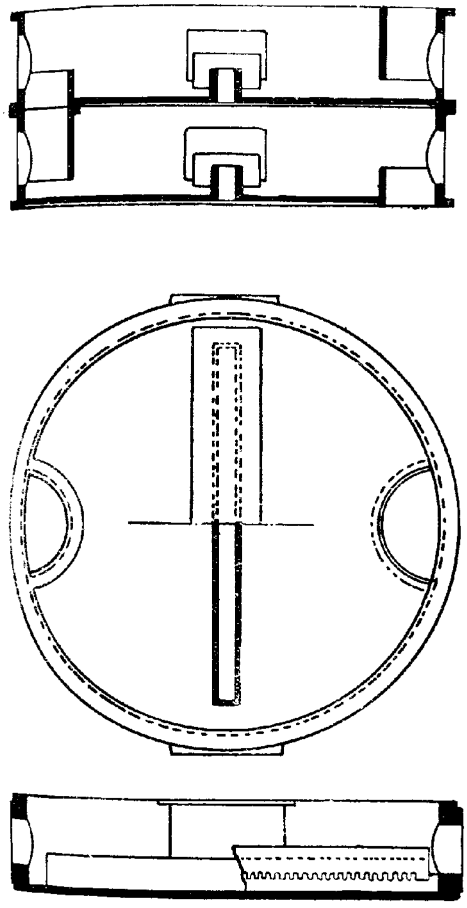


Fig. 10.

Fig. 11 represents the elements of a square still which by reason of its form must have the merit of cheapness as regards cost of production. The bubbling hoods are also readily accessible either for inspection or withdrawal. Whether the liquid will follow the path intended for it appears somewhat open to doubt. Whilst the arrangement of four hoods is a considerable advantage, it is feared that the area for the ascent of the gas is far too large for ensuring satisfactory bubbling, and the liquor overflows also appear to be unnecessarily restricted, although protruding as they do beyond the castings, they are without doubt easy of access.

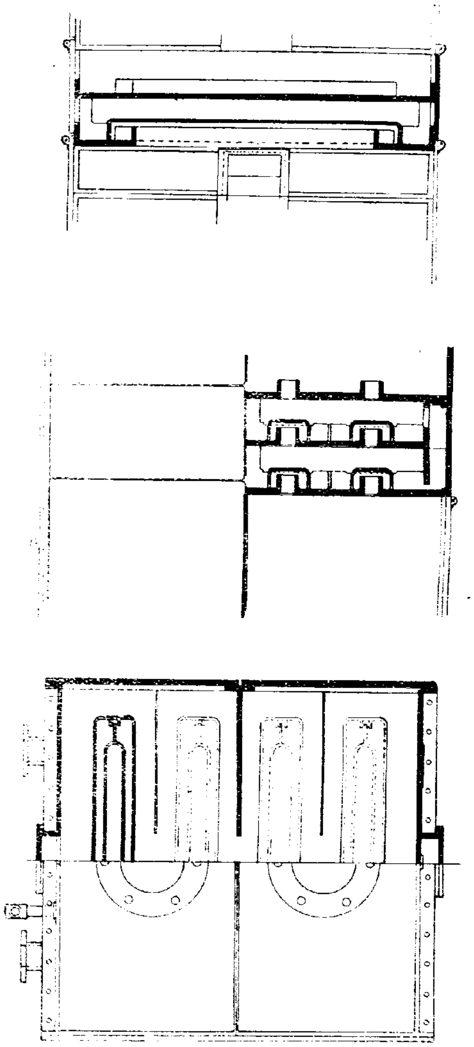


Fig. 11.

Fig. 12 represents the constituent parts of a still of recent design. This still has a very large capacity. The designers have recognised the importance of large overflows and the advantage attending the depth of chamber in relation to the liquor on the trays as increasing the factor of time contact. Moreover the weight of the still in relation to the capacity is certainly a chemical engineering achievement. The latter is largely due to the adoption of a small liming chamber, and of course introduces a subject on which there would be, no doubt, considerable divergence of views. It is believed that the design, by reason of the large area afforded by the serrations, militates against such a vapour velocity as is calculated to ensure satisfactory bubbling.

Fig. 13 represents the elements of a still possessing several merits, particularly the one of creating bubbling over a large surface area, and ensuring impact between the respective bubbles from the several hoods. It will be an advantage if the makers will in future increase the diameter of the overflow pipes, as it is not inconceivable that trouble may arise from this cause.

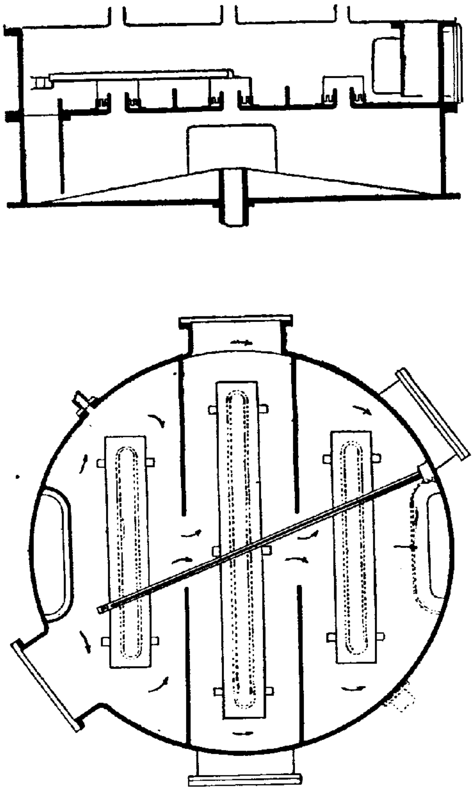


FIG 12.

Fig. 14 represents the chief constituent parts of a still which was designed nearly forty years ago. Whilst the designer has apparently recognised the importance of maximum agitation of the liquid, it is feared that the area of the serrations, which are largely in excess of the area of the gas outlet, will obviate this desideratum.

Fig. 15 represents the elements of a square still, certain advantages of which have already been named. Here the importance of vapour velocity appears to have been recognised, although impact of the bubbles appears impossible. The liquor overflow might with advantage be enlarged.

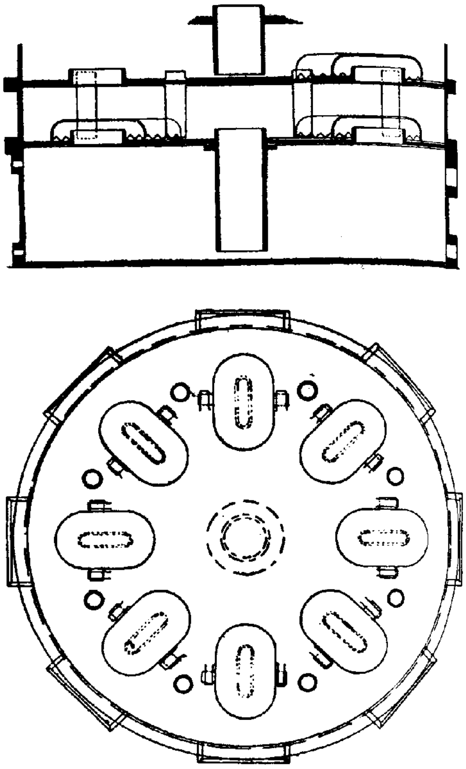


FIG. 13

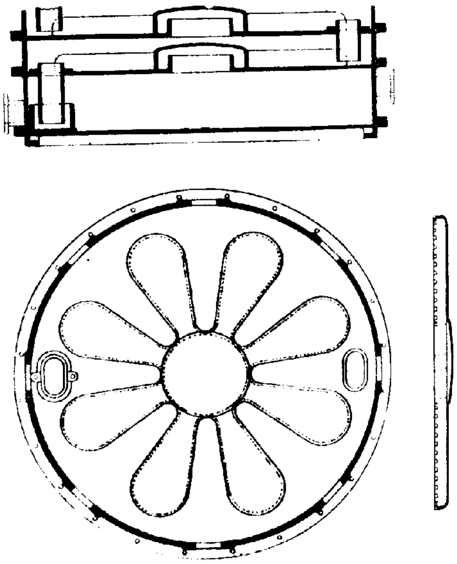


FIG. 14.

Fig. 16 represents the details of a still which it is understood is used to a considerable extent in connexion with ammoniacal liquor arising from the distillation of shale. The position in which the bubblers lie is varied alternately with each chamber. Thus they cross at right angles. Similarly the overflows are arranged alternately. This design, it is feared, does not allow of a suffi-

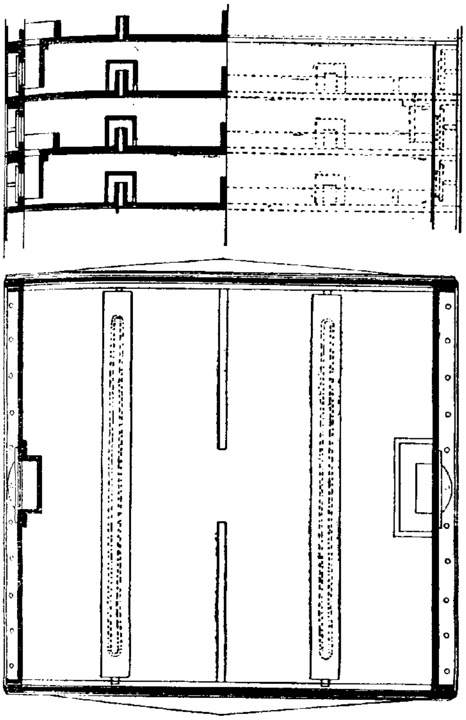


FIG. 15.

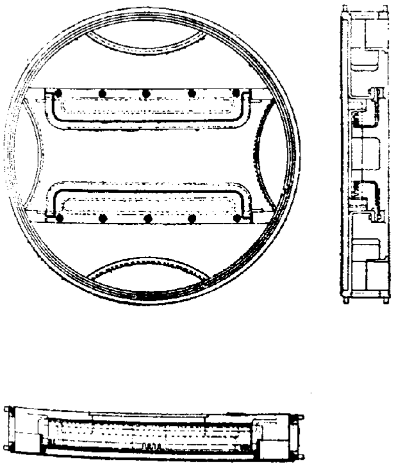


FIG. 16.

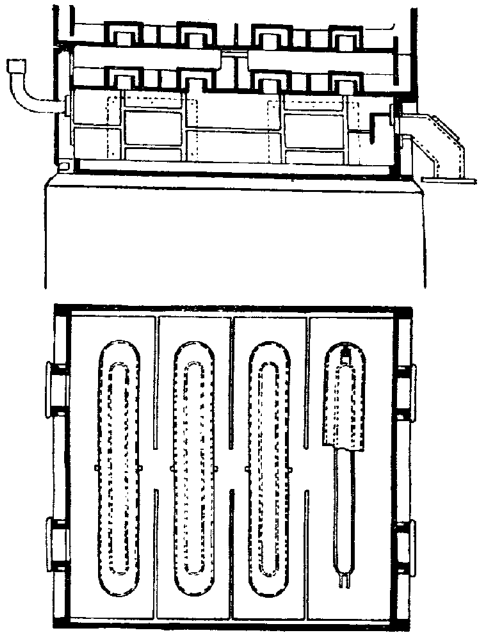


FIG. 17.

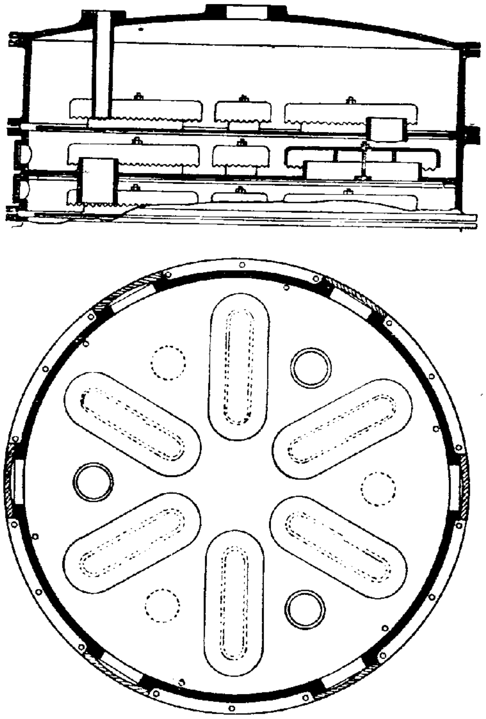


FIG. 18.

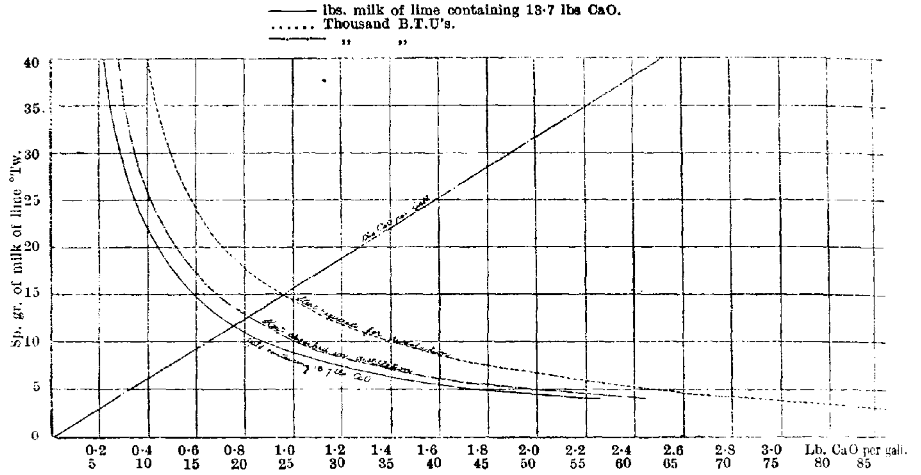
ciently rapid vapour velocity to ensure satisfactory bubbling, although the arrangement of the hoods and their camparative contiguity will doubtless assist in causing conflict between the respective bubbles.

Fig. 17 is similar in many respects to the elements of one of the other square stills to which reference has already been made.

Fig. 18 represents the sections of a still which has obviously been designed to ensure agitation over a large area, but unfortunately the low velocity of the gas is not calculated to assist to this end. The manholes appear to afford satisfactory access to the overflow pipes, but whether the serrations of the hoods can be as easily cleaned, or whether they can be readily withdrawn, is a matter of doubt. If there had been a larger vapour space above the liquid level in the trays, this would have ensured a greater time contact which obviously is a decided advantage.

"Liming" and liming chambers.

The most economical way of liming the gas liquor, which has been deprived of its volatile ammonia, is to introduce powdered lime by a positive method to the liming chamber. By pursuing this method steam and water are economised, and in addition advantage can be taken of the heat generated by the formation of calcium hydroxide. The importance of this aspect is made evident by the graphs and data furnished in Fig. 19.



Sp. gr. (°Tw.)	4	8	12	16	18	20	22	24	26	28	30	32	34	38	40
Lb. CaO per gall.	0·244	0·498	0·752	1·00	1·13	1·26	1·38	1·52	1·64	1·77	1·90	2·03	2·16	2·42	2·55
Galls. required to give 13·7 lb. CaO	56·1	27·5	18·2	13·7	12·1	10·9	9·9	9·0	8·4	7·7	7·2	6·7	6·3	5·7	5·4
Lb. required to give 13·7 lb. CaO	572	286	193	148	132	120	110	101	95	88	83	78	74	67	65
A. Heat required for dissolution, B.Th.U. (1000's)..	86·4	43·2	29·2	22·4	19·9	18·4	16·6	15·3	14·3	13·3	12·5	11·8	11·2	10·1	9·8
B. Heat absorbed in distillation, ditto	60·9	30·5	20·5	15·8	14·1	12·8	11·7	10·8	10·1	9·4	8·8	8·3	7·9	7·2	6·9

NOTES.—1. The above figures are calculated for the distillation of 100 galls. of 8-oz. liquor having a fixed ammonia content of 0·346% w/v (20% of the total ammonia).

2. An excess of 20% above theoretical lime quantity is allowed.

3. The milk of lime enters the still at 110° F. and has therefore to be raised through 106·5° to 216·5° (the temp. of distillation).

4. The heat required for the dissolution of the lime is taken as 151 B.Th.U. per lb. of solution.

FIG. 19.

Diagram having reference to the thermal aspect of the application of lime.

Unfortunately lime containing 96% CaO and free from ashes is very difficult to obtain, and no doubt this has been one of the deterring factors to the adoption of such a method as the one indicated. It is found in practice that cream of lime cannot be pumped satisfactorily, and that if pumping is resorted to milk of lime of about 16° Twaddell at 70°—75° C. has to be used. The lime mixer must obviously be placed in such a position that the cream of lime (say) of 30° Tw. can be gravitated direct to the liming chamber. When regard is had to the fact that lime is with difficulty soluble in water (only a 0·17% solution at 15° C. being possible) the importance of maintaining the cream of lime in agitation with the liquor need not be unduly emphasised.

The introduction of cream or milk of lime to the still chills the liquor at the foot of the liming chamber momentarily, but sufficient steam, usually about 10% of the total, has to be added to ensure the necessary agitation and to maintain the mixed liquor at boiling temperature.

Coming to the question of the size of a liming chamber, it would appear evident that if agitation is to be efficient, there must be a limit to the size of the liming chamber in relation to a given volume of limed-liquor treated. Undoubtedly one of the faults of design of many liming chambers is that they are too large and allow calcium salts to settle out, instead of being retained in a state of suspension. This is a matter to which increasing attention could be very profitably devoted.

Not infrequently has the question been asked, by managers in charge of small and medium sized sulphate of ammonia plants, whether any formulæ were known relative to the quantity of milk of lime required per unit volume of gas liquor containing a certain percentage of fixed ammonia in relation to the total ammonia.

Fig. 19 is of interest in this connexion. It is clear that a formula of the kind referred to can be readily calculated from analytical data. One such formula (based on the milk of lime required per hundred gallons of gas liquor) of which the writer has knowledge is expressed thus:—

$$V = 65 F \div L,$$

where V represents the volume of milk of lime in gallons, F the fixed ammonia content of the gas liquor in ounce strength, and L the strength of lime in degrees Twaddell.

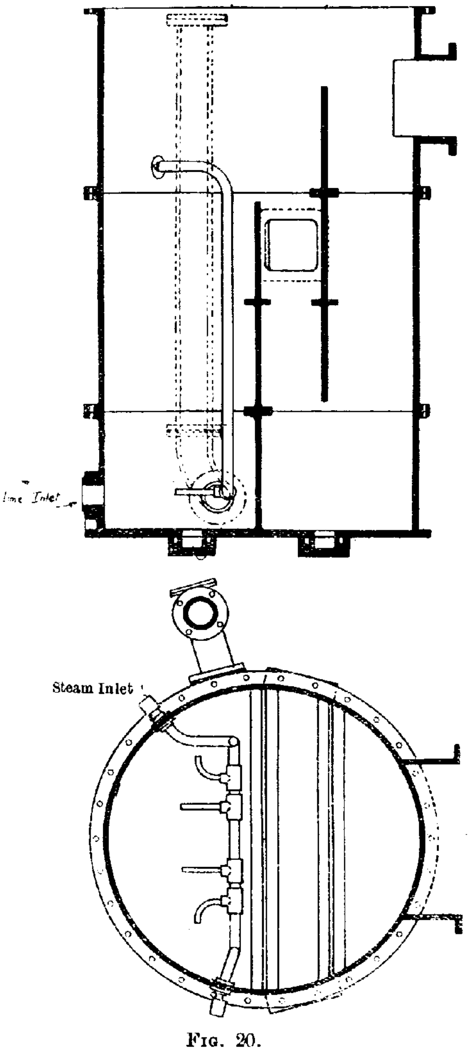


FIG. 20.

The following calculation will afford an indication as to how the above formula has been arrived at, and incidentally gives an idea of the excess milk of lime solution which it contemplates:—

1 oz. strength = 0·3469 oz. NH_3.
1° Tw. milk of lime = 0·845% CaO at 70° C.;
or, in 100 oz. ditto there is 0·845 oz. CaO
in 1 gallon ditto ,, ,, 1·352 ,, ,,
$2 NH_3$: CaO as 34 : 56

1 oz. fixed ammonia requires $\frac{0·3469 \times 56}{34}$
= 0·5712 oz. CaO.

The factor per gallon of gas liquor on the above given data is 0·5712 ÷ 1·352 = 0·42, or a factor per 100 gallons of 42.

Presumably the formula cited contemplates about a 50% excess of milk of lime. This is rather excessive as extended experience suggests that the whole of the fixed ammonia can be eliminated, given reasonable control with a surplus of milk of lime of 10—20% of the theoretical.

Coming now to the question of typical liming chambers, Fig. 20 shows a pipe bringing the gas liquor to be limed to the foot of the still, at which point the milk of lime is added. The steam inlet pipe is provided with four outlets two of which are placed tangentially, the other two being at right angles to the pipe. The baffle plates admit of considerable travel for ensuring uniformity of admixture.

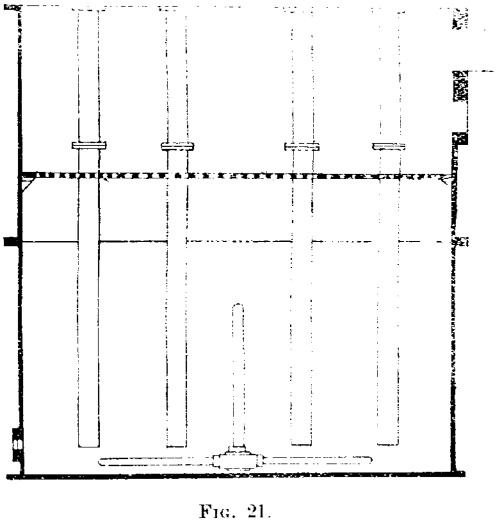


FIG. 21.

Fig. 21 represents another form of liming chamber. The liquor to be limed is brought to the foot of the still by four pipes and the milk of lime is admitted at the foot of the still, a suitable agitating steam pipe with radial arms being provided. The limed liquor ascends the liming chamber and is filtered through a perforated plate prior to being discharged to the fixed still. Whether blockages arise on the perforated plate is not known, but except the agitation is tolerably effective, it is feared that this may prove a possible source of difficulty, particularly so as the perforated plate is not too readily accessible.

Fig. 22 shows a simple form of liming chamber which intervenes between the free and fixed stills. The liquor to be limed enters almost at the foot of the chamber, at which point the milk of lime is

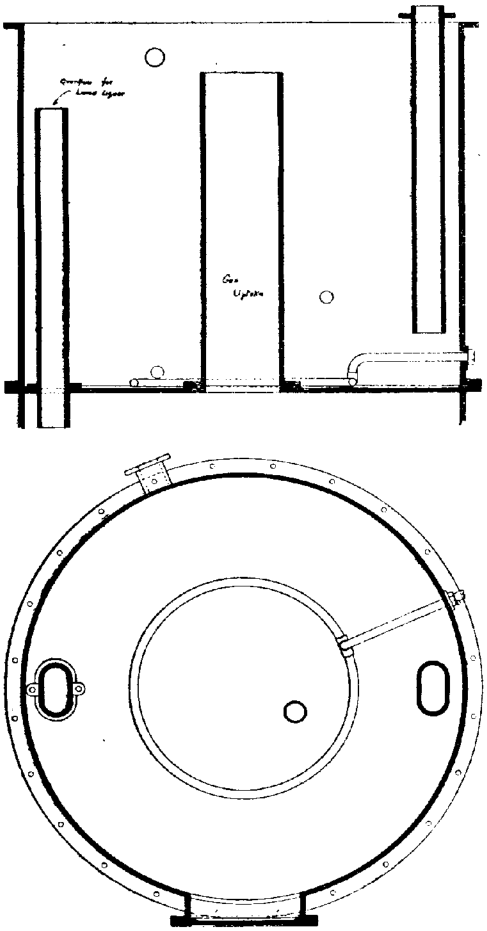


FIG. 22.

introduced. Agitation is created by a circular perforated pipe, the limed liquor leaving by the overflow pipe shown in the sectional elevation.

Fig. 23 represents another typical liming chamber having many features in common with those already described. It will be seen that this arrangement provides for the limed liquor passing to a chamber at the foot of the column before being led to the fixed still.

It is important that the gas liquor should be thoroughly decarbonated before entering the liming chamber, otherwise the ammonium carbonate will react with the milk of lime forming calcium carbonate, which becomes hard in the still and renders cleaning much more frequent and difficult.

Where the liming chambers are of tolerable size, provision should always be made for the periodic emptying of the liming chamber in order to remove the accumulations of lime sludge which settle out. Indeed, it has been found advantageous in the operation of many stills to run off part of the limed liquor from the liming chamber direct to the waste liquor main once or twice each day.

Manholes should also be provided in connexion with all liming chambers in order to afford access for cleaning purposes.

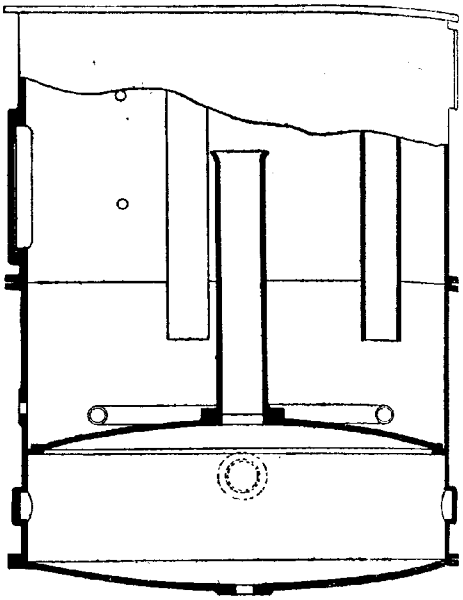


FIG. 23.

Seal pots.

To prevent the escape of steam etc. from the foot of the fixed still or fixed segment, it is necessary to provide some suitable seal pot or equivalent arrangement in order to ensure that the steam admitted to the fixed still will proceed through the several chambers and not by-pass the apparatus.

Constant steam supply.

The pressure against which the steam has to work in the fixed still, where usually 90% of the total steam is admitted, is the pressure of the combined seals in the several trays, plus the seal of the cracker pipes of the saturator, and the skin friction of the preheaters, coolers and pipe lines. This pressure will obviously vary with different stills, but usually does not exceed 3½ lb. per sq. in.

In the case of the steam admitted to the liming chamber, the pressure against which this will have to work will be of the order of 5–6 lb. per sq. in. It is clear, therefore, that some form of reducing valve must be used, in order to reduce the pressure at which the steam boilers normally work to a pressure compatible with the requirements of the stills.

Constant feed of liquor.

Many arrangements for ensuring a constant feed of liquor to ammoniacal liquor stills have been devised. Generally speaking, those having a float or suitable steel ball valve placed inside a small tank are the ones in operation in connexion with small and moderate sized distillation units. On the whole this type of constant feed arrangement has been found fairly satisfactory in operation. Some makers provide a graduated sight feed arrangement, consisting of a globe inside which is placed a pipe having a series of vertical stepped holes, graduated to represent varying rates of flow.

The only disadvantage of either of the above arrangements is the fact that the pressure against which the liquor is discharged is a slightly varying one, dependent on the depth of the acid seal in the saturator.

An arrangement for ensuring satisfactory and uniform feed in connexion with large units of plant provides for direct pumping of the liquor to the still, the rate of feed being governed by a cock to which is fitted a graduated quadrant and pointer. As a means of governing the delivery of liquor from the pump a connection is made from the delivery line to the suction, and inserted in this line is a spring-type of by-pass valve. The principle of this by-pass valve is that the liquor floats the mushroom valve against the pressure of the spring which can be adjusted.

Constant discharge.

This is dependent almost wholly on the maintenance of the two conditions to which reference has just been made. It has been found in practice that the setting of the outlet cock can best be adjusted by providing it with a graduated quadrant and pointer.

Prior to the admission of steam to the still for heating purposes it is important that all the trays should be sealed as well as the steam pipe or jets in the liming chamber and the fixed still. The heaters and coolers should also be filled with gas liquor and water respectively so as to prevent possible fracture of the pipes when the cold liquor is first introduced. Provision should be made for venting the air from the still. A suitable arrangement is to take a 1¼in. wrought iron pipe from the cast iron pipe leading from the still to the saturator, and provide this with a cock, allowing the discharged foul air to be emitted to the atmosphere.

The practice of venting a still inside the still-house is a dangerous one and should be discountenanced.

The gradual admission of steam to the still is important, particularly with the types of distillation apparatus which consist of a series of double-flanged pieces which are heavy in character. Such stills must be cautiously heated, otherwise the irregularities of expansion will cause fracture.

With a new still of tolerably large capacity at least twelve hours should be allowed for raising the temperature to the requisite degree for the admission of the gas liquor.

Thermometers should be provided, preferably fixed in suitable oil pockets, on the liquor inlet to the preheaters and on the outlet to the still, and similarly thermometers should be fixed on the waste gas inlet to the coolers and on the outlet.

It is also desirable to arrange a centrally situated gauge board so that the various pressures can be observed without difficulty by the operator of the plant.

It is equally important that each of the stills in the case of category A type of plant, and the columns in the case of categories B and C should be provided with an efficient safety valve, one form of which is of a simple spring type and can be easily adjusted and set to relieve at any predetermined pressure.

The heating of a still after temporary stoppage need not occupy more than four hours. After the top portion of the still has become warm, the cock of the vent pipe can be closed and the steam sent forward through the saturator, the cracker pipes in which have been sealed with mother liquor. It is important that the devil liquor outlet cocks should be opened immediately the heaters become warm in order to allow of the automatic withdrawal of condensation which must arise, due to the cooling influence of the gas liquor and water with which the heaters and coolers are filled.

Prior to feeding the still with gas liquor it is wise to pump, or gravitate, milk or cream of lime to the still, so that by the time the gas liquor is introduced, there is a complement of boiling milk or cream of lime in the liming chamber.

The raising of the temperature of the apparatus to this point is usually done with steam at boiler pressure, but immediately the liquor feed is commenced the reducing valve should be brought into operation by removing one or more of the weights on the spindle. The next step is to direct attention to the passage of the limed liquor to the fixed still, the connecting pipe to which is usually provided with a cock so that samples can be drawn from time to time. As soon as the limed liquor enters the fixed still a further and final adjustment of the steam reducing valve and the steam inlet valves to the stills is necessary.

Temperatures at the essential parts of the plant should be taken at regular intervals and should be recorded. Equally the liquor feed gauge board should be watched very carefully so as to make certain that a uniform feed is being obtained. Records of the liquor fed to the still should be made half-hourly.

It is usual to connect a cast iron pot to the fixed still, and to provide such pot with two vertical pipes, one of which is carried almost to the foot of the pot and which is provided above the pot with a glass tube suitably connected to give an indication of the working level of the still, the other pipe being attached to the cover of the pot in order to serve as a safety valve.

One other point of importance as affecting the operation of gas liquor stills has reference to the necessity for a uniform feed of devil liquor along with the gas liquor. It has been found that an indication of the uniformity of conditions is furnished by taking a continuous temperature record of the waste liquor leaving the still.

A continuous sample of the waste liquor leaving the still should be taken and a definite standard adhered to in this connexion. Experience suggests that 0·015% NH_3 in the waste liquor is an economic strength, as working below this limit simply resolves itself into the recovery of an exiguous amount of ammonia at the expense of labour in the operation of the plant. The devil liquor should be tested periodically from the points of view of its freedom or otherwise from ammonia and its volume. The presence of ammonia indicates that leakages are occurring, and these should be arrested at the very outset. An unduly large volume of devil liquor suggests a high consumption of steam in the distillation of the liquor, or otherwise the leakage of water in the coolers.

Early indications are furnished of the fouling of the stills by the necessity for reducing the volume of steam being introduced thereto, and it will be found, other things being equal, that the effluent liquor gradually increases in point of ammonia content. If tar accidentally becomes mixed with the liquor, in order to prevent this adversely affecting the working of the still, the preheaters and pipe lines to the still should be discharged, such discharged liquor being returned to a tank for separation or other suitable treatment.

In concluding these observations the author desires to summarise his views as to the direction in which progress in the design of ammoniacal liquor stills is likely to proceed in the future.

Designers must concentrate their attention and energies to the evolution of the elements of a still which will be economical as regards steam consumption. Data must be arrived at as to the relative value of attenuated bubbling, as compared with time contact of the liquid and the vapours as a factor in aiding equilibrium. Obviously distillation cannot proceed until the vapour pressure of the ammonia in solution in the trays is in excess of the vapour pressure of the ammonia in the vapours.

It should be possible to design such a form of bubbling device as will not only assist in promoting optimum bubbling, with maximum impact between the respective series of bubbles so formed, but that such an arrangement need not necessarily appreciably reduce the factor of time contact of the liquid and vapour. Such time contact can obviously be increased by allowing a tolerably large vapour space above the liquid in the trays.

Optimum bubbling is a function of a definite vapour velocity, which, when exceeded, will hold up the liquid and prevent contact between the vapour and liquid—in other words, will defeat its own object. This definite vapour velocity will differ in each compartment of the still, by reason of the varying vapour volumes, and instead of as at present the serrations, or perforations, of the bubblers being uniform in size, these must be modified in accordance with the varying volumes indicated.

As regards the utilisation of the surplus heat leaving the saturator, it is evident that the present arrangement of plant as generally known must be improved in order that more satisfactory conservation of the heat available can be ensured. There are several possibilities in this direction which must occur to one on careful consideration of the conditions obtaining.

Finally the author wishes to express his thanks to those chemical plant manufacturers and gas engineers who have kindly placed drawings and photographs of their stills and accessory plant at his disposal, without which the paper must obviously have been less comprehensive in its scope and data.

He also wishes to express his thanks to Dr. Carpenter and Mr. E. V. Evans, F.I.C. (the Chief of the Chemical Department), for their permission to publish certain experimental and other data embodied in the paper, and for their helpful guidance at all times.

His thanks are likewise due to Messrs. O. W. Weight, F. C. Snelling, and C. E. Parr for their assistance in the preparation of several of the drawings and diagrams, and for their helpful suggestions.

THE GENERAL PROBLEM OF EVAPORATION.

BY PROF. J. W. HINCHLEY, A.R.S.M., F.I.C.

[Abridged.]

The common meaning of the term "Evaporation" is the vaporisation of a liquid at some temperature below its boiling point, but in the technical sense the word may be considered to be synonymous with vaporisation.

The subject is a very difficult one and challenges the chemical engineer at every turn. It may be considered under two heads:—

(*a*) Evaporation below the boiling point of the liquid evaporated and

(*b*) Evaporation at the boiling point.

The study of the former has occupied the attention of meteorologists, physiologists and physicists to an extraordinary extent for many years, but unfortunately the work has rarely had any chemical engineering aspect, and its utility for this purpose is generally lost sight of.

Dalton, Apjohn, Maxwell and Stephan are the most celebrated of the host of workers who have studied this subject. Stephan showed that the rate of evaporation from a circular flush tank of radius a is given by the expression:—

$$4\ a\ k\ \log \frac{P - p_0}{P - p_1}$$

where

k is the coefficient of diffusion of the vapour,
P is the total barometric pressure,
p_0 is the partial pressure in mm. of Hg. of the vapour of the air,
p_1 is the partial pressure of water vapour at the temperature of the water surface.

If p_0 and p_1 are small in respect to P this formula becomes—

$$4\ a\ k \left(\frac{p_1 - p_0}{P}\right)$$

Such a formula is useless to the chemical engineer, since it is almost impossible of application. It states that the rate of evaporation is proportional to the linear dimensions of the tank.

A short experience with figures derived from industrial work rapidly proves that the rate of evaporation may be taken to be proportional to the area of the surface without serious error, provided that other factors such as the size, the ventilation and other points with respect to the factory are taken into consideration.

The urgent necessity some years ago of estimating the outputs of crystallising plant compelled the author to determine the rate of evaporation from water surfaces under ordinary factory conditions. The ordinary statement that the rate of evaporation in still air was proportional to the difference between the vapour pressure of the liquid and the vapour pressure in the air was found to be untrue, but a simple and reliable formula, at any rate for chemical engineering purposes, was found and adopted. The formula may be subject to criticism on account of its dimensions, but its utility justifies its existence. Since that date hundreds of experiments with simple apparatus have been carried out by the students of the Imperial College in the course of their training, and it is found that the rate of evaporation may be expressed by a simple formula:—

$$\text{Rate of evaporation in kilograms per sq. metre per hour from water surfaces} = \left(\frac{p_e - p_d}{50}\right)^{1 \cdot 2}$$

where

p_d = vapour pressure of the liquid in mm. Hg.
p_e = vapour pressure of the water vapour in the air in the same units.

This equation has been drawn in the form of a curve (Fig. 1), and as an alinement chart by Mr. Umanski (a former student of the Imperial College). Knowing the temperature of the water and the hygrometric state of the air, the formula enables one to determine at any instant the rate of evaporation from tanks of water in still air. With salt solutions it is obvious that the formula should give accurate results provided that the reduction of the vapour pressure of the solution through the presence of the salt be taken into account. These experiments have been made both with water and with salt solutions and compared with factory results. In general the agreement is good, but for estimating purposes the formula may be assumed to be 10% high.

When calculating the value of p for a salt solution using Raoult's law (the lowering of vapour pressure is proportional to the mol perunitage of the dissolved salt present), any dissociation of the salt should be taken into account.

Above 60° C. the experimental results are lower than those indicated by the formula owing to the fact that p_d is not the true vapour pressure in the air in immediate contact with the liquid. On the other hand the margin conditions modify the effect as between large vessels and small vessels to a small extent.

It may be remarked that since from a theoretical point of view the rate of evaporation in a still atmosphere should be proportional to the vapour pressure difference, some explanation of the index is desirable. The explanation seems to be that absolutely still air is impossible under the conditions, for moist air is lighter than dry air, so that convection must be a normal accompaniment of evaporation. Again, when there is a difference of temperature between the liquid and the atmosphere the convection effect must be still more evident.

Leonard Hill, in approaching the subject from a physiological standpoint, obtained a slightly different formula. He used a simple and ingenious instrument called a "Kata-thermometer," simply an alcohol thermometer with a large bulb which measures its own rate of cooling. By covering the bulb with a "muslin glove," after dipping the whole instrument in hot water, its rate of loss of heat could be determined in any air conditions imposed. He referred all his results to the temperature of the human body. It will be obvious that the area of surface of a "muslin glove" could not be a very accurate figure for our purpose, although it is remarkably valuable and satisfactory for physiological purposes. He obtained the formula—

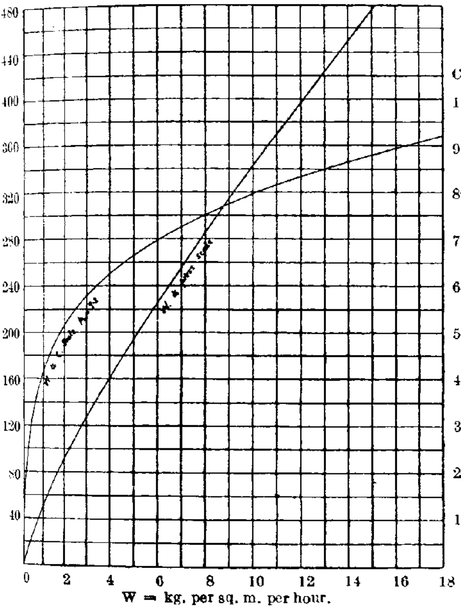


Fig 1.

$$E = 0{\cdot}085\left(p_e - p_d\right)$$

where E is the rate of evaporation loss in heat units—millicalories per sq. centimeter per second. It will be noticed that the index is $\frac{4}{3}$, not 1·2.

The work of Carrier in America calls for special mention, since he has approached the subject from a chemical engineering point of view and has obtained extremely useful results. His formula for evaporation in still air is—

$$R = 0{\cdot}093\ (e^1 - e)$$

where R is the number of pounds of water evaporated per sq. foot of surface per hour and e^1 and e are the vapour pressures of the liquid and in the air respectively in inches of mercury. Converted into metric units and using the same notation as before we get—

$$W = 0{\cdot}0178\ (p_e - p_d)$$

It will be noticed that 0·0178 is nearly $\frac{1}{56}$.

Effect of velocity.—The effect of a draught on the rate of evaporation from the surfaces of liquids has been investigated by many observers. There is a difference of opinion as to whether the rate of evaporation is increased in proportion to the velocity or in proportion to the sq. root of the velocity of the current of air.

Jeffries in 1918 discussed the subject mathematically and found that:—

(1) The rate of evaporation is proportional to the sq. root of the velocity.

(2) The total evaporation from surfaces of the same shape and orientation to the wind are as the $\frac{3}{4}$ powers of the respective areas.

The difficulties of ensuring that the current of air is parallel to the surface, that its velocity is uniform and is measured accurately, apart from the presence of disturbances and convection effects, make the problem extremely difficult.

Leonard Hill's experiment first led him to a formula involving the sq. root of the velocity, but he has now added to his "still air" formula the factor $0{\cdot}102V^{0{\cdot}3}$, where V is the velocity of the wind in metres per second. This would indicate that the rate of evaporation is doubled in a wind velocity of 0·55 metre per second.

It is obvious that the rate of evaporation will be greater for a wind impinging on a surface than for a wind parallel to a surface, and it is usually found that the rate is nearly doubled when the wind strikes the surface at a right angle. This would explain the high rate given by Hill's formula, since his "Kata-thermometer" exposes a large area of vertical surface.

Carrier states that the rate of evaporation is $3\frac{1}{2}$ times as great in a wind of 4000 ft. per minute velocity as in a wind of 1000 ft. per minute velocity, and the formula he adopts indicates that the increase in evaporation is proportional to the velocity. Converted into metric units his equation becomes—

$$W = 0{\cdot}0178\left(1 + \frac{v}{1{\cdot}17}\right)(p_e - p_d)$$

It will be seen that in a current of air parallel to the surface the evaporation is increased to twice that in still air at a velocity of 1·17 metres per second—almost exactly half that given by Hill's formula. The effect of changes in barometric pressure on the rate of evaporation may be allowed for by modifying the formula as follows:—

$$W = 26{\cdot}2\left(\frac{p_e - p_d}{P}\right)^{1{\cdot}2}$$

and if we adopt Carrier's figure for the effect of velocity on evaporation we obtain the following formula:—

$$W = 26{\cdot}2\left(1 + \frac{v}{1{\cdot}17}\right)\left(\frac{p_e - p_d}{P}\right)^{1{\cdot}2}$$

where, as before, W is the number of kilos of water evaporated per sq. metre of surface per hour, v is the velocity of air in metres per second, p_e and

p_d are the vapour pressures of the liquid and in the air respectively in mm. Hg. P is the barometric pressure in mm. Hg.

This formula can be approximate only, but under ordinary practical conditions where the temperature of the liquid is less than 60° C. the error should not be more than 10%.

The experimental work at the Imperial College has not reached the stage when this formula can be thoroughly criticised.

It is obvious that the formula must fail with high velocities of air current because saturation of the air will impose a limit—in fact, the straight line law suggested cannot be strictly true.

There are many applications of the fact that the rate of evaporation from a vertical surface is practically twice that for a horizontal surface—the conditions under which direct impingement of the current of air may readily take place.

In drying cakes of wet material the rate of drying is increased greatly by placing them on edge. One of the most successful air-drying peat processes depends largely on that fact.

With respect to the evaporation of liquids other than water, the rate of evaporation appears to be proportional to the molecular weight, and for liquids which are not associated the law may be stated—

$$W = 0{\cdot}48\,M\left(\frac{p_e}{P}\right)^{1\cdot2} \text{ (approximately)}$$

where

M is the molecular weight of the substance
p_e is the vapour pressure of the liquid
P is the barometric pressure.
W is the weight of liquid evaporated in kg. per sq. metre per hour.

Measurement of vapour pressure.—The accurate determination of the vapour pressure in the air is becoming more and more important as the effect of air-conditioning on the output of factories is becoming appreciated. The determination of the dew point directly is often in error through the temperature or heat gradient in the instrument being comparatively great. Fig. 2 shows a convenient dew point hygrometer designed by the author. The thin silver chamber is charged with ether and air drawn through it by means of a water pump or rubber bulb. The cooling produced by the evaporation of the ether lowers the temperature of the surface until dew appears. The flow of the pump is then reduced until the dew just disappears. The mean of the temperatures at which these phenomena occur is taken to be the dew point. Unfortunately, even if the experiment is performed very slowly, and although a reading of less than one-fifth of a degree can be obtained, the temperature gradient may produce an error of twice or three times that amount. This fact is due to the high surface resistance of even such a conductor as silver, so that the temperature of the thermometer for both readings may be as much as half a degree different from that of the surface upon which the dew is formed. By making the bulb of the thermometer the container for the cooling agent as well as the surface for the deposition of dew the effect of the temperature gradient may be eliminated and a very accurate result obtained.

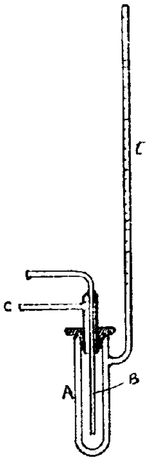


FIG. 2.

The dry and wet bulb thermometer appears to be the universal instrument of the factory for the determination of the hygrometic state of the air. A discussion of the instrument would be too long for this paper, but it may be stated that although it is nearly always inaccurate it is rarely misleading. In instruments where the bulbs are shielded and the air is drawn past the wet bulb by mechanical means most satisfactory results are obtained, but the ordinary stationary instrument is very unreliable.

The more recent electrical methods give excellent results, but if used without a complete knowledge of the principles involved may be very misleading.

Drying.—While the evaporation formula given are devised for use in cooling, crystallising, and concentrating operations, they may also be applied to drying operations in air dryers.

If the rate of drying does not exceed the rate of liquid diffusion through the material the rate of drying is nearly proportional to the perúnitage of "free" moisture present in the material. The texture and plasticity of the material affect this rate to an extent which cannot generally be estimated, and experimental tests for the determination of drying factors (the relation of the rate of drying of the material to the rate of drying of a water surface under the same conditions) are always necessary.

Knowing the maximum and minimum drying factors for the material in question and therefore the maximum and minimum rates of drying the logarithmic mean of these rates will give the average rate of drying. Since the determination of a logarithmic mean is one of the commonest calculations the chemical engineer must make I have ventured to submit a graphical method of determining it. If the smaller number be divided by the larger number and the fraction obtained be called "j," the logarithmic mean will be given by multiplying the larger number by the fraction:—

$$(1-j) \div \log_e 1/j$$

The values of this fraction are given by the curve (Fig. 3).

Boiling point evaporation.—In considering the subject of evaporation at the boiling point we meet with many new conditions and limitations to the rate of evaporation possible or desirable. A successful evaporating plant is one in which for a given quantity of heat supply the maximum rate of evaporation is produced at the minimum cost. On this account it is necessary to employ heating surfaces at their highest rates of working, to use sizes of vessels and pipe work so that for a given expenditure in capital, fuel and labour, the maximum amount of profit is obtained.

There is no question that the efficiency of chemical plant is capable of enormous improvement by the application of sound chemical engineering science both in design and operation. Few are aware to what a considerable extent this improvement may be carried.

The rate of heat transmission in evaporating plant from steam to water solutions may vary in the same kind of plant from 300 to over 3000 calories per sq. metre of surface per hour per 1° C.

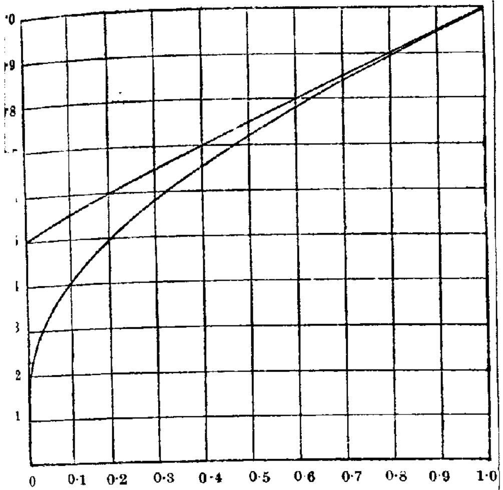


Fig. 3.

temperature difference. This simple fact illustrates the possibilities of sound chemical engineering.

In plant in which evaporation takes place from the surface it is obvious that the area of that surface should bear some relation to the amount of evaporation. The equation we have already discussed fails when $p_e = P$ (*i.e.*, at the boiling point), but it suggests that at the boiling point of water the rate of evaporation in still air would be about 26 kg. per sq. metre per hour and that such an evaporation would be produced from water without any disturbance of its surface, that is, without any boiling. This figure seems to indicate the rate of evaporation from any water solution at which no difficulties from frothing, entrainment, or other troubles could occur.

The maximum rate at which evaporation might take place from an evaporator is not easy to determine, but everyone who has had charge of evaporators or stills will have experienced the effect of projection of the liquid from the still, either as a whole or by frothing or by ordinary entrainment. The designer of the plant, however, must fix a limit to the rate of evaporation from the surface in his particular apparatus, and it has been the author's practice to suggest the figure of 250 kg. per sq. metre per hour. In rectifying plant, where entrainment must be avoided at all costs, this rate should not exceed 100 kg. per sq. metre per hour. These figures do not represent the maximum rate at which any apparatus may be worked, but they do give a convenient design figure.

In that type of evaporator in which the liquid is forced through tubes and the contents of the tube are projected into the chamber in which separation of liquid and vapour may take place, this limitation of area does not arise. In this type we obtain a more or less fine spray in which the convex surfaces of the drop present a maximum area and the best conditions for vaporisation. On the other hand, however, frothing of the liquor may impose a working limit.

An interesing feature about frothing is the fact that there is generally a critical rate above and below which the plant may be worked without any trouble from this source.

An effective "save-all" or arrangement for the separation of spray from vapour makes the question of area of pan of less importance, but it is always desirable to measure the amount of entrainment, which is occasionally excessive.

In most commercial plants it is obvious that the limitation of the rate of evaporation is mainly a question of heat transmission. On this subject it is quite easy to produce observations which are mutually contradictory, unless one takes into account secondary effects which are neglected and generally misunderstood.

It is generally assumed that the rate of heat transmission through any given surface is proportional to the temperature drop, and this assumption enables the chemical engineer to make calculations for design purposes which are usually satisfactory in practice.

It has been stated by many observers that the rate of heat transmission per degree Centigrade of temperature difference per unit of surface increases with the temperature drop. On the other hand, there are quite a number of observations which would suggest that the rate of heat transmission is greater with small temperature drops.

In many experimental results the figures obtained are simply measures of the rate of supply of heating agent to the apparatus, the capacity of the pipe-work to supply steam, etc.

Contradictory results may be explained by simple physical facts that have been overlooked, errors in determination of mean temperature and temperature differences etc.

A few preliminary experiments at the Imperial College gave curves of heat transmission which could only be expressed by a cubic equation. It is obvious that contradictory conclusions could easily be drawn from such experimental results if they had not been carried far enough to reveal their character.

A slight consideration of heating by steam is all that is possible in this paper.

The rate of heat transmission from steam to boiling liquids is determined mainly by :—

(a) temperature drop and temperature level.

(b) the velocity of the liquid and of the heating steam.

(c) the density and viscosity of the liquid.

(d) the resistance of the surfaces and scale.

(e) the resistivity of the material of which the heating surface is made.

The work of Badger and others in American Universities is very valuable on these points.

Temperature drop.—There is little doubt that the rate of heat transmission is not strictly proportional to the temperature drop; but since the amount of mechanical disturbance bears some relation to temperature drop and temperature level, and is limited by the construction of the plant, no mathematical relation is possible except for a particular design. It is found that with a particular type of plant or at a particular temperature level, a certain temperature drop will give a maximum rate of heat transmission. At high temperature levels this drop will be greater than at low temperature levels and with high hydrostatic heads greater than with low hydrostatic heads. With film evaporation this drop is smallest.

Velocity effect.—The effect of temperature drop and temperature level is bound up with (b) the effect of the velocity of the liquid and of the heating steam.

The effect of velocity on increasing the rate of heat transmission is well known, but full scientific knowledge is not available.

Scale.—The effect of density and viscosity of the liquid on the heat transmission will be obvious without discussion, but much experimental work is needed on this point. The resistance of the metallic surfaces and of any scale formed is perhaps more important to the user than any other point. To keep clean the heat transmitting surfaces of a plant is not a question for the chemical engineer only, but for the chemist as well. The chemist can often prevent the formation of a hard scale by slight modifications of the process. The chemical engineer in charge is often powerless, and can only stop for cleaning at definite intervals—with most plants the best solution of the problem is only obtained by the assistance of the chemist.

Where the circulation is high and the heating surfaces are well submerged scale to a minimum is produced. It may be mentioned that the presence of fine solids in a well circulating evaporator will often keep the surfaces clean.

Material.—Although the effect of the heat resistivity and thickness of the material of the heating surface is much smaller than the other factors, it must not be neglected. Rates of heat transmission of over 3000 are not possible except with good heat conductors.

Multiple evaporation.—It will be realised that owing to the high latent heat of water the cost of evaporating water is very high. By using the evaporated steam as the heating agent in another apparatus a large portion of this latent heat may be recovered and a further evaporation obtained, and so on. This is the well-known system of multiple effect evaporation.

The heat pump.—Early in the last century, it was suggested that by compressing the evaporated steam, its temperature could be raised and it could be used in the same evaporator as heating steam. Siemens tried this plan in 1868, but on account of the low efficiency of compressors of his day the experiment was a failure. To-day four or five firms are making plant on this principle.

On account of the immense improvement in efficiency of electrically-driven turbo-compressors, and also by the use of high pressure steam injector compressors, a considerable amount of success has been obtained

It will be realised that in this form of evaporation the condenser is the heating surface itself and is at a higher temperature than the liquid in the evaporator. Of course, the condensed water from the heating surface is used in a heat-exchanger for heating the in-coming liquid.

Provided that the temperature rise is small, about 5° C., the efficiency of the "heat pump" is sufficiently good. By the turbo-compressor, about 10% heat efficiency is obtained and by the injector probably over twice this amount.

It is obvious that on account of the small temperature difference (3° C. or 4° C.) the method cannot be used efficiently for concentrated salt solutions and that in any case special methods must be used for obtaining a high coefficient of heat transmission. In the Söderlund and Boberg evaporator the liquid is allowed to flow in a thin film down vertical tubes. In the Prache and Bouillon evaporator, mechanical means are adopted to move the liquid at a high speed and a very high coefficient is obtained.

Communications.

THE HEAT DEVELOPED ON MIXING SULPHURIC ACID, NITRIC ACID, AND WATER.

BY J. W. McDAVID, D.SC., F.I.C.

It is well known that when sulphuric acid or nitric acid and water are mixed heat is developed, and that the actual amount of heat depends on the initial and final concentrations of the acid solution. The quantity of heat generated has been determined in the case of mixtures of sulphuric acid and water and of nitric acid and water by Thomsen (Thomsen's "Thermochemistry," translated by K. A. Burke, p. 76). Thomsen's results put in slightly different form, are given in Tables 1 and 2, while they are shown graphically in Fig. 1.

TABLE I.

Quantity of heat liberated when pure sulphuric acid is diluted with water to give 1 g. of solution of strength shown. Taken from Thomsen's "Thermochemistry," p. 76.*

Mols. H_2SO_4.	Mols. H_2O.	Total weight of mixture, g.	Gram-calories evolved.	% H_2SO_4 in product.	G.-calories evolved per g. of solution produced.
10	1	998	9480	98·2	9·5
5	1	508	8930	96·4	17·6
2	1	214	7770	91·6	36·3
1	1	116	6382	84·5	55·0
1	1·5	125	8122	78·4	65·0
1	2·0	134	9404	73·1	70·4
1	3·0	152	11167	64·4	73·5
1	4·0	170	12320	57·6	72·5
1	5·0	188	13135	52·1	69·8
1	6·0	206	13740	47·6	66·7
1	9·0	260	14886	37·7	57·4
1	15·0	368	15950	26·6	43·4
1	19·0	440	16256	22·3	37·0
1	30·0	638	16430	15·7	25·8
1	40·0	818	16580	12·0	20·2
1	80·0	1538	16780	6·4	10·9

* *Cf.* also Porter, Trans. Faraday Soc., 13, 373.

TABLE II.

Quantity of heat liberated when pure nitric acid is diluted with water to give 1 g. of solution of strength shown. Data taken from Thomsen's "Thermochemistry," p. 78.

Mols. HNO_3.	Mols. H_2O.	Total weight, g.	Gram-calories evolved.	% HNO_3 in product.	Calories per g. solution produced.
10	1	648	4880	97·2	7·5
5	1	332	4420	94·9	13·3
2	1	144	3915	87·5	27·3
1	1	81	3285	77·8	40·5
1	2	99	4808	63·6	48·1
1	3	117	5690	53·9	48·5
1	4	135	6266	46·7	46·5
1	5	153	6608	41·2	43·4
1	10	243	7318	25·9	30·2
1	20	423	7440	14·9	17·5
1	40	783	7440	8·0	9·5
1	100	1863	7440	3·4	3·9

Similar data for mixtures of sulphuric acid, nitric acid, and water are very often required in connexion with the designing of cooling plant employed in acid mixing, but hitherto, with the exception of results determined for a few special cases, such information has not been available. It was evident, however, that, with the assistance of the figures given in Tables I. and II., a very few series of experiments would give a sufficient number of results to enable a diagram to be constructed which would be of considerable assistance in heat problems dealing with acid mixing or acid distillation.

As a triangular diagram is the most suitable method of representing results for mixed acids, the data given on the H_2SO_4—H_2O and HNO_3—H_2O graphs in Fig. 1 were first of all transferred to the triangle in Fig. 2. For this purpose the percentages of sulphuric acid in 1 g. of solution, which hen produced from pure acid and water give 10, 20,), etc. g.-calories of heat, were read off from the aph and plotted along the side H_2SO_4—H_2O of ie triangle in Fig. 2. Similarly the results refer- g to mixtures of nitric acid and water were read ff from Fig. 1 and plotted along the side HNO_3—$_2O$ of the diagram in Fig. 2. The points repre- enting 10, 20, etc. calories were marked with the ppropriate number.

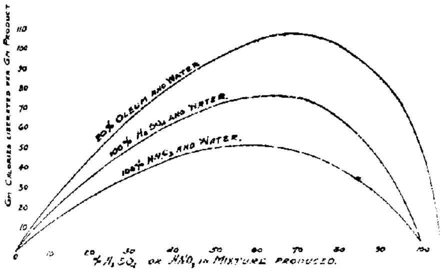


Fig. 1.

Graphs showing heat developed on mixing pure sulphuric id, or 20% oleum, or nitric acid with water. Calculated from ta given by Thomsen (Thermo-Chemistry, p. 76) and Porter rans. Faraday Soc., **13**, 373).

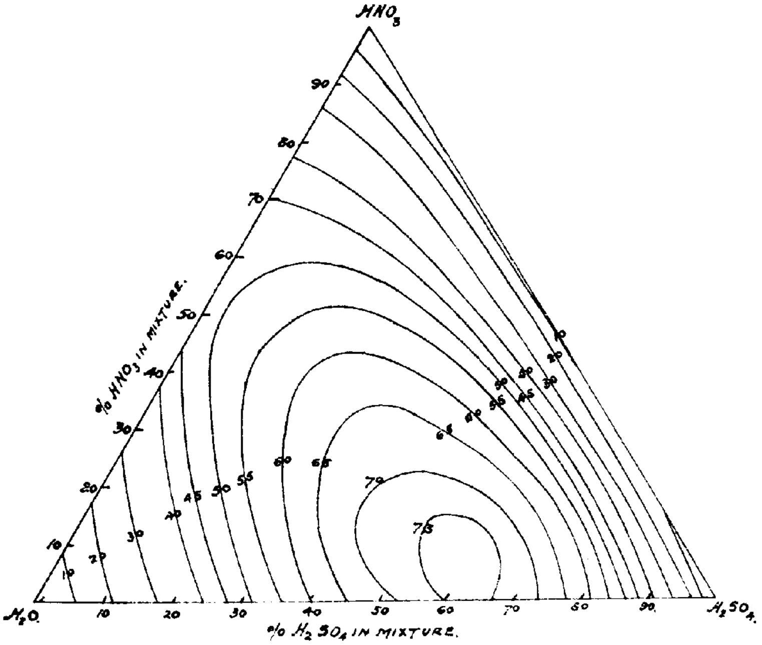


Fig. 2.

Heat developed in g.-calories per g. of product when mixed acid is produced from 100% H_2SO_4, 100% HNO_3, and H_2O.

Next, in order to obtain similar points inside the riangle, it was necessary to determine the heat leveloped in producing mixed acids of various com- ositions, and for this purpose mixtures of the fol- owing acids were employed:—(1) 49·2% HNO_3 and 6·16% H_2SO_4. (2) 20·0% HNO_3 and 96·16% H_2SO_4. 3) 96·8% HNO_3 and 60·0% H_2SO_4. (4) 96·8% HNO_3 nd 99·5% H_2SO_4. (5) Mixed acid containing 9·8% H_2SO_4, 48·4% HNO_3, 1·8% H_2O, and water.

The experiments were carried out in the silvered glass vessel of an ordinary vacuum flask. In each experiment 400 g. of mixed acid was prepared by placing one of the constituents in the flask, noting its temperature, bringing the other constituent to the same temperature, then adding it to the liquid in the flask and noting the rise in temperature.

In order to calculate the heat developed, a knowledge of the specific heats of the mixtures, over the temperature range employed, is necessary, but such data are not available. The specific heats of mixtures of sulphuric acid, nitric acid, and water at 20° C. have, however, been determined by Pascal and Garnier (Bull. Soc. Chim., 1920, 18) and the results obtained by them have been used in calculating the quantity of heat liberated. From one or two isolated specific heat determinations carried out at higher temperatures it is evident that the error introduced in this manner is negligible for all practical purposes.

The method of calculating the amount of heat developed can be best explained by means of an actual example. When 250 g. of 49·2% nitric acid and 150 g. of 96·16% sulphuric acid were mixed there was a rise in temperature of 49·2° C. The water equivalent of the calorimeter was 17 g. and the specific heat of the resulting mixed acid was 0·573. The heat actually evolved was therefore $(400\times0{\cdot}573+17)\times49{\cdot}2=12113$ g. calories. But this is only the heat evolved in producing the mixed acid in question from 49·2% nitric acid and 96·16% sulphuric acid, and to obtain the total heat evolved in producing the mixed acid from 100% sulphuric acid, 100% nitric acid, and water, it is necessary to add to the above figure the heat already developed in producing 250 g. of 49·2% nitric acid and 150 g. of 96·16% sulphuric acid.

Now from Fig. 1 the heat developed in producing 1 g. of 96·16% sulphuric acid from H_2SO_4 and water is 19·5 calories. Hence the heat developed in producing 150 g. of 96·16% sulphuric acid is 2925 g.-calories.

Again, from Fig. 1 the heat developed in producing 1 g. of 49·2% nitric acid from the 100% acid and water is 47·8 g.-calories, and therefore the heat emitted in producing 250 g. of 49·2% nitric acid is 11,950 g.-cals. Hence the total heat emitted in producing 400 g. of the mixed acid in question from 100% H_2SO_4, 100% HNO_3, and water is 12113+2925+11950=26988 g.-calories or 67·5 g.-calories per g. of mixed acid produced.

All the results given below were calculated in this manner.

The details of the experiments carried out and the results obtained are given in Tables III.—VII.

TABLE III.

Results of experiments on mixing 49·2% nitric acid and 96·16% sulphuric acid.

Weight of 49·2% HNO_3 used. g.	Weight of 96·1% H_2SO_4 used. g.	Composition of mixed acid produced.		Temp. rise. ° C.	Sp. heat of mixed acid.	Heat developed in making 1 g. of the mixed acid from H_2SO_4, HNO_3 and H_2O. g.-calories.
		% H_2SO_4.	% HNO_3.			
250	150	36·06	30·77	49·2	0·573	67·5
300	100	24·04	36·91	32·6	0·615	62·2
350	50	12·02	43·05	17·4	0·640	56·1
200	200	48·08	24·61	64·0	0·52	69·7
150	250	60·10	18·46	72·0	0·475	67·3
100	300	72·12	12·30	68·0	0·447	59·9
50	350	84·14	6·15	47·8	0·410	44·6
0	400	96·16	0	—	—	19·5*
400	0	0	49·2	—	—	47·8*

* Taken from Fig. 1.

TABLE IV.

Results of experiments on mixing 20% nitric acid and 96·16% sulphuric acid.

Weight of 20% HNO_3 g.	Weight of 96·1% H_2SO_4. g.	Composition of mixed acid produced.		Temp. rise. ° C.	Sp. heat of mixed acid.	Heat developed in making 1 g. of the mixed acid from H_2SO_4, HNO_3 and H_2O. g.-calories.
		% HNO_3.	% H_2SO_4.			
350	50	17·5	12·02	22·5	0·765	41·2
300	100	15·0	24·04	42·7	0·705	54·4
250	150	12·5	36·06	65·6	0·640	66·8
200	200	10·0	48·08	85·5	0·565	73·4
100	300	5·0	72·12	105·7	0·458	68·8
50	350	2·5	84·14	77·9	0·420	51·0
0	400	0	96·16	—	—	19·5*
400	0	20·0	0	—	—	23·5*

* Taken from Fig. 1.

TABLE V.

Results of experiments on mixing 96·8% nitric acid and 60·0% sulphuric acid.

Weight of 96·8% HNO_3. g.	Weight of 60% H_2SO_4. g.	Composition of mix d acid produced.		Temp. rise. ° C.	Sp. heat of mixed acid.	Heat developed in making 1 g. of the mixed acid from H_2SO_4, HNO_3 and H_2O. g.-calories.
		% HNO_3.	% H_2SO_4.			
350	50	84·7	7·5	12·7	0·49	22·9
300	100	72·6	15·0	19·7	0·515	35·4
200	200	48·4	30·0	22·9	0·54	54·2
150	250	36·3	37·5	21·2	0·54	61·5
100	300	24·2	45·0	17·9	0·54	68·5
50	350	12·1	52·5	11·7	0·535	72·3
0	400	0	60·0	—	—	73·5*
400	0	96·8	0	—	—	8·0*

* Taken from Fig. 1.

The figures given in the last column of each of the Tables III.—VII. could now be plotted on the diagram in Fig. 2 and an attempt made to draw curves through points of equal magnitude. It is, however, simpler to determine, for each series, the points which represent 10, 20, 30, etc. calories.

TABLE VI.

Results of experiments on mixing 96·8% nitric acid with 99·5% sulphuric acid.

Weight of 96·8% HNO_3. g.	Weight of 99·5% H_2SO_4. g.	Composition of mixed acid produced.		Temp. rise. ° C.	Sp. heat of mixed acid.	Heat developed in making 1 g. of the mixed acid from H_2SO_4, HNO_3 and H_2O. g.-calories.
		% HNO_3.	% H_2SO_4.			
350	50	84·7	12·4	14·5	0·460	13·0
300	100	72·6	24·9	22·2	0·445	17·5
200	200	48·4	49·8	30·7	0·415	19·3
150	250	36·3	62·3	33·5	0·395	19·2
100	300	24·2	74·6	32·7	0·370	17·4
0	400	0	99·5	—	—	2·5*
400	0	96·8	0	—	—	8·0*

* Taken from Fig. 1.

TABLE VII.

Results of experiments on mixing mixed acid containing 49·8% H_2SO_4 *and 48·4%* HNO_3 *with water.*

Weight of mixed acid. g.	Weight of H_2O. g.	Composition of mixed acid produced.		Temp. rise. ° C.	Sp. heat of mixed acid.	Heat developed in making 1 g. of the mixed acid from H_2SO_4, HNO_3 and H_2O. g.-calories.
		% HNO_3.	% H_2SO_4.			
350	50	42·35	43·75	63·0	0·475	50·0
300	100	36·3	37·3	84·6	0·540	63·8
250	150	30·25	31·25	82·5	0·603	65·7
200	200	24·2	24·9	71·5	0·665	60·0
175	225	21·1	21·8	63·5	0·684	56·9
400	0	48·4	49·8	—	—	19·3*

* Taken from Table VI.

If the figures in the last column of Table III. are plotted against the percentage of sulphuric acid given in column 3, a graph will be obtained from which the mixed acids corresponding to 10, 20, 30, etc. calories can be read off. These points can then be marked on Fig. 2. The results in Tables IV.—VII. can be treated in the same manner and when the points are plotted on Fig. 2, curves can readily be drawn through corresponding points. Fig. 2 shows the completed diagram. The curves in most cases pass through all the corresponding points which were determined by experiment and interpolation. Each curve in the diagram is marked with a number, which denotes the number of g.-calories evolved when 1 g. of any acid situated on the curve is produced from 100% sulphuric acid, 100% nitric acid, and water. The heat evolved in the production of 1 g. of any acid which is situated between two of the curves can, of course, be obtained by interpolation.

The diagram in Fig. 2 can be employed for solving many problems in connexion with acid mixing, but a great many problems, for which Fig. 2 is of no assistance, are connected with the mixing of oleum with other acids. It is therefore convenient to construct from the data already obtained curves showing the heat developed when 1 g. of mixed acid of any composition is produced from, say, 20% oleum, 100% nitric acid, and water. In order to do this it is necessary to know in the first place the heat developed in making any strength of sulphuric acid from 20% oleum. Porter (Trans. Faraday Soc., 13, 373) has dealt exhaustively with the heats of dilution of oleum and sulphuric acid, and the oleum-water graph in Fig. 1 has been compiled by combining his figure for the dilution of 20% oleum to 100% H_2SO_4 with Thomsen's results in Table I. From this graph the percentages of sulphuric acid in 1 g. of solution which when produced from 20% oleum and water will generate 10, 20, 30, etc. g.-calories can be read off and plotted along the H_2SO_4—H_2O side of a triangular diagram. The figures on the HNO_3—H_2O side of the diagram are exactly the same as in Fig. 2 and the points within the triangle can all be obtained by calculation from the data given in Tables III—VII. The finished diagram is given in Fig. 3 and will be found to give the same results as Fig. 2 in such problems for which either can be employed.

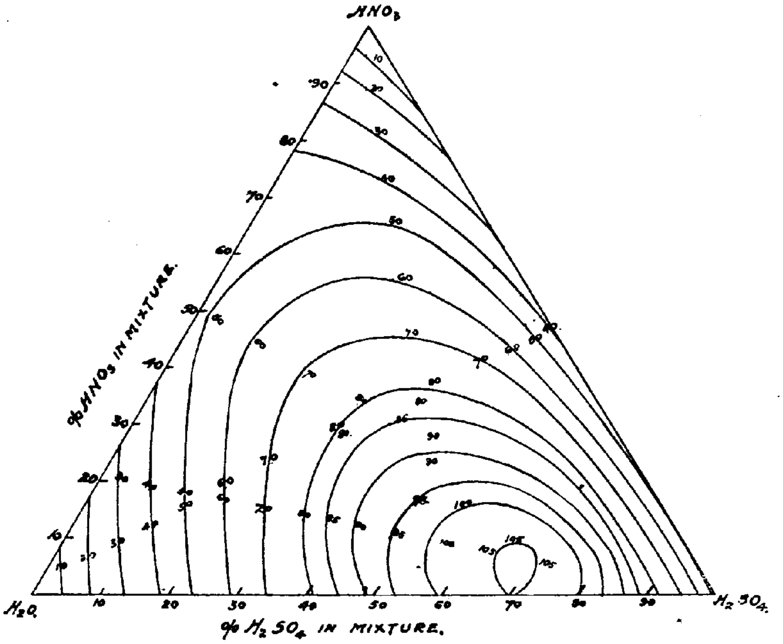


Fig. 3.

Heat developed in g.-calories per g. of product when mixed acid is produced from 20% oleum, 100% HNO_3, and H_2O.

Similar diagrams can be constructed starting with any strengths of oleum or nitric acid.

Use of the diagrams in Figures 2 and 3.

The diagrams in Figs. 2 and 3, especially the latter, are necessary for the solution of all heat problems in connexion with acid mixing. Suppose, for example, that weak nitric acid is to be added to C.O.V. to form mixed acid, and it is desired to know the quantity of heat that will be generated, the result can be obtained with little trouble from either Fig. 2 or Fig. 3. As one illustration of the use of the diagrams this problem is worked out in detail below.

Again, the heat generated in the production of nitroglycerin mixed acid from oleum and nitric acid can be determined without difficulty. The diagrams can also be employed to solve thermal problems in connexion with acid distillation or denitration.

Two examples of the use of the diagrams are given below.

Determination of heat generated in mixing 96% sulphuric acid and 65% nitric acid to produce mixed acid containing 64% H_2SO_4, 21·7% nitric acid, and 14·3% H_2O.

Calculation shows that to make 100 parts of mixed acid of the above composition 66·7 parts of 96% sulphuric acid and 33·3 parts of 65% nitric acid are required.

Now in the production of 100 parts of the mixed acid from sulphuric acid, nitric acid, and water the heat generated = 100×57 g.-calories (see Fig. 2) = 5700 g.-calories. But the heat generated in making 66·7 parts of 96% sulphuric acid from H_2SO_4 and water = 66·7×20 g.-calories (see Fig. 1) = 1334 g.-calories. Also heat generated in making 33·3 parts of 65% nitric acid from HNO_3 and water = (33·3×47·5) g.-calories (from Fig. 1) = 1583 g.-calories. Hence heat generated in producing 100 g. of mixed acid from 66·7 g. of 96% sulphuric acid and 33·3 g. of 65% nitric acid = (5700 − 1334 − 1583) = 2783 g.-calories = 27·8 g.-calories per g. mixed acid.

The above problem can also be solved by using Fig. 3 instead of Fig. 2, as follows:—

In the production of 100 parts of mixed acid from oleum, nitric acid and water the heat generated = 100×88·0 (Fig. 3) = 8800 g.-calories. But heat generated in making 66·7 parts of 96% sulphuric acid from oleum and water = 66·7×66·5 = 4435 g.-calories (Fig. 1), and heat generated in making 33·3 parts of 65% nitric acid from HNO_3 and water = 33·3×47·5 = 1583 g.-calories. Hence heat generated in producing 100 g. of mixed acid from 66·7 g. of 96% sulphuric acid and 33·3 g. of 65% nitric acid = 8800 − 4435 − 1583 = 2782 calories = 27·8 calories per g. of mixed acid.

In order to calculate the temperature rise it is only necessary to divide the result obtained above by the specific heat, which is 0·45. Hence temperature rise in this case = 27·8 ÷ 0·45 = 62° C.

Determination of heat liberated in the production of mixed acid containing 58% H_2SO_4, 40% HNO_3, and 2% H_2O from 20% oleum and 90% nitric acid.

Calculation shows that 55·5 parts of oleum and 44·5 parts of 90% nitric acid are required to produce

100 parts of mixed acid of the above composition. Now, from Fig. 3, in the production of 100 g. of the mixed acid from 20% oleum, anhydrous nitric acid, and water, the heat generated = (100 × 49) = 4900 calories. But from Fig. 1 the heat developed in producing 44·5 g. of 90% nitric acid from anhydrous nitric acid and water = 44·5 × 23·3 = 1037 calories. Hence heat liberated in producing 100 g. of mixed acid from 20% oleum and 90% nitric acid = 4900 − 1037 = 3863 = 38·6 calories per g. of mixed acid.

In conclusion, the author desires to thank the management of Messrs. Nobel's Explosives Co., Ltd., for permission to publish these results.

Ardeer Factory,
Stevenston, Ayrshire.

ELECTRIC HEATING AND CONTROLLING APPARATUS FOR A SMALL THERMOSTAT.

BY S. O. RAWLING, B.SC., A.I.C.

(*Communication No. 23 from the British Photographic Research Laboratory.*)

In working with automatically regulated, constant-temperature baths, it is frequently found that to change from one temperature to another involves troublesome readjustments of heat supply and regulating gear. The apparatus to be described has been devised with a view of overcoming this difficulty, within the temperature range from 25° to 40° C.

Electrical heating and controlling is employed, and the general principle of the apparatus is illustrated diagrammatically in Fig. 1. Current is supplied from the direct current power mains.

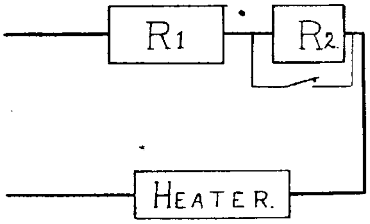


FIG. 1.

A thermo-regulator controls a device whereby the resistance, R_2, is short-circuited when the temperature of the bath falls below its working level. The resistance, R_1, is adjusted so that when current is passed through it and the heater alone, more heat is supplied by the heater than is necessary to keep up the temperature of the bath. The second resistance, R_2, is of such a value that when the short-circuit is broken, the total resistance causes the rate of heat supply to become too small to keep the temperature up to its working degree.

The thermo-regulator (Fig. 2) consists of a large bulb, A, from the neck of which a side arm, B, slopes downwards and connects it with the middle of the U-tube, C. The U-tube itself is divided into two parts by a seal, D, through which a platinum wire is fused. The arm, F, of the U-tube is provided with a short length of capillary tubing of about 1 mm. bore. A side tube, G, is fitted above the top of the capillary and a rubber stopper, H, fitted in the widened end of the U-tube, carries a platinum electrode mounted in a glass tube. The end of the electrode projects about 1·5 cm. into the capillary tube. The upper end of the tube leading from the top of the main bulb is closed by a glass tap, K, with a fairly wide bore. It is essential that the plug of this tap should be very well fitted.

To fill the regulator, clean mercury is poured into the U-tube so that its level is about halfway up the capillary tube; G is then closed by a rubber tube and clip. The working fluid—saturated calcium chloride solution or toluene—is next poured into the main bulb by means of a funnel of which the neck has been drawn out so that it can be passed through the bore of the tap.

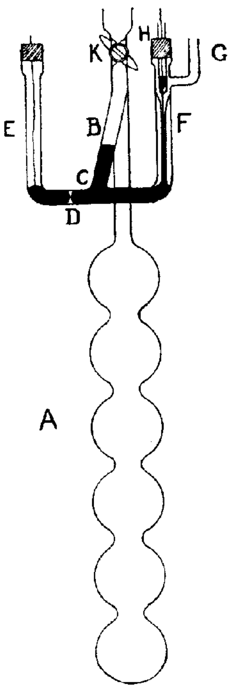


FIG 2.

Electrical terminals are provided on one side by a copper wire dipping into mercury placed in the arm, E, of the U-tube and on the other by a wire dipping into mercury in the electrode tube fitted through the stopper, H.

Adjustment is effected by heating the bath to its working temperature with the tap, K, open. Towards the end of the heating, the rate of supply of heat is reduced to ensure that the liquid in the bulb has attained the temperature of the bath. The tap is then turned off and the electrode tip is adjusted to the surface of the mercury* in the capillary with the arm, G, open. This regulator works well, and for a working temperature of 25° C. is capable of keeping the temperature of a bath containing about 27 litres of water constant to ±0·02° C.

The arrangement of the short-circuiting relay, resistances, and switchboard is shown in Fig. 3.

Carbon-filament lamps are used as resistances. Provision is made for varying these resistances by placing two bayonet sockets in parallel for each resistance. By using different combinations of lamps, a considerable range of resistances may be covered. The relay itself is part of an electric bell, and consists of the electromagnet, A, armature and spring, C, and the contact point, B. When no current is passing through the magnet coils the spring of the armature makes contact at B and so the resistance, R_2, is short-circuited through the spring to B and the small resistance, R_4, which is a toy resistance of 7 ohms placed in series with the principal circuit. When the temperature of the bath rises so as to make contact between the mercury and platinum in the thermo-regulator, current will flow round the magnet coils and the contact at B will be broken. The main current must then flow through R_1 and R_2 in series and in this way the current through the heater is diminished.

---

* In cases where the temperature need not be adjusted nearer than 0·1° C. it is unnecessary to make a fine adjustment of the electrode point.

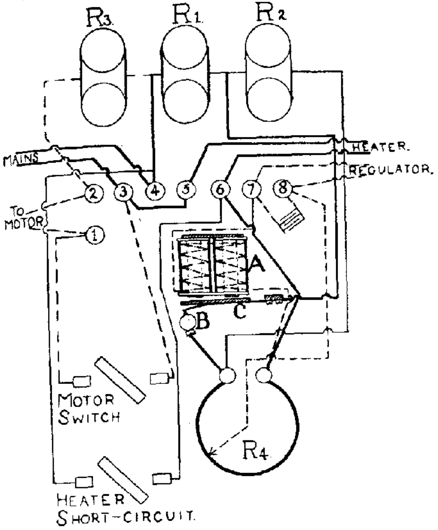


FIG. 3.

The terminal board is made up of fibre, and the variable resistance, R_4, is mounted on a block of the same material. In making up this board it is advisable to number the terminals as shown in Fig. 3. The wiring is then an easy matter.

Efficient stirring is provided in the thermostat bath by means of a centrifugal stirrer driven by a small motor. A switch is provided on the terminal board to control the motor, which takes its current from the mains through a lamp resistance, R_3.

In order to heat the bath quickly from room temperature a switch is arranged to short-circuit both resistances, R_1 and R_2, and so allow the heater to develop its full power.

The heater actually in use at present is a nickel "hot point" immersion heater capable of supplying 300 watts; it has a resistance of about 160 ohms, and works on the 210-volt circuit.

As an example of the method of calculating the resistances necessary for R_1 and R_2 the following case may be taken:—

The thermostat consists of a tank of copper,† 30 cm. cube, lagged round the bottom and sides with thick felt. A glass window 20 cm. by 22·5 cm. in each of the opposite faces is left uncovered. The top of the tank is open. A cooling curve was plotted to find roughly how much heat per second must be supplied in order to keep the temperature up to any desired degree. The volume of water in the tank is about 27 litres. With the room at about 15° C. and the bath at 25° C. the heat lost per second is about 12·4 calories. This is equivalent to 52 watts. It is then necessary to choose R_1 and R_2 so that with the voltage across the mains (in this case 210 volts) the power developed in the heater when R_2 is short-circuited is about 70 watts and when R_1 and R_2 are in series, about 30 watts.

As already stated, the resistance of the heater is about 160 ohms. Thus the current required to develop the necessary power in the heater can be calculated. Heat developed per second in a conductor of resistance R ohms carrying current C amps. $= C^2R$ watts. When R_2 is short-circuited, $C_1^2 \times 160 = 70$, where C_1 is the current in ampères necessary to give 70 watts in the heater. Hence $C_1 = 0{\cdot}665$ amp. When R_1 and R_2 are acting in series, $C_2^2 \times 160 = 30$, where C_2 is the current necessary to give 30 watts in the heater, whence $C_2 = 0{\cdot}434$ amp.

The values of R_1 and R_2 can now be calculated. $0{\cdot}665 = 210 \div (160 + R_1)$ whence $R_1 = 157$ ohms (approx.), $0{\cdot}434 = 210 \div (160 + 157 + R_2)$ or $R_2 = 167$ ohms (approx.).

The resistances chosen were as follows:—R_1: two 32-candle-power 200-volt carbon-filament lamps in parallel; net resistance about 150 ohms. R_2: a single 16-candle-power 105-volt carbon-filament lamp; resistance about 160 ohms.

The lamps used for the various resistances must be able to withstand the voltages which occur across them. The conditions obtaining in the present arrangement are as follows:—When R_2 is short-circuited, the voltage across R_1 is 100 volts, across the heater 110 volts, and across R_2 nil. When R_1 and R_2 are in series the voltage across R_1 is 67 volts, across the heater 73 volts, and across R_2 70 volts.

The use of lamps for resistances in circuits that are made and broken frequently has the advantage that very little sparking occurs at the contacts. As has been shown, the voltage drop across the short-circuiting device and its contact breaker amounts only to about 70 volts in the particular case given. The sparking occurring is hardly perceptible. The only part of this apparatus having large self-inductance is the electro-magnet of the relay. In order to cut out the sparking at the platinum and mercury contact in the regulator, a small induction coil condenser has been placed across the regulator terminals, 7 and 8 (Fig. 3).

To estimate the resistances of carbon filament lamps the catalogue values of nominal candle-power and voltage are used. The consumption per nominal candle-power may be taken as about 4·3 watts for these lamps. From this the watts consumed by any lamp working at its correct voltage may be calculated and the resistance of the lamp is then calculated from the formula $R = E^2/W$, where R = resistance in ohms, E = voltage (catalogue value), and W = watts consumed.

The apparatus has worked very well for six months. The lamp combinations for R_1 and R_2 necessary for various temperatures have been worked out, and so to change from one temperature to another takes only as long as is necessary actually to bring the temperature of the bath itself to the new one required.

In conclusion the author wishes to express his thanks to Dr. T. Slater Price and to Dr. G. I. Higson for much help and advice in the working out of the details of this apparatus.

THE DETERMINATION OF SULPHUR IN VULCANISED RUBBER.

BY J. W. W. DYER, M.SC. (LOND.), AND AMY R. WATSON, B.SC. (LOND.).

In the course of endurance tests on a large number of rubber-proofed balloon fabrics it was necessary to make chemical analyses of the proofings.

The methods which will be described have been tried only on vulcanised rubbers suitable for this kind of material, *i.e.*, on mixings containing usually little more than 5% of ingredients other than rubber, of which 1—3% may be sulphur, but there is no reason for supposing the usefulness of the method is limited in application to such mixings. For the purpose in view, a knowledge of the amounts of free and combined sulphur was desired. It was always preferable, and often necessary, to work on the proofed textile itself, and not on scraped-off proofing, and the oxidation of a large amount of organic matter with a very small weight of sulphur was thus involved. This necessity limits the agreement obtainable with repeat tests, because of slight uncertainty as to the weight of the textile components. It does not, however, affect the figures given in this paper.

---

† With electrical heating, a glass battery jar, inverted bell jar, or even a large beaker might be used instead of a metal tank.

A review of available methods, and some preliminary experiments led to adoption of a modified form of the nitric acid process.

Method for combined sulphur.—The modification of the simple nitric acid treatment consists in the addition, in the later stages, of small amounts of potassium permanganate, to complete the oxidation in a shorter time. From 0·5 to 3·0 g. of material (depending on whether rubber alone, or rubber on textile is being used) is added to 30—40 c.c. of nitric acid, sp. gr. 1·42, in a suitable open flask. Gentle heat starts the reaction, which may at first need restraint by cooling. Subsequently the mixture is heated to gentle boiling, with a funnel in the mouth of the flask, and the boiling continued till the liquid is clear. Powdered pure potassium permanganate is now added to the slightly cooled liquid, about 0·25—0·5 g. at a time, and the heating continued between the additions. The first rapid disappearance of the permanganate soon slackens, and finally a permanent black precipitate is obtained on further addition of a little permanganate: usually about 2 g. in all is required. The contents of the flask are transferred to a basin, and evaporated to dryness once, and then again after addition of about 10 c.c. of concentrated hydrochloric acid and a little water. The residue is treated with water, brought to a bulk of 100 c.c., and made just acid to methyl orange at boiling point. Since small amounts, usually less than 0·1 g., of barium sulphate are involved, great attention to the conditions of precipitation is necessary; particularly the free acidity and bulk of liquid should be kept low. It is usually necessary to filter from a few specks of insoluble matter before precipitation, but perfectly clear, colourless solutions, filtering quickly, are always obtained.

Although, as stated, the method is intended, and is normally used for combined sulphur only, we have found it satisfactory for total sulphur where the amount of free sulphur is not large. The following figures exemplify results obtainable by this and other methods:—

Example 1.—Total sulphur in a proofed fabric. Nitric acid only, 2·05% S; bromine plus nitric acid plus potassium permanganate to finish, 2·09% S; nitric acid plus potassium permanganate to finish, 2·15% S.

Example 2.—Total sulphur in a proofed fabric. (*a*) Two tests by nitric acid—permanganate method on the whole fabric gave 2·49, 2·55%—mean 2·52%. (*b*) Two tests by Carius' method on peeled-off proofing gave 2·17, 2·25%—mean 2·21%. (*c*) A considerable amount of free sulphur is present in the textile of new proofed fabrics. A determination of this in the cotton enclosing 100 g. of rubber gave 0·35 g. Adding this to result (*b*) the figure 2·56% is obtained, in good agreement with direct determination (*a*), viz., 2·52.

Example 3.—On a vulcanised mixing, rubber 100, litharge 3, sulphur 3 (total sulphur content 2·83%) the results obtained were:—With nitric acid alone, 2·38, 2·54—mean 2·46%; nitric acid plus permanganate, 2·90, 2·96—mean 2·93%.

Example 4.—On a mixing made as Example 3, but with double the quantity of litharge, the Carius method gave 0·1030 g. $BaSO_4$, and the nitric acid and permanganate method 0·1021, 0·1024 g.

Method for free sulphur.—By the term "free sulphur" is meant that extracted by acetone at or near its boiling point. It is determined by oxidation with neutral potassium permanganate in the acetone solution. If the weight of the acetone extract is required, either the acetone is distilled off, the dry extract weighed and redissolved for oxidation of the sulphur, or else two separate extractions are made, one for oxidation direct, and one for drying and weighing. In the case of normal new fabrics, an amount equivalent to 1—2 g. of proofing is used. In the apparatus employed, about 50—60 c.c. of acetone is required, and to this acetone extract 0·5—1 g. of pure potassium permanganate is added all at once in powder form, the mixture shaken round for a minute or two, and allowed to stand for half an hour or so at room temperature. If the deep purple colour disappears on this treatment a little more permanganate is added, but this has only been found necessary where much oxidation resin is present, as in perished proofings, and then the determination of free sulphur is largely meaningless. Following this the acetone is distilled off from a water bath. To prevent bumping, which may cause serious loss, a glass bead is put in. The brown residue is heated in an oven for a short time at 100°—110° C. to remove every trace of acetone.

Concentrated hydrochloric acid is then added in amount* only slightly in excess of that required to bring the residue to a clear dark greenish solution, becoming colourless on heating for a short time in the water bath. This solution is diluted a little, and filtered from a very slight insoluble residue. The filtrate is brought to near 100 c.c., ammonia cautiously added till the clear nearly colourless solution becomes yellowish and slightly turbid, the solution made just acid and precipitated at boiling with 4 or 5 c.c. of $N/2$ barium chloride.

The following results indicate the sufficiency of the method.

Example 1.—A quantity of proofed fabric was extracted with acetone, and five equal volumes of the extract, each representing 1·5 g. of the original fabric, were taken.

	Method of oxidation.	$BaSO_4$ g.
1.	Carius	0·0421
2.	Cold neutral potassium permanganate in acetone solution	0·0418
3.		0·0413
4.	As 3 and 4 but heated under reflux condenser	0·0416
5.		0·0425

Example 2.—A different fabric treated as above.

	Method.	$BaSO_4$ g.
1.	Carius	0·0338
2.	1 g. potass. permanganate in acetone half an hour	0·0338
3.	1 g. potass. permanganate in acetone 24 hours	0·0341
4.	1 g. potass. permanganate heated under reflux condenser half an hour	0·0340

It is clear that the method is rapid, simple, and accurate. Blank tests on all reagents are necessary. Results given above are corrected for blanks, which were never more than 1 or 2 mg., and frequently nil.

Acknowledgment is made to the Director of Research, Air Ministry, for permission to publish this paper.

Chemical Laboratory,
Royal Airship Works,
Cardington, Bedford.

---

* From 3 to 5 c.c. of acid of 1·16 sp. gr. for each gram of permanganate used.

Annual General Meeting.

Wednesday, July 5th.

The **President**, in calling upon Professor H. E. Armstrong to deliver the first of the Messel Memorial Lectures, said that Dr. Rudolph Messel had been one of the original members of the Society, and on his death, in 1920, he had bequeathed upwards of £20,000 to the Society of Chemical Industry. A part of this the Council had decided to use for the first of a series of lectures, to be known as the Messel Memorial Lectures, and to prepare a medal, which would be known as the Messel Medal, to be given, by vote of the Council, to the most distinguished chemist of the time in England. Dr. Messel had been President of the Society of Chemical Industry in 1911–12, and during his visit in that year to America and Canada he had done more, probably, than any other individual in popularising the Society in North America. Dr. Messel might be described as a typical chemical engineer. At first he had been a chemist, and carried out research work in Germany for many years. He had also done research work in this country, and had then devoted himself to chemical engineering and made the contact or catalytic process for the manufacture of sulphuric anhydride a commercial process. After a few years of work he had turned out no less than 10,000 tons of sulphuric anhydride by the process. Before calling upon Professor Armstrong to give the ecture, the President, on behalf of the Society of Chemical Industry, presented to him the Messel Medal in recognition of his distinguished career as an educationist and his outstanding work as a chemist and as a scientist.

The Medal was then presented to Professor Armstrong amid applause.

Sir **William Pope** said that the late Dr. Messel had been one of the great pioneers of technical chemistry in the British Empire; he had cultivated close friendships amongst the select few who had been worthy of his friendship. The fact that Professor Armstrong had been an intimate friend of Dr. Messel would alone make the choice of the first Messel Medallist an appropriate one, but the Medallist had many other qualifications. Just as Dr. Messel had been a pioneer in technical chemistry, so Professor Armstrong had been a pioneer in technical education; the great schemes for bringing a scientific technical education within the reach of all who were capable of profiting by such a training—schemes which had become realities some 40 years ago—had been carried into execution by Professor Armstrong and a small band of similarly far-sighted enthusiasts. It was certain that such co-operation as now existed between chemical scientists and chemical technologists in the British Empire and in America—a co-operation from which both pure and applied chemistry had greatly benefited—had originated in the great campaigns for technical education which Professor Armstrong and his few brother enthusiasts had initiated nearly half a century ago. Closely identified with Professor Armstrong's conceptions of scientific educational method was the idea that the student should early become imbued with that spirit of inquiry which was the source of all progress in either pure or applied science. Their Medallist had been himself a keen investigator; his name was permanently associated with the discovery of those facts and with the enunciation of those speculations which now formed the basis of our modern knowledge of the several branches—inorganic, organic, physical, and biological—into which the complex chemistry of to-day was divided. This breadth of interest had been perpetuated throughout a long and laborious life, and he had no doubt that it would be reflected in the vigour and scope of the Memorial Lecture which they were about to hear; it could be seen reflected in the fact that the audience that morning included a large number of men who had been trained by Professor Armstrong. In conclusion, he wished to express very keenly his own appreciation of the honour which they had done to one of Professor Armstrong's former students in calling upon him to make a few remarks introductory to the Messel Memorial Lecture.

Professor **Armstrong** then delivered the Messel Memorial Lecture.

First Messel Memorial Lecture

RHAPSODIES CULLED FROM THE THIONIC EPOS
CHEMICAL CHANGE AND CATALYSIS

BY HENRY E. ARMSTRONG

(Delivered at the Forty-first Annual Meeting of the Society at Glasgow, J[illegible] 4th, 1922)

Semper aliquid certi proponendum est.

When this Address was undertaken—

> What did we do but make a vow
> To do we knew not what nor how?[1]

What should be my theme? I could not well round upon you, as I might have done upon the Brewers when addressing them last year, with the lines—

> Thou that with ale or viler liquors
> Didst inspire Withers, Pryn and Vicars
> And force them, tho' it was in spite
> Of Nature and their stars, to write,

unless, indeed, sulphuric acid were counted among "viler liquors," a course I would not advocate: in fact, I shall plead for it the place of Prince among them and ask that once more due honour be given to its might and solidarity.

Fortunately, you inspired me by a flashed vision of platinum. No tip more appropriate to the occasion could be imagined, as you had charged me with the duty of lighting the torch that is to be kept burning, in future, to illumine the memory of the man who, learning from Döbereiner, Edmund Davy and Wöhler, was the first to use, as a catalyst, the metal now valued so highly, which is an aid to man in so many ways and the most prized among metals by woman. Indeed, platinum may well become the bond of union between the sexes, a bond that the fair ladies now in revolt may perchance hereafter admit, when the force of "some tonic" they "have drunk" is spent and the spell of Meredith's admonition is fully felt—

> Ah! madam, were they puppets who withstood
> Youth's cravings for adventure, to preserve
> The dedicated ways of womanhood?
> The light which leads us from the paths of rue,
> That light above us, never seen to swerve,
> Should be the home-lamp trimmed by you.

Mayhap platinum, fit symbol of stability, will be used to light that lamp, for as gold has led woman to minister to man in the past, why not platinum in the future, especially as our gold is now reduced to paper which cannot be worn with effect as jewellery?

---

[1] American readers please note, the citations when not identified are from sources at least two centuries old.

Saying this, however, I must not pass the chance to appraise the greatness of our art. Confided to a thionic embrace, even paper, in the chemic hands of the Courtauld firm, is now forced into the state of colloid and spun into a simulacrum of the butterfly's activity. The physicist but dreams of changing the atoms: we are facultative alchemists and transmute trees grown on the cold heights of Scandinavia into stockings fit for the fair in the most heated climes. What can men of letters set against these achievements? On account of his works the chemist should be highly honoured of men in all the pathways of the world; woman has still to appreciate the part he plays in providing her not only with platinum and stockings but also with the complete series of rainbow tints which permit her to outrival not merely the peacock but even the lilies of the field: she little knows the extent to which in this and other ways she is his unconscious debtor. Still the claim, nay the right, of chemistry to rank as fundamental, not only to other sciences but to all human activity, has yet to be made clear: those historic lovers of ale, Wither, Pryn and Vicars, if with us to-day, could but agree that we have the right to think no small beer of ourselves. Is not this a point worth making on such [illegible] occasion, in this drab town which is so nee[illegible] of beauty? Think what we could make of it if we had our way; at least we could rid it of its chronic murky atmosphere, if not of its heritage of rickets.

To leave the serious, my task is to lay a foundation and set an example. Those who follow, with less opportunity to indulge in panegyric, will doubtless be moved to develop some special theme and carry Thionism to greater heights. Hence the propriety of my text,

Semper aliquid certi proponendum est,

which appears to have been Matthew Arnold's favourite maxim, as he cites it more frequently than any other in his *Note Books*. At least, it is a good one for a scientific essayist and Arnold is an honourable example to follow, as he was both critic and thoughtful, exact writer. The chemist *should be* all these: is he either, in any sufficient way? If not, why not? To take rank in the world he must not only hold his own against the best of his competitors but force his way ahead of them. To save the world from a Russian fate science must be made as constructively effective in commanding human nature as it has been hitherto in hurrying the nations to their ultimate destruction. To-day, *you* are only thinking of speeding up the process of wasting Nature's resources and are giving little or no thought to their conservation. The chemist alone, through his thionic influence, has made the Northcliffe press possible, the destruction of forests certain: think what that means! How will you counteract the evil work?

Our word-spinning literary friends—rather might we characterise them as enemies, so narrowly have they led the world, if we could think of them as other than thoughtless offenders—infer that we cannot express ourselves properly and Goths upbraid us from Cambridge that we are Greekless! Themselves, they have little regard for truth and realities, worshipping form rather than substance. It is difficult not to believe that they are consciously seeking to prevent us from coming to expression in the public service: how otherwise are we to account for the rare appearance in the Press of the scientific writer? He would be there, if in the least encouraged: is he perhaps feared and kept out because it is felt that he might show up the futility of the hack writer or is it because journalism is now a close ring? Blame is often cast upon public taste but this is the herring across the trail: the public is not so simple as it is often made out to be and is willing to learn.

The man of words, in some degree conscious of their music, is more or less careful in their arrangement; he would not be paid for them if he did not place them with fair effect. The scientific writer, who, be it noted, has usually had the same early schooling as the literary writer, has his attention so fully directed to realities and is so occupied in thinking out the consequences of his acts and in placing his work on record, that he is apt to give too little attention to style and rhythm. Too frequently, therefore, he is verbose and lacking in lucidity; mere tricks of speech pass muster which should be avoided. To think every way at once is a little difficult, as those who have tried are aware. Yet not a few compare more than favourably with their literary colleagues—because they have something real to say. Darwin's *Origin* has often been cited as a model of clear statement: Huxley's studied style may be set against Ruskin's perfervid oratory: both were founded upon the Bible; Huxley's was not merely the product of genius but due to the exercise of thought and his sense of proportion, yet his utterances, at times, border on the sententious and if not less convincing, are certainly less alluring, than the sentimentalist's spontaneous ravings. Let us, however, be mindful of Milton's lines:—

Thus they in mutual accusation spent
The fruitless hours but neither self-condemning;
And of their vain content appeared no end.

Each of us has sufficient task in clearing the motes from his own eyes: we should seek to work together.

Unfortunately, the pages of our chemical journals are full of examples of careless writing—of careless writing due to careless thinking. Little is done to overcome the influence of habit; self-criticism is rarely practised. We have no school of criticism to impose discipline in our ranks. I well remember the effect on myself of a [*sic*] appended by that old Etonian warrior, Dr. Warre, to a quotation he gave from a letter of mine, to which he was replying in *The Times*; though he could not parry my argument, he caught me out over a split infinitive. Since then I have not repeated the heinous literary offence consciously and shall ever hold him in pious memory for his act of grace in curing me of the habit. It may comfort some if I say that I was once a dire offender. The current rumour that a free-lance journal may be established in connexion with the Chemical Societies is an augury of a happier future—if only the pedantry of a publication committee of superior, elderly intolerants, without imagination, can be avoided. Free exchange of opinion, free criticism, is much needed among us; we are far too narrow in our outlook, too sensitive to remark; Professor Patterson's famous tilt over " But " is an amusing extreme example of the intolerance of the hard editorial mind, worth remembering as an indication of the difficulties to be overcome and the danger we run in limiting freedom of expression.

Is't not enough to make one strange
That some men's fancies should n'er change
But make all people do and say
The same things still the self-same way?

Our position as chemists, the position of science in the community, will depend far more upon words than upon works—upon the use we make of our English tongue. We must not only learn to weigh our words and use them effectively but use clear words, words that can be understood. Far from eing Greekless, we are overfond of using an ffected Attic terminology. Striking examples of l-directed zeal are to be found in the pretentious ıanuals of so-called colloid chemistry. The bee in he bonnets of the dreamers in this field is the ərminal *oid*. After wading through much colloid ıire of late, I am wondering whether the 15,000 ld members of Dr. Parsons' happy and obedient ock of chemists in the land of Wilder D. Bancroft o not consider suspenders a vulgar term for races and wear their pants adsorbed by suspendids. If I be not misinformed, the younger ladies ow wear corsoids and chemiseoids, no longer the eal thing; in fact, I believe all feminine garments re *oids* in these days, except hose, perhaps—and his because chemists have made them of an ttractive *sericoid* material. Everything seems to e now a shortened, sort-of-a-kind-of what it used) be; canned goods have captured the world and npudent advertisement counteracts conscience.

I trust what has been said will suffice to

Force you by right ratiocination
To leave your vitilitigation.
And make you keep to the question close
And argue dialecticos.

The need of care has been specially impressed pon us of late owing to the attitude adopted by he Official Referee of the Board of Trade ppointed under the Safeguarding of Industries ct, 1921. Nothing could be more humiliating ıan the manner in which, sitting as a Delphic racle in Whitehall or the Law Courts, this gentlean has created chaos in Chemistry by his pronouncements upon our vocabulary. The discussions n the subject in various Sections of this Society ıve been far from illuminating; the lack of agreeent among speakers, in fact, is sufficient proof at clear thinking is not yet our characteristic.

Mr. Edmund Gosse tells us, on the authority of e Marquis de Racan, that the leader of the ssical reaction in France, M. de Malherbe, one ur before he died, woke with a start out of a ep slumber to rebuke his hostess, who was also s nurse, for using an expression which he did not nsider to be correct French. When his Confessor ntured to chide him, he replied that he could t help it and that he wished to preserve up to e moment of his death the purity of the French guage.

My exhortation is, in like manner, that we should content only to play upon

. . . the lyre of language clear
Love's tongue and source,

of the most perfect of Meredithian couplets.

'o return to platinum, to mention it is to excite imagination in many ways. Its attributes are such perfection that the metal must have been ture's first care had due forethought been rcised at the Creation: it is clear that little as re is now, in the beginning there was no scious science, otherwise platinum would be as n in quantity and much more oxygen free in the ld. The electrons, however, seem to have been -willed and proportions may well have been ermined merely by their affinities as influenced transcendental temperatures, just as is the comxity of benzenoid hydrocarbons at ordinary ts.

ron has many attractive qualities: without it haps the world would have been colourless and r; without it perhaps we could not have been with air; yet it has many imperfections:

Ah me, what perils do environ
The man that meddles with cold iron.

er were we so mindful as now of its misuse and re striving to minimise this to the utmost; but as usual are lacking in outlook, leaving chemistry out of account and failing to take proper measure of human nature and its structural stability, failing to realise that the problem is chemical at bottom, living Nature being but one huge laboratory, in which structure is the main determinant of function, its operations largely catalytic.

If platinum could be used as iron much trouble and loss would be avoided: polish and paint would be far less in request; of no knight's pistol could the mock-heroic have been written—

But Pallas came in shape of rust
And 'twixt the spring and hammer thrust
Her gorgon-shield, which made the cock
Stand stiff, as if 'twere turn'd t' a stock.

Think of the chemist's generations-old struggle to decipher the mysteries of rust: what it will eventually be worth to us if all iron be made rustless!

Helmholtz's complaint against Nature of the imperfectness of the eye is a small matter in comparison with the lament the chemist may utter as to the scarcity of platinum: the uses to which he could put it are so many and so important. The man whose mentality it is my allotted task to picture, a task of exceeding difficulty, was the first to give it to full industrial use: this was his great achievement.

We often spoke of its wonderful activity; I more than once said to him, "Whe[illegible] have done with using it, we will set to work together to find out, if possible, how it does its work." That day never came and seemingly we drifted away from our purpose: he stuck to sulphuric acid and kept his platinum in technical use; whilst occasionally taking a sip at the acid I began to play with organic catalysts, not uninfluenced by the thought of his disease; there was no money in them but they gave what I believe to be the final clue to the behaviour of platinum. I little thought that I should be called upon and privileged to display my knowledge in his honour.

RUDOLPH MESSEL

I first met him in my initial year of office as a Secretary of the Chemical Society, in April 1876, on the evening when Dr. Squire and he described and demonstrated the process they had developed of manufacturing sulphuric anhydride, already in operation at Silvertown. He was elected a Fellow of the Chemical Society that same evening. I was the only speaker to break the harmony of the meeting by suggesting that Nordhausen sulphuric acid was not a mere solution of the anhydride but mainly a definite acid, a compound of the anhydride with sulphuric acid, anhydrosulphuric acid, then unrecognised except by Schützenberger. I trod on Messel's heels with a paper on "Systematic Nomenclature": this, too, shadows me to-day.

I was greatly attracted to him from the beginning and we soon became fast, I may say affectionate, friends. Perhaps I surprised him by knowing the work he had done as a student on strychnine and maleic acid: I would here emphasise the fact that he started his career as a chemist on the organic side. Moreover, I had been ahead of him in cultivating the acquaintance of sulphuric anhydride—on German soil—as it was the subject of my Ph.D. thesis, published in English in the *Proceedings of the Royal Society*, under Frankland's patronage, in May, 1870, under the modest title "Contributions to the history of the acids of the sulphur series. I. On the action of Sulphuric Anhydride on several chlorine and sulphur compounds." This was my introduction to the Royal Society. A little later, in 1871, I made my first appearance, as an independent worker, at the Chemical Society, with a paper on the use of sulphuric chlorhydrol as a sulphonating agent. Messel was afterwards led to take an interest in this compound through preparing it for me.

I thus came under thionic fascination at an early stage of my career and was fully prepared to appreciate Messel's work and its value, the more as I had worked alongside Graebe in Leipzig and Perkin was my fellow secretary.

Messel was born January 14, 1847, in Darmstadt. He died April 18, 1920, at his chambers in Victoria Street, London. He was of Jewish extraction but professedly Lutheran.

To-day I will give only a brief survey of his history, sufficient to make clear his proclivities and the influences to which he was subject.

His father, Simon Messel, was not originally intended as his father's successor in the banking business but was apprenticed to a Parisian maker of artistic furniture, which accorded more with his own taste for art. The interest of this fact lies in the indication of the source of the highly developed artistic tastes which most of his children evinced. Before he had completed his training in Paris, however, Simon Messel was recalled to Darmstadt to take the place assigned to his elder brother, who had journeyed to America and there disappeared from the sight of his relatives. In consequence of this change, Rudolph Messel's early years were spent in what for those days ranked as affluence and his father was able to provide adequately for his education. He was the second of five children, of whom four were to make their homes in England; the fifth acquired great distinction as an architect in Berlin.

He received his elementary training at Schmidtz's Academy in his native city. Shortly after his father's death in 1859, he was sent to a Huguenot school at Friedrichsdorf in the Taunus, where he remained until early in 1863, that is to say, until he was fifteen years old. His early interest in science and his precocity are shown by the following reference he made to this period in his Presidential Address to this Society in New York in 1912.

> "In 1861, when I was at school at Friedrichsdorf, in Germany, my master, Philip Reis, invented the first telephone. I was present at its birth and assisted Reis in making the mechanical parts of some of his instruments and also repeatedly in his experiments, Reis being at one end of the circuit, speaking or singing, I listening at the other or *vice versa*."

While he was at school, the family circumstances had changed and it was clear that Messel would have to be self-supporting at an early date. His intention, formed during the last years at school, was to become an engineer, either civil or mechanical. In January, 1863, he discussed his future course of action with an old friend of his father's, Heribert Rau, an author of some distinction, then living in Frankfort. Rau wrote to him a letter strongly advising against this choice of a profession, basing himself upon the fact that the demand for engineers already fell short of the supply, whilst the boy's religion would, he said, militate against his receiving a State appointment. If the boy were father to the man, as all accounts indicated that he was, Rau knew well the love of independence and self reliance which were among this young friend's salient characteristics. After citing the reasons given above, he lays the greatest stress upon the fact that to become an engineer would entail many years of study preceded by years of practical work at the bench, so that the day when he would be able to support himself must be far distant. He then gives the young Rudolph positive advice, which it is clear determined all his future. He bids him devote himself to the study of commerce, which, he said, would rapidly lead to independence and to combine with this the study of Chemistry, Physics and Technology and so become a manufacturer. Rau seems to have felt that to become a manufacturer was a great falling away from grace for an ardent boy, because he goes at great length into the great future which lies before him and the noble examples of enlightened and well-spent lives which were to be found among the great manufacturers of the day. Finally, he advises Messel to move to Frankfort, to enter the business of some large merchant, to attend at the same time lectures in Chemistry, Physics and Technology and after completing his apprenticeship, to travel to France, Belgium and England, the lands of factories and industry, to keep his eyes open for this or that article the making of which was urgently needed and to become himself a factory owner.

That Messel's whole course of action was influenced by this letter is clear, not only from the fact that he kept it to the last amongst his rarest treasures but that he followed the advice it contained, almost verbally.

In April, 1863, he became apprenticed to E. Lucius, in his wholesale drug, chemical and pharmaceutical factory in Frankfort, where, according to a letter from Lucius, he obtained a thorough knowledge of the business in all its branches. He remained in Frankfort until September, 1866. Although there is no definite evidence that he attended lectures at the same time or who his teachers were, there can be little doubt that in this respect also he followed the advice given him. In 1864 and 1865 he was a member of the "Physikalischer Verein," which was then and later a teaching institution; the teacher in chemistry was Prof. Rudolph Boettger and in Physics first Prof. Oppel and later Prof. Friedrich Kohlrausch.

On leaving Lucius, Messel entered the Federal Polytechnic in Zürich, where he followed the regular first year course. Among the subjects taken were organic and inorganic chemistry (taught by Städeler); technical experimental physics (taught by Bolley); mechanics, mineralogy, botany and technical drawing. Messel completed his year in Zürich. The following winter he spent at Heidelberg studying organic chemistry under Erlenmeyer. According to a letter from Bunsen, he worked with the utmost zeal on analytical subjects in the laboratory of that great teacher, then in his prime. Bunsen, who wrote two years later, especially mentions Messel's manual dexterity, which he says was clearly shown in his later published researches on strychnine-oxyethylene compounds and sulphomaleic acid.

From Heidelberg Messel moved in the spring of 1868 to Tübingen, where he finished his education. Here he spent a year attending the course of experimental physics of Prof. Reusch and courses in organic, inorganic and analytical chemistry by Prof. Strecker. From the spring of 1869 onward he appears to have been engaged in various inquiries under Strecker. A description of those referred to by Bunsen in the letter noted above formed the thesis he presented for his degree. Messel left Tübingen for England in April, 1870.

I believe he came to England originally to act as private assistant to Roscoe. During the short period he spent in Manchester, he worked both with Roscoe and Grace Calvert. The outbreak of the Franco-Prussian war, however, led to his recall to Germany. Owing to some physical defect, he did not serve in the army but was relegated to the Ambulance Corps; he was wounded while on service. When recovered, he returned to England, where he remained during the rest of his life and ultimately became an Englishman. He entered the service of

Dun, Squire and Co. at Stratford, as assistant to Dr. Squire and here he became a thionist; but the virus was already in his veins.

In his Presidential Address, he tells of a conversation in the beginning of the 70's with his former teacher Strecker, of Tübingen—who was the first to discover the relationship of alizarin with anthracene —and Brüning, of Höchst, on the importance of fuming sulphuric acid in the synthetic alizarin industry, then rising into importance. To his question, how the acid should best be made, Strecker gave the prescient reply: "That is a problem for you to solve." A few experiments convinced him, he says, that given pure gases, the catalytic action of platinum was the rational solution of the problem. On April 8, 1875, a telegram came to him at the laboratory, from Squire, asking him to read up that night about Nordhausen acid, as it was wanted by an alizarin works. The response was Messelian and immediate: no reading was necessary. Next day he showed how simple a matter it was to marry sulphur dioxide with oxygen by means of platinum. However, Squire was conventional and thought that the decomposition of an acid sulphate would be a simpler method. Experiments were made as requested but eventually Messel was told "to try his dodge."

With Messel to try what he had once conceived as practicable was to succeed. He was there already; he had seen and he conquered forthwith. A patent was taken out by Squire in 1875 and the process was described at the Chemical Society early in 1876. Meanwhile, Squire had established as a new firm Squire, Chapman and Co., with Messel as factotum; he would have objected to my calling him chemical-engineer, as he had no belief in half-breeds, also he was an entire disbeliever in the attempt to bring the works into the laboratory.

The process was established at Silvertown and in 1878 he succeeded Squire as manager of the works, which he only quitted in 1915, when his health gave way under the excessive strain of the times.

The paper Messel and Squire read at the Chemical Society was never published: even I cannot say why; probably because of patents; from a remark made by Messel, I gather that it was not sent in by Squire. The record of the meeting on April 20 in the *Chemical News* runs simply as follows:—

> "The speaker (Messel), after giving a sketch of the history of the manufacture of sulphuric acid, described the process for preparing the anhydride. The vapour of ordinary sulphuric acid is passed through a white-hot platinum tube, whereby it is almost completely decomposed into water, oxygen and sulphurous anhydride: the mixed gases, after passing through a leaden worm to condense the greater portion of the water, are completely dehydrated in a leaden tower filled with coke, over which a stream of concentrated sulphuric acid is allowed to trickle. The dry mixture of oxygen and sulphurous anhydride is now passed through platinum tubes heated to low redness and containing fragments of platinum pumice, when the gases recombine to form sulphuric anhydride which is condensed in a series of Woulffe's bottles."

In early days, I was a frequent visitor at Silverown, where Messel not only worked but also lived n the modest quarters of a small house attached to he works, until he removed to chambers in Ebury treet and afterwards to Victoria Street. Characeristic of the man throughout his career was his npretentious, simple mode of life. I only knew im to be vain in one connexion—as President of is Society; but he was very proud of the F.R.S. d not a few of us were proud of him as a colleague. enerous and ever thoughtful of others, unselfish to a degree, he had little thought for himself and a hatred of all display; the artist came out, first in his extreme devotion to his own art—for chemistry, technical chemistry in particular, is an art—then in his love of the company of artists and other bohemians: he was a great admirer and friend of Gilbert—of Gilbert and Sullivan fame—and a constant frequenter of the Savage Club; may I add, as a judge of quality in Champagne; in Weib and Gesang he had no estate, though he was musical. Living among them, he knew his work-people and was in sympathy with them: hence his popularity and power.

One understood his success when one followed his work. A man of astounding vigour and full of feeling, he burnt the candle at both ends and all over its surface. That he lasted so long always surprised me. When about sixty he was overtaken by diabetes. He was everything—not only chemist, engineer and business man; he also took care to cultivate the social side of his life; he was the only manufacturer of my acquaintance who attended regularly at scientific gatherings and showed real interest in the proceedings. He was thorough in everything he did. Probably he did far too much himself but he could not suffer fools gladly, though not often impatient outwardly and always considerate. He had no hobby outside his business and science. During many years, his one way of recuperating was a weekly visit to Brighton on Sundays. He went down by the early train, walked out to the Devil's Dyke, had lunch and then returned to town, usually to spend the evening with friends. In those days he was a real walker, as I found when occasionally his joyful companion.

Those who knew him, especially in the early days, will remember his vigorous frame, his black hair and sparkling eyes, his smiling face, his hearty bass staccato laugh, his peculiar gutteral accent. If his portrait were to be painted, I think we should ask the artist to depict just that smile alone, following Tenniel's living presentation of the Cheshire Cat up in the tree by its grin. We can fancy him to-day, smiling at King Ruttan and his crowd and at me the executioner, chuckling at my use of the axe of criticism. He never mastered English properly, though he spoke it fluently. He was very fond of young people, many of whom rejoiced in his generosity. We who knew him all think of him as one of the most loveable men we have met. His outlook on life was always cheerful and optimistic but he was a close observer and critic; always broad, clear and careful in his judgments but deliberate in forming them. The example he set in leaving his fortune to science is a remarkable one and best proof of his considerate outlook. Honest and sincere himself, he hated insincerity and all meanness of spirit. He combined in his person all the best of German good qualities, fired and softened by Jewish imagination.

Nordhausen or Fuming Oil of Vitriol was the only kind of sulphuric acid known to the early chemists. Even in comparatively recent times, not more than a hundred years ago, the manufacture of Vitriolic acid, by burning sulphur, was so imperfect a process, that the old method, troublesome and crude as it was, still held its ground.

The production of the anhydride, by decomposition of a sulphate, appears to have been known in very early times, indeed up to the year 1736 the only way of preparing sulphuric acid was to evolve vapours of the anhydride by destructive distillation of a sulphate and to pass these into water.

When Messel and Squire began their work, Baron Stark, in Bohemia, was sole maker of the fuming acid, the process he used being substantially that of Basil Valentine, born 1394. A particular kind of Pyrite was weathered (oxidised) by exposure to the air. The copperas (ferrous sulphate) so formed was dissolved out and the solution concentrated. The sulphate crystals which separated were usually sold; the mother liquor, containing much ferric sulphate, was then evaporated to dryness and the residue slightly roasted, so as to dry it. The vitriol-stone, as it was called, so produced, was broken up and charged into small bottle-shaped retorts arranged in a gallery furnace, in such a way that they could be heated to a high temperature. Instead of receiving the vapours in water, as in making sulphuric acid, they were condensed in oil of vitriol, a small vessel containing the acid being luted to each retort. The distillation lasted about 36 hours and as the quantity put into each retort was small, the product was also small. The consumption of fuel was great and much labour was involved in charging and discharging the retorts, many of which were broken. The process required great skill on the part of the workers. All attempts to manufacture the acid in larger apparatus appear to have ended in failure.

At the outset, when the attempt was made, to produce the anhydride by passing the vapour of burning sulphur mixed with air over heated pumice coated with spongy platinum, the chief difficulty met with was in condensing the anhydride. As Messel and Squire remark—the manner in which sulphuric anhydride will evade condensation from a gaseous mixture is something quite marvellous. When pure gases were used, the condensation was easily effected; on this account, in the early days of the industry, when the value of the fuming acid was much greater than that of oil of vitriol, a suitable mixture of sulphur dioxide with oxygen was obtained by decomposing the latter. In their experiments referred to in the paper, a small platinum still about 4 inches in diameter was so arranged in a Hofmann Gas Furnace that it could conveniently be maintained very nearly at a white heat. Ordinary oil of vitriol was slowly fed into the still and kept strongly boiling; the vapour was almost completely decomposed, the condensed water containing but little acid. After the mixture of gases had been dried by means of sulphuric acid, it was passed over pumice stone prepared with platinum, enclosed in a large tube made of thick platinum foil, heated to a dull-red heat by the waste heat of the gas furnace. Little or no sulphur dioxide passed away when the heat was properly managed, the process was continuous and the condensation perfect. Nearly 70 parts of anhydride were obtained from 100 parts of white sulphuric acid, the theoretical amount being 80 or thereabout.

In the early days, the demand was limited by the requirements of the dyestuff industry, especially that of the madder colours. When the use of the fuming acid was introduced into the Cordite industry, in connexion with the displacement nitration process, the demand became much greater. At the close of his industrial career, Messel was producing from 250 to 300 tons of Oleum per week, containing 20% of anhydride in admixture with sulphuric acid.

As experience was gained and the difficulty of condensing the anhydride was overcome, sulphur dioxide prepared by burning sulphur and ordinary air were used. In this case also exact proportions were at first adhered to. I remember Messel telling me that he was first led to use excess of air and therefore to abandon the use of special appliances for the supply of the gases in due proportion by having his attention called, by his workman-foreman, to the fact that the plant worked better when air was supplied in excess.

In early days, to reduce the cost of carriage, acid was sent abroad of 80% anhydride strength and diluted with 'monohydrate.' Where this was done I forget but that this was his practice I know, as when I once asked him if he had any knowledge of the process of making sulphuric acid (H_2SO_4) by freezing it out from oil of vitriol, he told me that he had at one time so made it for the purpose stated above.

Over and over again he told me that he aimed at making vitriolic acid by his process as cheaply as by the chamber process and I well remember the joy with which he told me that he had at last succeeded.

Messel's claim to distinction does not rest upon the discovery of a chemical process but upon his initial success in building up from the foundation, unaided and almost alone, a novel industry of great importance and in having solved a variety of technical problems of extreme difficulty. His success was due not only to his great mechanical ability and clear understanding of the task before him but particularly to his high moral standard and his absolute devotion to work.

'The strongest weapon one can see
In mortal hands is Constancy.'

Doubtless, in later days, as we all do, he derived assistance from outside but this was only when his primary work was accomplished and it became necessary largely to extend the plant. We have been accustomed to admire the systematic manner in which the German chemical works are conducted with the aid of a considerable staff of trained, disciplined workers: what always appealed to me was the fact that he, a German working under our English conditions, with scarcely any technical staff, was long far in advance of his countrymen. His success was due, in the first place, to his thorough scientific training and to his scientific outlook but, to an exceptional degree, to his moral attitude towards his work. The lesson to be learnt from his life should be of no small value to us.

CHEMICAL ACTION *AND* CATALYSIS

AN ESSAY ON CLEANNESS

"*A Satyrical Allusion to the Heathen Gods, who are supposed all of them to have been Kings or famous Men in their Time and fabl'd into Deities by the Error and Ignorance of those Days; concluding with a list of Great but Vicious Princes in our Modern Times fit to make Gods of in the next Promotion.*"

Chemical Action *and* Catalysis: if not these words, καταλύω should be graven at the base of the monument to my friend.

The industry which Rudolph Messel had so large a share in developing, more than any other perhaps, is commonly thought of as one in which "*catalysis*" has a leading part: every budding student during generations past has been taught to regard nitric oxide as the catalytic agent in the *chamber process* and platinum as similarly effective in the later *contact process*. No two less similar processes could well be imagined; yet if choice were to be made between them, I imagine the latter would be regarded as the "typically" catalytic process.

Berzelius, in first communicating his conception in 1835, included a long list of interactions under the influence of agents which appeared to take no permanent part, even if included, in the change, as they were ultimately recovered unaltered.

Whilst in the interval attention has been more and more concentrated upon platinum, nickel and the enzymes as catalytic agents *pur sang*, of late years there has been a growing tendency to extend the conception to all agents determining change—in other words, to chemical change in general.

A strange confusion of thought prevails, in fact: rather, may it be said, perhaps, a strange lack of thought. Francis Bacon three hundred years ago could point out, that "the ill and unfit choice of words wonderfully obstructs the understanding." The term catalysis would seem to be one of those "Idols of the Theatre," as he terms them, "which have immigrated into men's minds from the various dogmas of philosophies and also from wrong laws of demonstration."

If, as Bacon insisted, "words force and overrule the understanding and throw all into confusion and lead men away into numberless empty controversies and idle fancies," it behoves us to be most careful in our choice of words and concise in our definitions, remembering that "even definitions cannot cure this evil in dealing with natural and material things, since the definitions themselves consist of words and those words beget others, so that it is necessary to recur to individual instances and those in due series and order."

It is a strange fact that whilst the "criteria of catalysis" are more or less fully discussed in recent works, there is practically no reference to the broader problem of chemical change or action; even Mellor, in his two encyclopœdic volumes, makes no attempt to consider the conditions which determine it. This is equally true of the lengthy dissertation compiled by the pillar of American Physical Chemistry, Wilder D. Bancroft and his adsorbed body of assistants. The recent discussion at the Faraday Society, apart from Langmuir's experimental contribution, appears to have been in a "greenery-yallery, Grosvenor-Gallery" Valhalla to which chemists can never hope to attain—only Dr. Lowry spoke from a foundation of fact, in earthly but shattering terms.[*] The main lesson to be drawn from the two documents is that Dr. Miall should continue his efforts to found an Association for the Discouragement of the Integral Calculus of which he has given notice in the U.S.A.

Students, we know, have been taught of late years to worship Idols of the Theatre, to lisp certain Teutonic shibboleths; but the inner mysteries of chemical change have never been confided to them. The state of ignorance induced by our text-books is astounding: a vast burden of facts is laid upon us but processes are rarely considered: the manuals mark no advance in methodical treatment, and are best described in Shelley's words as—

> . . . . tomes
> Of reasoned wrong, glozed on by ignorance.

We physicians have a long way to go in healing ourselves before we prate of scientific method to the public. As to text-books, let us Scrap the lot![*]

> *Spermatick Vigour* spreads the poison'd Race,
> Conveys Hereditary Crimes apace;
>
> . . . . . .
>
> What strange, what inconsistent Thing's a Man?
> Who shall his Nature search, his life explain?
>
> . . . . . .
>
> A constant Bondage bows his Couchant Neck
> His Will corrupted and his Judgement weak.
>
> . . . . . .
>
> Subjected Man submits to the Controul
> Of Forty Thousand Tyrants in his Soul.
>
> . . . . . .
>
> *Wonder no more* the Sons of such a Race
> Grow ripe for Slavish Principles apace;
> The Victory of Vice is so Compleat
> The Conquer'd Faculties at once submit:
> He's born with Slavery in his very Face
> And hands it down to his subjected Race.

In R. L. Stevenson's apposite words: "Culture is not measured by the greatness of the field which is covered but by the nicety with which we can perceive relations in that field, whether great or small."

Thus defined, where is the cultured chemist to be found to-day? Recent hearings before the Board of Trade Official Referee show that the witnesses —I will not call them chemists—were not even agreed as to what is "A Chemical"; the innocent lawyer was trapped into the belief that it was something manufactured.[†] Doubtless this definition was paid for—nothing else could explain and excuse its absurdity.

Chemical Change

All single things dealt with by the chemist are chemicals. A chemical can only be defined as a material which can take part in a chemical change; combustion undeniably involves chemical change: argle—Oxygen is a Chemical! Who manufactured oxygen? We can only say—It is!

What is involved in the process of Combustion— to take the simplest possible case, that of the formation of *hydrone* (water) from hydrogen and oxygen? Every text-book we have *lies* in telling the student that hydrogen and oxygen interact to form "water." We *know* they do not. The effect of drought upon the country is patent to everyone —especially of late years—yet no notice is taken of its effect in chemistry. The remarkable work of Wanklyn, Cowper, Dixon and especially of H. B. Baker may be just mentioned occasionally but its entirely fundamental value is in no way appreciated; Lowry's work may be seen but it is not heard.

It is as Bacon said three hundred years ago: "The Idols and false notions which are now in possession of the human understanding and have taken deep root therein not only so beset men's minds that truth can hardly find entrance but, even after entrance obtained, they will again in the very instauration of the sciences meet and trouble us, unless men, being forewarned of the danger, fortify themselves as far as may be against their assaults."

Surely it were time that we fortified ourselves; that we sought to deserve the title of scientific workers and thinkers? Human understanding *is* frail and limited but not so limited as we make it appear. There is no conscious effort made by us to be impartial and logical; and our difficulties arise from lack of culture—from the gross specialisation of the day, which is largely conditioned by our satanic system of competitive examinations: a system more calculated to kill genius and prevent progress could not possibly be devised.

---

[*] Bancroft's essay is written with child-like innocency of purpose. He meanders through three numbers of the Journal of Industrial and Engineering Chemistry (April to June) without ever stating what he thinks he means by catalysis, without making the slightest attempt to overlook the process of chemical change in general. Like most chemists of the time, he seems to be clad in little more than a chemical loin cloth: that a whole suit is necessary for a change seems never to have occurred to him. Such be your Gods, Oh Israel!

The same sense of disappointment is left on turning over the pages of the monographs on the subject. Jumble sales of facts, vastly interesting and valuable as catalogues of observations, they lead nowhere in particular:—

> When they cry, "Steer to starboard but keep her head larboard,"
> What on earth is the Helmsman to do?

The mind is reduced to the condition of the map so vividly described by the Bellman in *The Hunting of the Snark*—"A perfect and absolute blank."

The statement made by Samuel Butler, under the heading "First Principles," is worthy of quotation in this connexion:—

> "When we are impressed by a few only or perhaps only one of a number of ideas which are bonded pleasantly together, there is hope; when we see a good many, there is expectation; when we have had so many presented to us that we have expected confidently and the remaining ideas have not turned up, there is disappointment. So the sailor says in the play: 'Here are my arms, here is my manly bosom but where's my Mary?'"

Indeed, "Where's my Mary?" must be the general cry of those who read of catalysis in the journals; we miss her dear form everywhere.

[*] It is estimated that new books will be "Homeless" at the Chemical Society five years hence. It is clear that a "Palace" must be found in which the united Chemical Societies can foregather with the books of the future and those of the past which are worth preserving: no other Catalyst will serve the purpose. Meanwhile let selection be made of the few text books worth preserving and the rest publicly burnt, as a warning to budding authors: there will then be sufficient room on the shelves to meet passing needs while the Palace is building.

[†] Judgment upon the Act was pronounced by the author of *Robinson Crusoe* when he said:—

> Reason is the Test of the Law; for Laws which are contradictory to Reason are void in their own Nature; and ought not either to be made or regarded.

Yet hope is in the offing. To me it seems, I am glad to say, that, in upper scientific circles, there are clear signs of a return to chemistry and reason—that the attention paid to pseudo-physical aspects having outworn its welcome is giving place to the desire to consider the inner meaning of chemical phenomena, to be eclectic, to recognise the insufficiency, if not the emptiness, of the treatment to which they have been subjected by the Syncretists. The work done by Hardy in correlating lubricating power with chemical structure and that of Jacques Loeb, following that of Hardy, on proteins, may be referred to by way of example. We are returning to the sane vision before the early workers that molecular structure is the key to function; let us hope that the change will be marked by the rejection of the pedantic jargon which has so long marred the fair field of our science.

From morning to night we must impress upon our students that they must learn to think for themselves but that thinking rightly is an outcome of experience, no easy thing; that they must therefore give due heed to experience but have no belief in authority—above all, be wary of the journalist and propagandist and of the text-book.

The experimental evidence put forward by H. B. Baker is of such cogency that it may now be asserted, that hydrogen and oxygen *cannot interact* and that to determine interaction *a third component must be introduced into the system.* What is the nature of the third component? Whilst affording proof that moisture promotes the change, Baker's observation that liquid water might be present and yet no explosion take place apparently is proof that water alone cannot act as third component. By using the hardest glass and gases liberated from a solution of baryta, Baker eliminated acid impurity as far as was practicable; as interaction takes place when these precautions are not observed the legitimate inference is that water becomes the determinant only when it is rendered conducting by the presence of impurity, usually acid. The interaction is an electrolytic process, in fact. One Faraday taught this doctrine in early days (1833). By his study of the power of metals and other solids to induce the combination of gaseous bodies and of electro-chemical decomposition in general, he laid the foundation, for all time, of the theory of chemical change; and yet, whilst honouring it in its transcendental aspects—for we recognise that Faraday foreshadowed the electron—we pay no attention to the ordinary applications of his work. Why is it that we so rarely read in order that we may mark, learn and inwardly digest? Whatever of logic I have in my composition, whatever unfortunate tendency to be critical, I owe it, in some measure, to Trench's *Study of Words* but mainly to reading Faraday. An early purchase of his collected works was the most fortunate I ever made. The exquisite lucidity of his logic at once impressed me. The Electro-chemical Researches are in *Everyman's Library* and every youthful student who wishes to gain the scientific habit of mind should acquire and master this volume—if only as a literary exercise. All the essayists may well be put aside for it, if the desire be to cultivate style and to escape from the tyranny of the literary plagiarists who eternally harp upon one theme and make no attempt at progress.

To-day, I but take up the position I took with reference to Baker's work in March, 1885, when he was only beginning his chemical studies—merely telling us that the combustibility of phosphorus and charcoal had been overrated and misinterpreted. Influenced by a Faradic current of thought, intensified by my association with two pioneer workers in electricity, Ayrton and Perry, I dared to project my mind into the future and say that some day it would be found that a mixture of pure hydrogen with pure oxygen would be inexplosive. The position, I assumed, was perfectly simple—that action always takes place and only takes place in a conducting or electrolytic circuit. Neither gas was a conductor nor did either make water conducting. Following Ayrton and Perry, I argued that Ohm's well-known electrolytic law, $C=E/R$, was equally the law of chemical change. My forecast was verified by Baker in 1902 and he has since given not a few other proofs of the validity of my thesis.*

I venture to think that the discussion we had on the occasion referred to at the Chemical Society is the most important in its history and yet how little real recognition it has received. Who reads such literature, any real literature to-day.† The Tit-bits miscalled abstracts and illiterate text-books alone hold the field. Very few remain mindful of Liebig's counsel to Kekulé: "No one who does not ruin his health with study (he meant reading) will ever do anything in chemistry nowadays." Some excuse, perhaps, is to be found in the quality of too many modern memoirs.

Altars have been set up everywhere for the worship of a narrow doctrine mislabelled Physical Chemistry; the chief Ikon has been St. Arrhenius, a divinity of Scandinavian origin; Teutonic priests, the Ostwalds especially, have ministered faithfully at his shrine; latterly they have gradually changed the material of his effigy and have formed it in glue. The fashion set has not only stuck in many places but has assumed epidemic proportions. The ritual the school has developed is as vague, as wordy and as mystical as that of any of the Churches. Leipzig for a time was a veritable Lourdes and full of pilgrims; everyone knows the miraculous curves that were issued from the temple there. The prominent symptom of the disease is that it renders the mind semi-permeable to ideas; if any, only those of one kind get through. However, we all have partially permeable intellects—not semi only but some much smaller fraction. The Americans, as was to be expected. have been worst hit; we come next; the French have displayed their characteristic immunity towards external influences and have shown a sense of proportion which has enabled them to preserve their sanity. No cult can last for ever; some free men there still are in the world; the war has made people think a little; shortly we shall realise how silly we have been in adopting clerical methods and substituting faith for evidence, particularly in putting faith in any one hypnotist and allowing him and his lieutenants to dogmatise us into belief. Science is a human occupation like others; we are all prone to hero-worship and seekers after praise and position, making pleasurable statements, are always taken too much at their own valuation; when followed by the trail of Nobelism they are irresistible.

---

* As the Proceedings of the Chemical Society are not generally available, I venture to reproduce my prophecy:—

> "He (Dr. Armstrong) had even ventured to affirm to Mr. Dixon that some day it would be ascertained that a mixture of pure oxygen with pure hydrogen was not explosive."
>
> "Dr. Armstrong said that the view which he now held was best stated by defining chemical action as *reversed electrolysis*, *i.e.*, in any case in which chemical action was to take place it was essential that the system operated upon should contain a material of the nature of an electrolyte. Neither oxygen nor hydrogen was an electrolyte, therefore a mixture of only these two gases should not be explosive; a mixture of pure oxygen and pure carbonic oxide for like reasons should not explode. There was, however, a tendency perhaps to exaggerate the importance of water and to overlook the possible presence in minute quantity, and influence of, other bodies. Water not being an electrolyte, as it was scarcely probable that water and oxygen or hydrogen would form an electrolyte, it was difficult to understand that the presence of water pure and simple should be of influence in the case of a mixture of oxygen and hydrogen."

† The Americans, almost more than the French and Germans, now pay scant attention to outside literature and are on the way to give a new meaning to the term Monograph—not the graph of a subject but that of a notion. Falk disregards the whole of my work, including that on enzymes, in his monographs.

There is nothing dogmatic in the assertion that all chemical change is an electro-chemical, *i.e.*, an electrolytic process—facts prove it to be such: let those who doubt study Faraday. Modern discovery only serves to deepen the conviction. The nature of the electro-chemical process, however, is still open to argument.

To the pure all things are pure, it is said; but none of us dare claim to be otherwise than impure and so we may reverse the proverb and say that to us, the impure, all things are impure. Strange to say, the physicist is still affecting to love the simple life and has not yet learnt to take things impurely: he has yet to recognise the value of chemical soap-and-water, the need of attaching importance to cleanliness, perhaps it should rather be said, to dirt; his interpretation of the phenomena of electric discharge has yet to be justified under dry conditions. The intermediary is difficult to find. Langmuir seems to be the most likely holder of the office, if he can but come down to earth and be proportionate in his judgments—in Faraday's sense; if he will work at the open window.

The Determinant

Most will now admit that the interaction of hydrogen and oxygen is *determined*—please mark the word—by conducting water. What is conducting water? The Arrhenists claim that water itself is a conductor—though only a very feeble one at best. I need not remind that the plea, " It's only a wee one," is not admitted in law. The assumption that water is a conductor *per se* is purely gratuitous. The value accepted is that arrived at by Kohlrausch—but he worked in prehistoric times and used prehistoric methods; he cannot conceivably have dealt with pure water. Pure water is impossible in mortal hands. Some minute impurity must ever be present. Knowing as we do that impurity is present and that conductivity falls rapidly as impurity is removed, it is only logical to assume that ideal, .pure water would be a non-conductor, at least to all ordinary potentials. The situation is one which cannot well be resolved by experiment. We must proceed by way of hypothesis, as in the case of gravitation.

Let our hypothesis be this—that the interaction of two diverse molecular systems is determined by the presence of a third system, itself an electrolytic system and compatible with them, in the sense that the three can be associated into a single conducting system. I would call this third system the *Determinant* and say that every chemical change involves the presence of a Determinant. Please mark the word *Determinant* and note that the Determinant is always an electrolyte.

Sauce for the goose being sauce for the gander, all that I have said may be read backwards. If hydrone cannot be formed by the direct interaction of hydrogen and oxygen, it cannot be directly resolved into these; some determinant must intervene to bring about the decomposition. H. B. Baker has given proof of this thesis by showing, to take only a single case, that the stability of ammonium chloride is greater the more carefully it is dried.

Recognising this, let us give effect to our belated conversion to a true faith by including in every equation the symbol of the determinant, E or Ed, a small one, if you will; better an epsilon, ϵ, if not $\epsilon\delta$, as these foreign signs will have greater appearance of learning. Let us not be ashamed of acknowledging the determinant, especially in Grecian dress, as a necessary member of any family party of chemical agents we may call together, *e.g.*, in expressing the formation of hydrone empirically, in order to show what factors are involved, let us write:—

$$(O_2+\epsilon\delta+2H_2)=2H_2O+\epsilon\delta;$$

or if we wish to represent the operation as a reversible change

$$(O_2+\epsilon\delta+2H_2)\rightleftarrows(2H_2O+\epsilon\delta).$$

The brackets are added to indicate that a complex system is involved in each case.

The argument may be extended even to explosives. We know from Gattermann's work that the stability of nitrogen chloride depends upon its purity. In firing Cordite—a mixture of cellulosic and glyceric nitrates—not a little of the unburnt material is often projected from the gun in the form of perfect rods much reduced in size. The explosive is not shaken to pieces molecularly but just burnt away at the surface and we have to picture to ourselves the long-despised little ee's or ed's bombarding this with incredible activity as the charge is slowly fired—slowly in comparison with the intra-molecular activities of the explosive system.

A horribly pedantic jargon has been piled up around ethylic aceto-acetate and other compounds which lead a double life, beginning with the word *tautomeric*: an unnecessary invention, Berzelius having rightly assigned *metameric* to such use. They were long represented as not knowing their own minds for two seconds together—strange to say, no Ostwald ever coined the term *Lunoids* for them—as ever undergoing an internal molecular change at their own sweet wills. It has always been clear that little $\epsilon\delta$ was at work. Groves and I took this view in several instances in writing our (Miller's) *Organic Chemistry* (1880); and Lowry, in my laboratory, has given the most complete proof of the thesis. Recently, it has been found that either of the two metameric (isodynamic) forms of the aceto-acetate may be obtained at will by observing certain precautions—mainly, be it noted, by using quartz instead of glass vessels.

I have not yet reached a terminus. If logical and we have faith in our prophetic powers, we may project our minds into the future and foresee the time when it is admitted that liquids and also solids are not as we see them. Baker is already leading the advance into this field. By drying benzene, he has raised its boiling point above that of water—if indeed the explosive behaviour at the higher temperature can be characterised as " boiling." He has obtained similar results with carbon bisulphide and other liquids. Carnelly's dream of hot ice was perhaps not the absurdity it was deemed to be at the time! Benzene boiling at 107° or mercury at about 450° would have been scoffed at equally. Benzene and similar liquids which are not miscible with water are not easily dried but once dried they are not easily wetted. Baker being a veritable wizard has been able to boil off water through dried benzene. Modest in manner and modest in statement, he has made far too little impression upon our cloth; no Teutonic Boswell has log-rolled his progress, no special Journal has been founded to acclaim the peculiar joys or drawbacks of the dry state in chemistry, no Act of Congress has been passed to provide for its operation. The main reason probably why the prophet has been insufficiently honoured even in his own country is the fact that we chemists are educated into being the dullest of drones—without imagination. We cannot remain dry ourselves, even in the U.S.A., therefore, apparently, we have neither belief nor interest in the dry state, except as one to be avoided; we only subconsciously realise perhaps that you cannot get on in it; presumably it is one involving the death of chemical change, as it is of all artistry, because of the inanimate life the molecules enjoy during drought.

The Catalyst

Having considered the conditions which determine the occurrence of chemical change, let us now pass to those which hasten its progress. The interaction of hydrogen and oxygen is promoted by platinum in any state of division but more especially when it is very finely sub-divided, as in the spongy platinum first used for the purpose by Döbereiner in 1823, although Humphry Davy had previously (1817) noted the inductive effect of the metal in the massive state.

Döbereiner, as Faraday wrote in 1833,

> "refers the effect entirely to an electrolytic action. He considers the platina and hydrogen as forming a voltaic element of the ordinary kind, in which the hydrogen, being very highly positive, represent the zinc of the usual arrangement and like it, therefore, attracts oxygen and combines with it."

The only essential condition, as Faraday insists, is a clean metallic surface. As he recognised,

> "The effect is evidently produced by most, if not all, solid bodies, weakly perhaps by many of them but rising to a high degree in platina. Dulong and Thénard have very philosophically extended our knowledge of the property to its possession by all the metals and by earths, glass, stones, etc.; and every idea of its being a known and recognised electric action is in this way removed."

What could be better, too, than the following?—

> "All the phenomena connected with this subject press upon my mind the conviction that the effects in question are entirely incidental and of a secondary nature; that they are dependent upon the *natural conditions* of gaseous elasticity, combined with the exertion of that attractive force possessed by many bodies, especially those which are solid, in an eminent degree and probably belonging to all; by which they are drawn into association more or less close, without at the same time undergoing chemical combination, though often assuming the condition of adhesion; and which occasionally leads under very favourable circumstances, as in the present instance, to the combination of bodies simultaneously subjected to this attraction."

The modern work of Hardy, Langmuir and others is justification of the view that condensation at solid surfaces is the outcome, not of a mere mechanical cohesion but of an attraction due to residual chemical affinity and therefore selective—in fact, a function of structure. The peculiar activity of platinum seems to be due to the fact that it is highly attractive of both hydrogen and oxygen—whether and to what extent it combines with them to form an "oxide" when exposed to the two gases is open to question. Willstätter has argued that the presence of some oxygen in platinum sponge is essential to its activity as a hydrogenating agent and he assumes that an unstable compound with both elements is formed. Faraday's observation that, although the plate is less readily cleansed when made the negative pole in diluted sulphuric acid, a platinum plate at which hydrogen has been evolved, when clean, is equally active in promoting the interaction, would seem to preclude the presence and need of oxygen, unless it be that the formation of the oxide postulated by Willstätter takes place immediately, by partial displacement of hydrogen, on presentation of the clean metal to the gas; also the fact that most if not all solid bodies are in some degree active, is against the oxide view; but the gradual corrugation of the solid metal and the expansion of palladium as it is charged must not be overlooked as favouring it.

For the present argument, this is a question of minor importance. The main function of the platinum surface would seem to be to capture and raise the concentration of the interacting substances; not to induce change but to hasten it by this increase of concentration. The determinant is as necessary as in the ordinary case of interaction of the gases in its absence, as without it no electrolyte would be present. The problem has not yet been submitted to any refined study but it is known that moisture favours the action.

I am thus brought to the definition of a Catalyst* as something different from a Determinant and to accept the statement, which is commonly stressed, that it is an agent which accelerates a change in being. Unlike the Determinant, however, the Catalyst is not an electrolyte but merely a solid superficies at which the interacting substances become condensed and therefore of increased concentration; hence the acceleration of the interaction and hence the value of its aid.

In the mind's eye, from Faraday's massive plate to the most minute speck of platinum mounted upon a Messelian asbestos support, the change in size and increase in activity is continuous and doubtless in correspondence with the increase in surface area; the greatest activity would be that of molecular fineness. The speck, however, must remain a speck: it must retain its particulate character; in solution, the molecules are too often married with the solvent, their distribution is too uniform, to permit of an excited rate of change.

The activity of the catalyst would seem to be due to the operation of the force of residual affinity; on no other assumption can we well understand the preferential activity of various catalysts. The work of Hardy and Langmuir especially has afforded proof that molecular structure is a determining factor and that a single layer of molecules can cover and effectively occupy a solid surface. The molecules in some way become ranged in accordance with their structure. Chemists have long thought of the carboxyl radicle in acids as the active part of the molecule and it is no surprise to have proof given that when a fatty acid is spread out upon water the molecules become ranged in the film in serried ranks, like porcupine-fishing-floats in a stream, only the carboxyl radicle dipping into the liquid; the argument may be extended to an oiled solid surface.

The character of the surface also plays its part. Hardy has definitely shown that glass, metal and various kinds of composite material of the ebonite class behave differently. We can but imagine that the structural character comes into play and that centres of attraction may be offered. No other explanation can well be given of the entirely selective activity of the colloid catalysts—the enzymes, the potent agents of change at the root of all vital activity. It is commonly stated that these fit their compatible hydrolytes as a key fits a lock; the hypothesis was put forward by the late Prof. Emil Fischer, long my venerated friend; as he has been regarded as a super-authirity, not only in

---

*I believe I introduced the term in 1885. *Catalyser* (*catalyser*) is a word without euphony to my ear and I would specially deprecate the use of the verb *to catalyse* or any verbal form of the term.

Germany where it is customary to worship the words of professors but by chemists generally, the suggestion has been made one of our chemical shibboleths. Infinitely gullible we are, as Carlyle has said. The suggestion does not bear thinking about, charming though it be as a literary parallel. A key is something entirely different from a lock—something which fits into its blanks. Blanks are unknown to us in our chemical locks. The fit cannot well be other than that of similarity: in some part the enzymic complex must be so like the compatible hydrolyte that the two fit together when superposed; we are therefore driven to think of this active centre as the hydrolyte itself gathered into the structure of the complex. My son and I have long advocated this view.

The influence of proteid colloids other than enzymes as catalysts has been little studied.* The production of hydrazine from ammonia and hypochlorite, according to Raschig, is promoted by the presence of a little glue; but it is found, I believe, that all glues do not equally serve the purpose. If so, is the difference due to some structural peculiarity? It is conceivable that the interaction may involve the intervention of a protein chloramine? If so, structure might tell.

In addition to directly active catalysts—catalysts which exert a definite attractive effect upon substances whose interaction they promote—there is conceivably a neutral class, effective through the agency of the specially active layer of simple hydrone molecules deposited at their surface.

Hydrone and Water

Progress has too long been stayed by the fiction that water is represented by the symbol OH_2—by the failure to recognise that it is a "mush" of molecules of several degrees of complexity.† Unfortunately, we can only distinguish one at present, the simplest, that of hydrone, OH_2, probably always a minor constituent of water. Bragg's recent work rather favours the view that ordinary ice is a benzenoid complex in which six hydrone molecules are conjoined. I have long been of the belief that water is to be thought of as a mixture of hydrone with several polyhydrones of the polymethylene type.

If we could be logical, we should only apply the term water to the liquid substance, never to that symbolised as H_2O. We have as little right to think of this as water as we have of the various polymethylenes as methylene.

The Pseudo-Physical School has been so impassive and impenetrable by ideas, so intellectually pachydermatous, that it has never given heed to the composition of water. The treatment of the problems of solutions by the school has therefore been purely empirical and of small value. The main object has been to force agreement with a formula; this satisfies the mathematical mind but not the free-spirited chemist striving to see within and to dissect out the active factors. We are often told that a return to the land is now our one hope of salvation as a people—in any case our ultimate fate. Let us chemists recognise that we can only abide in chemistry and let this be to us a word of real significance, of broad and intensive meaning. A chemist must be a chemist and not a mere bit of one, still less a formula-seeking mathematician, to do effective work.

To begin with, we must purify and simplify our nomenclature and use only words of clear import. We must arrive at an understanding as to the meaning to be given to the term solution. The term solid solution is a contradiction in terms; Colloid solution is equally bad; in a crystalline solid mixture there cannot be that evenness of distribution which is the characteristic of a solution; motion must be constrained and limited, not illimitable; there cannot be that exercise of affection between solute and solvent, that compatibility of temper due to oppositeness of character, which is at the root of solubility and dissolving power, which leads to short marrying long, to beauty mating with ugliness.

Determinant and Catalyst

This brings me to the final distinction I desire to make between Determinant (εδ) and Catalyst (κ).

The one is active in solution, the other in suspension; in the one case the distribution of the components is even; in the other it is uneven and local, the catalyst being a surface-centre towards which the interacting substances are attracted.

In the presence only of a determinant, the rate of change is in accordance with the sacred Law of Mass Action, which is ever subject to modification however, owing to changes in the medium conditioned by the alterations in molecular character and complexity which attend all interactions, just as human laws are always being modified by circumstances.

---

* The attempt has been made by the school that dubs itself "colloid" to read into the term the sense of particulate—of very finely divided matter in suspension in a fluid. Nothing was further from Graham's mind.

I would urge that the term colloid should be used only in its etymological sense and confined to substances such as Graham contemplated—substances opposite to the so-called crystalloids in the scale of solubility.

Then that a distinction be drawn between actions in solution and those at particulate surfaces.

The passage of the colloid from solution into the particulate state probably involves far more than meets the eye, even that of imagination, to-day. McBain's fascinating studies of soaps have brought to light the existence of a tendency similar to that apparent in compounds such as the cobaltammines and other complex salts, in which one or more of several negative radicles is lost to view. In the soaps, several primary molecules of the salt are merged into an aggregate in which the alkali is in large part hidden away. We have to remember that even acetates have a tendency to take on a more complex form than that of the simple molecule. It is possible to think of a wheel-like arrangement of the molecules, in which most of the carboxylated groups are at the hub, the hydrocarbon radicles ranging outwards like spokes. The coagulation of colloids may well involve the formation of aggregates, in like manner: and the production of a jelly is conceivably due to the interlocking of such polymerised molecules, water filling the waste spaces. As Wilder D.B. has the goodness to say: "For the moment it looks as though the organic chemist were the safe man to follow," rather than the adsorbist. Yet such an explanation can scarcely be given of the agglutination of micro-organisms under some special conditions which we cannot yet appreciate; the primary change, in these cases, may be in water.

† The rapid increase in the rate of chemical change as the temperature of a solution is raised, it may be suggested, is mainly due to the changes which water itself undergoes—to its increasing activity.

* When Mr. Walcot has exhausted his imaginative power in depicting Roman and Persian subjects, he will perhaps find a worthy stimulus to his needle in an allegorical presentment of the new Babylon science is building. I said much of our abuse of our language in 1894, in my first Presidential Address to the Chemical Society. As Secretary, I had had some influence in securing uniformity and clearness of expression. To-day, there seems to be no check to lawlessness—no clear understanding of law, no desire to arrive at and obey the law. Proceedings under the Safeguarding of Industries Act show that we must spring-clean our vocabulary and give thought to our words. Why do we so carelessly use Interaction and Reaction indifferently, when the former expresses our meaning and the latter does not? Why are we not satisfied to speak of chemical agents, instead of reagents? The medical man is content with "therapeutic agents." Why introduce "reactant"—an unnecessary and un-English word? Our object should be to use words as near as possible to those in popular use, if not those in actual use: our desire being to live on terms of intimacy with the public. Why coin new words when old ones will suffice? Adsorption would be a proper word to introduce, if a new word were necessary; but several popular words suffice to convey the idea underlying its use. It is strange to the common ear and to the novice. If we are to coin new words, they should suit the genius of our language; no language is so hospitable to foreign intruders, yet it cannot admit every stranger that may call in. To get over the difficulty arising from the alternative use of absorb and adsorb, it is proposed to omit the prefix; but sorb is a word without dignity, and the attempt to introduce it should not be countenanced. The introductory "But" is a mild offender compared with it. Then why so un-English a term as ionic *micell* when aggregate gives complete expression to the underlying idea: the word carries no crumb of comfort to the British ear: and what will it become in America—My-y-sell? Anything may happen to such a word. It is time some sense of eternal fitness, if not of the ridiculous, were infused into the scientific mind—if we wish to secure public sympathy. Still:

Oh ye who tread the Narrow Way
By Tophet-flare to Judgment Day,
Be gentle when the heathen pray
To Buddha at Kamâkura.

In the presence of a catalyst, the action is not in accordance with the nominal concentration but much more rapidly and nearly at a linear rate over the greater part of the period of change. Unfortunately, the action of catalysts, especially of enzymes, is often obscured by secondary actions and the assumption that all chemical change must be subject to the mass action law has gained such credence that almost everywhere the temptation to twist the results to this interpretation has been irresistible. There has, however, long been a suspicion that enzymic hydrolysis takes place mainly at linear rates, so long as disturbing influences are inoperative; it is permissible to say, I think, that the work done in my laboratory, especially that with urea and the enzyme urease, has raised this to a certainty, confirmed as it has been, in the most striking manner possible, by the observations made by Drs. E. F. Armstrong and Hilditch on the hydrogenation of oily fluids in presence of very finely divided metallic nickel.

Let me cross the t's in this section by saying that if we desire to give expression to the action of a catalyst in writing an explanatory equation, this may be done as in the following example:—

$$O_2+\epsilon\delta\kappa+2H_2=2H_2O+\epsilon\delta\kappa.$$

By associating the symbol of the electrolytic determinant with that of the catalyst, the fact is brought out that the former is necessary and that both factors are concerned in the operation.

Hydroxylation not Oxygenation

The formation of hydrone from hydrogen and oxygen is but imperfectly expressed even in the equation

$$O_2+\epsilon\delta+2H_2=2OH_2+\epsilon\delta;$$

it is true unusual attention is paid to the character of the process but this is not fully developed as an electrolytic event.

When writing my *Introduction to the Study of Inorganic Chemistry*, published in 1874, although I was grossly ignorant and inexperienced, I was beginning to think. Discussing the formation of acids by the oxidation of the corresponding aldehydes, having assimilated Avogadro's theorem and knowing the formula of oxygen, which few did at that time, I wrote (p. 241):—

$$2R'.COH+O_2=2R'.CO(OH).$$

In a footnote I added:—" Perhaps

$$R'.COH+O+OH_2=R'.CO(OH)+OH_2,$$

i.e., the reaction is one of double decomposition, H being replaced by OH and does not consist in the mere addition of oxygen." In Miller's *Organic Chemistry* (p. 417), published in 1880, this conception was logically extended to cases of oxidation generally.

I had not then consciously developed a consistent electrolytic conception of chemical change, yet I was approaching it and had foreseen that the oxidation process is to be interpreted as primarily one involving hydroxylation.

It may safely be asserted, taking the facts generally into account, that when acidified water is electrolysed, hydrone molecules are primarily resolved not into oxygen and hydrogen but into perhydrone (hydrogen peroxide) and hydrogen:—

$$\begin{array}{llll} H & \cdot\quad\cdot\quad\cdot & OH. & \\ H & \cdot\quad\cdot\quad\cdot & OH. & \end{array} = H_2 \quad \cdot\quad\cdot\quad\cdot \quad (O_2H_2)$$

The dots stand for the little $\epsilon\delta$'s, the electrolytic systems which carry H and OH at their terminals. The perhydrone, maybe a sulphonic-perhydrol, is decomposed at the electrode face. How? Not by mere contact with the chilly metal; the process resorted to is a warmer one, I believe, involving hydroxylation of the perhydrone:—

$$HO.OH+\epsilon\delta\kappa+HO.OH=HO.O.OH.+OH_2+\epsilon\delta\kappa$$

and when the hydroxyls are crowded together, as they are at certain strengths of sulphuric acid or when currents of relatively high density are applied to the solution, probably still higher perhydrones are produced by a similar process.

Oxygen and ozone appear to be the products of the breakdown of these perhydrones.

A wicked and perverse generation, to the present day, we teach the poor student that when water is electrolysed—acid is added, to make it conducting, we say—it is resolved into hydrogen and oxygen; occasionally a reference is made to by-products, never to the probability that the oxygen is a by- or secondary product. Endless talk about hydrogen and hydroxyl ions is probably indulged in and the student carries the scars of these through life, though nothing more; fiction is always preferred to fact, in reading.

What is true of electrolysis is true of oxidation phenomena generally.* Hydrogen is first burnt to perhydrone (hydrogen peroxide); the oxygen is merely hydrogenised. In turn, the perhydrone molecule serves as the oxidant, so that the oxygen molecule is broken down in two stages; there is no reason to think of atomic oxygen as ever engaged in the operation. Were it not that the mystic word " ionised " is now grafted into our being, we should think without difficulty in terms of molecules and be rational.

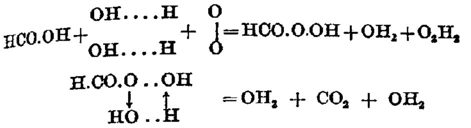
Hydrocarbons behave, in general, as hydrogen.

Carbonic oxide is peculiar in this as in most other respects. It is commonly recognised not only that this gas cannot be burnt dry but that the rate of combustion rises as the amount of hydrone in admixture with it is increased, up to a certain point; hydrone apparently plays a peculiarly active part in its combustion, primarily through incorporation into its being. In fact, it is difficult to think of hydrone as active in conjunction with carbonic oxide except by giving rise to formic acid; the two molecules cannot well grip each other at all with any other result. Carbonic oxide, under ordinary conditions, is an alert molecule which cannot easily be caught; tamed at the surface of a catalyst it is docile enough. A mixture of carbonic oxide and chlorine must be well sunburnt to induce interaction but an active charcoal will induce the immediate pairing of the gases. Faraday found that unheated clean platinum was without sensible action on a mixture of carbonic oxide with oxygen; further, that in presence of any considerable proportion of carbonic oxide, hydrogen and oxygen were indifferent to each other at the metallic surface. It is therefore to be supposed that the carbonic oxide molecules, having the greater affinity for platinum, cover up its surface against hydrogen. Faraday's observations were confirmed by Groves' later study of the gas battery. It is an unfortunate fact that carbonic oxide and oxygen cannot, as far as we know, be usefully associated in an electrolytic circuit; if the disability could be got over and economically, how golden might the future of industry be.

Given the initial production of formic acid, all else in the behaviour of carbonic oxide is clear. The oxidation of this acid presumably involves the formation in the first instance of a perhydrol (per-acid) which breaks down on hydrolysis into carbon dioxide and hydrone:—

---

* Compare my *Studies on Oxidation*, this Journal, 1913, 391.



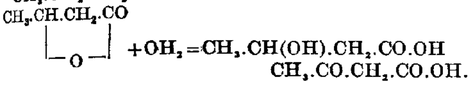
$$\mathrm{HCO.OH}+\begin{matrix}\mathrm{OH....H}\\ \mathrm{OH....H}\end{matrix}+\begin{matrix}\mathrm{O}\\ |\\ \mathrm{O}\end{matrix}=\mathrm{HCO.O.OH}+\mathrm{OH_2}+\mathrm{O_2H_2}$$

$$\begin{matrix}\mathrm{H.CO.O..OH}\\ \downarrow\quad\uparrow\\ \mathrm{HO..H}\end{matrix}=\mathrm{OH_2}+\mathrm{CO_2}+\mathrm{OH_2}$$

I call attention to these operations in order to make clear the point that the "Sweet to the Sweet" principle prevails in chemistry, as in life. Oxygen seeks oxygen but falls a prey to hydrogen by the way. Only on this assumption can we understand the manner—sometimes dubbed peculiar by the thoughtless—in which the oxidation of carbon compounds is effected. In the case of the fatty acids, the candle is mainly burnt not at both ends but at the carboxyl wick, which is necessarily attractive as an electrolytic centre. Apparently the perhydrol that is formed then proceeds to curl its hydroxylic-tail and, like the whiting, the CH_2 radicle next but one to the carboxyl group swallows the hydroxyl at its tip; then casting off hydrone, it is reduced to a weakened state, in which it soon falls a victim to further hydroxylic attack. In plain symbols—

$CH_3.CH_2.CH_2.CO.OH$

$CH_3.CH_2.CH_2.CO.O.OH$

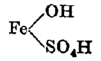


$$\begin{matrix}\mathrm{CH_3.CH.CH_2.CO}\\ \lfloor\!-\mathrm{O}-\!\rfloor\end{matrix}+\mathrm{OH_2}=\begin{array}{r}\mathrm{CH_3.CH(OH).CH_2.CO.OH}\\ \mathrm{CH_3.CO.CH_2.CO.OH.}\end{array}$$

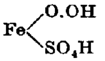
Dakin has written a special monograph on the subject—but without discussing the process: such is the advanced state of our chemistry. Ions to right of us, ions to left of us, onward we stumble: but look, let alone see, where we are going, rarely. Why the tail is swallowed at the third carbon atom history does not tell: the future historian will probably recognise that it is a consequence of a structural peculiarity innate in the carbon chain. The agent also at times is not without influence upon the result; probably it alters the length of lash of the tail.

I have yet to withdraw one reputed catalyst from your sight—the ferrous salt; to put it in its proper place, that of a mere determinant, a little εδ.

By hypothesis, perhydrone is not an oxidising agent: like water, it is not an electrolyte. When coupled with an iron salt, it becomes active, we may assume, in virtue of the formation of a perhydrol which is an electrolyte in solution:—



Ferrous sulphate.



Ferrous sulphate perhydrol.

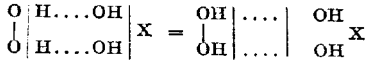
This compound may be produced, be it noted, starting with oxygen. The perhydrol, moreover, can not only serve as an "oxidase" but also as a "catalase": it can oxidise perhydrone itself and so determine the liberation of oxygen.

The idea that oxygen acts *directly* as an oxidising agent is so fixed in our minds that it is with difficulty put aside; yet it is one to be discarded.

Directed oxidation

We have also to realise that hydroxylation may take place in the absence of oxygen—under the influence of reducing agents. This process is one of special importance as playing a determining part in vital phenomena, in fermentation, for example. It is that which renders anaerobic life possible. A specially interesting case has been dealt with recently by Gowland Hopkins, Morgan and Stewart, who have studied the action of a peculiar agent in milk which induces the oxidation of both xanthin and hypoxanthin in presence of a reducible substance such as methylene-blue, for which oxygen may be substituted. The agent in question is not a mere determinant like ferrous sulphate but a catalyst, as change proceeds under its influence at linear rates. As its activity is confined to the two bases mentioned, the catalyst is to be regarded as an enzyme, the more as it is destroyed by heat.

The oxidising agent acts only indirectly as depolariser, the active hydrogenating agent in the oxidation process being the hydroxyl of hydrone liberated in an electrolytic circuit in the following manner:—

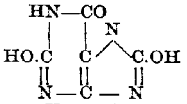


$$\begin{matrix}\mathrm{O}\\ |\\ \mathrm{O}\end{matrix}\left|\begin{matrix}\mathrm{H....OH}\\ \\ \mathrm{H....OH}\end{matrix}\right|\mathrm{X}=\begin{matrix}\mathrm{OH}\\ |\\ \mathrm{OH}\end{matrix}\left|\begin{matrix}....\\ \\ ....\end{matrix}\right|\begin{matrix}\mathrm{OH}\\ \\ \mathrm{OH}\end{matrix}\mathrm{X}$$

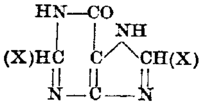
X is the oxidised material. Methylene-blue (or other reducible substance) may be set in the place of oxygen in this expression. The only distinction to be drawn between them is that oxygen has double the value of methylene blue as a reducible substance, the perhydrone produced at first being itself reducible to hydrone.

The remarkable fact has been established, by Hopkins and his fellow workers, that with the aid of methylene-blue the two bases are oxidised (to uric acid) at molecularly equal rates, twice the amount of work being done upon the one as upon the other: it is therefore necessary to conclude that the two oxidisable centres in hypoxanthin are in a single circuit.

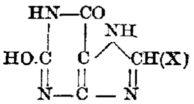
The striking similarity in the two bases and uric acid is brought out clearly when their formulæ are written in the following way, X being the centre at which hydroxylation takes place:—



Uric acid.



Hypoxanthin.



Xanthin.

As the oxidase can influence or direct attack at two centres simultaneously in hypoxanthin, it is probable that the enzyme fits upon a large section if not the whole of the molecule.

An enzyme which could thus act may be imagined, containing as active component uric acid itself; this might be compatible with both molecules, as the CH group to be oxidised would probably be no obstacle to its fit, whilst the presence of NH in place of O in adenine and guanine would certainly be an interference. It is possible to think of such an enzyme becoming perhydroxylised under the influence of the hydrogen acceptor and the product as inducing in turn the hydroxylation of one or both sensitive centres in the two bases. The effect on hypoxanthin would be like that of using two voltaic cells in series instead of a single cell of about half their joint electro-motive force.

In ordinary alcoholic fermentation, assuming that the glucose molecule be primarily resolved into two molecules of glyceraldehydrol,

$$CH_2(OH).CH(OH).CH(OH)_2$$

both a highly reducible and a highly oxidisable substance, the reduction of the one molecule may be supposed to take place, directly or indirectly, in virtue of the hydroxylation of the other.

The results obtained by Hopkins, Morgan and Stewart are also of special interest in connexion with the oxidases so frequently met with in plant and animal fluids; the evidence that these are enzymes has hitherto been inconclusive, though from their specific behaviour it appeared probable that at least most of them were.

Such enzymes should be distinguished from those which simply induce hydrolysis of a single molecule. These latter may be termed *homolytic*, whilst those which promote hydroxylation by the co-operative action of two distinct molecules, the one reducible and the other oxidisable, may well be termed *heterolytic*.

I thus end my discussion of chemical change upon a natural note and pass to

Sulphuric acid

yet only again to voice a conplaint of inattention, if not of ignorance. Over fifty years ago, when fellow students, Horace Brown and I were Frankland's "Versuchsthieren," used in imagining graphic formulæ, to test the application of the then new practice of such exercise; we played the game much as that of noughts and crosses is by children, in accordance with certain very elementary rules. To-day we cannot express the structure of sulphuric acid with any less uncertainty than Horace Brown and I did in those distant days of our early innocence.

What *is* the structure of sulphuric acid? We simply do not know. What indeed do we mean by sulphuric acid? It is premature to ask the question until we agree in our definition of an acid. To get this fat out of the fire will be no easy matter.

I ask you to face the facts. It matters little how much knowledge we have; it can avail us little if we are not alive to our ignorance of things fundamental.

The Acid Function

I have been much struck of late by the frequency with which in examination papers of schoolboys *oxygen* is referred to as a misnomer. In a French scheme for the reform of the nomenclature of inorganic compounds, brought forward at the Lyons Conference a few days ago, the compound formulated HCl is referred to as a hydracid and given the name "acide chlor-hydrique"; we often go one worse, calling it hydrochloric acid, seeing that there is no "chloric" about it. Such base use make we of our perversity.

Sacré nom de Lavoisier! Oxygen a misnomer! Hydrogen chloride an acid! Asticot would say: *C'est abracadabrant!* Are we not told that when the *Quartier Latin* so calls a thing, there is no more to say? Is it not truly written and for evermore: "La Chimie est une Science Française, *Elle fut constituée par Lavoisier*," etc.? In designing the word Oxygen, Lavoisier rose to the greatest height of his unparalleled genius. Not only is the word a monument to his astounding insight into chemical phenomena, to his philosophic power; it is also proof of deep philological feeling and acumen, as well as of his sense of the beauty of words. Think of the astounding step he took, after his instant appreciation of Priestley's discovery, in translating the old nonconformist's ponderous reminder of the doubtful past of our science conveyed in the name *Dephlogisticated Air* into an all significant word of the aural and lingual perfection of *Oxygen*, paralleled only, to those who have an ear for nordic harmony, by *Sauerstoff*, which unfortunately we cannot translate into English, though *Sauerkraut* sounds just as well in our tongue as in German: stuff unfortunately has gone out of fashion in our language; at best we associate it with either nonsense or dreams.

Lavoisier did more—he atticised our Science for all time; and the scribes and literary Goths, uncultured in all but their own works, scoff at us as Greekless! The while they are unable to interpret a word so all-meaning as Oxygen or construe a single passage in our writings. Don't let us think of Lavoisier merely as a man who heated mercury in air and lost his head; think of him as the pioneer who not only sought to put system into the souls of chemists but also tipped their tongues with harmony.*

In my early days, the Berzelian sun was not yet set. Oxides were of two classes, acidic and basic; and these combined to form a third, the salts. Debus and Williamson spoke of the *oxide* formulated SO_3 as sulphuric *acid*; the compound formulated H_2SO_4 was hydric sulphate. Messel always spoke of this latter as *monohydrate*—a survival of the significant Berzelian nomenclature.

Some disturber of the peace then came along and gave unnecessary prominence to the least of atoms, Hydrogen. A fashion arose of teaching chemistry, instead of allowing students to learn it; so it was necessary to furnish with definitions the poor mummers who taught. For text-book purposes, an acid was defined as a compound containing hydrogen displacable by metal through the action, if not of the metal itself, of a base, a miserably thin description subject to many more exceptions than the oxygen rule of Lavoisier, if indeed there be any to this latter. There is none, if the acid formed in water by the addition of hydrogen chloride be in truth chlorhydric acid, $HCl.OH_2$, as I contended so far back as 1885.

When hydrogen is turned out from an acid, it is in no direct, open and honest way; the more stal-

---

*This is equally true of the name Lavoisier gave to the companion of oxygen in air. The passage in which he states his reasons for terming this *Azote* is of extraordinary interest.

> "Les propriétés chimiques de la partie non respirable de l'air de l'atmosphère n'étant pas encore très-bien connues, nous nous somme contentés de déduire le nom *de sa base* de la propriété qu'a ce gaz de priver de la vie les animaux qui le respirent, nous l'avons donc nommé *Azote*, de l'*a* privatif des Grecs et de ζωή, vie; ainsi la partie non respirable de l'air sera le gaz azotique.
>
> Nous ne nous sommes pas dissimulé que ce nom présentait quelque chose d'extraordinaire; mais c'est le sort de tous les noms nouveaux; ce n'est que par l'usage qu'on se familiarise avec eux. Nous en avons d'ailleurs cherché longtemps un meilleur, sans qu'il nous ait été possible de le rencontrer; nous avions été tentés d'abord de le nommer gaz alcaligène, parce qu'il est prouvé, par les expériences de M. Berthollet, que ce gaz entre dans le composition de l'alcali volatil ou ammoniaque; mais, d'un autre côté, nous n'avions pas encore la preuve qu'il soit un des principes constitutifs des autres alcalis; il est d'ailleurs prouvé qu'il entre également dans la combinaison de l'acide nitrique; on aurait donc été tout aussi fondé à le nommer principe nitrigène. Enfin, nous avons dû rejeter un nom qui comportait une idée systématique."

It is unfortunate that we did not follow the French in preferring *Azote* to nitrogen—the name is so perfect and significant—as applied to the inert gas in air: the contrast would have been complete had the active constituent been termed *Zote*. In some way this latter word seems to lack force without the privative *a*. Still, it would not be difficult to accustom our ears to Zote and Azote; we should then be able to draw the distinction that is so desirable between the two chief materials of air and their constituent stuffs symbolised by O and N, which represent ideals: Lavoisier clearly intended the names Oxygen and Nitrogen to apply to these ideals; he as definitely draws a distinction between azotic gas and azote, in the above passage, as he does between oxygen gas and oxygen in giving his reason for the adoption of this name.

> "Nous avons donné à la base de la portion respirable de l'air le nom d'oxygéne, en le dérivant de deux mots Grecs, ὀξὺς acide, γείνομαι j'engendre, parce, qu'en effet une des propriétés les plus générales de cette base est de former des acides en se combinant avec la plupart des substances."

The distinction is again made clear in the following passage:—

> "De la Décomposition du Gas Oxygène par les Métaux." Lorsque les substances métalliques sont échauffées à un certain degré de température, l'oxygène a plus d'affinité avec elles, qu'avec le calorique: en conséquence toutes les substances métalliques, si l'on en excepte l'or, l'argent et le platine, ont la propriété de décomposer le gas oxygéne, *de s'emparer de sa base* et d'en dégager le calorique."

Lavoisier's clearness of vision in seeking for a name other than azote, significant of the chemical character of the element, is very remarkable. Had he known of the amines, he would surely have proposed *Aminogen* and we should then have been in possession of two of the most perfect names possible.

The quickness of the Darwinian uptake of ideas is well shown by Erasmus Darwin's early use of Lavoisier's term in Canto IV of his poem "Economy of Vegetation."

Sylphs! from each sun-bright leaf, that twinkling shakes
O'er Earth's green lap or shoots amid her lakes,
Your playful bands with simpering lips invite
And wed the enamour'd Oxygene to Light.

wart metal is brought in *sub rosa* at the stage door and is effective owing to the superior attraction it offers to the *oxygenated* radicle of the acid: in symbols—

$$\text{Neg.}\left|\begin{array}{l}\text{H}\ldots\text{HSO}_4\\ \text{H}\ldots\text{HSO}_4\end{array}\right|\ \text{Zn}=\text{Neg.}\ \left|\ \text{H}_2\ \right|\ \begin{array}{l|l}\ldots & \text{HSO}_4\\ \ldots & \text{HSO}_4\end{array}\!\!>\text{Zn}$$

We are agreed that in chemistry we must rely upon formal definitions: no single definition based upon behaviour is of universal application. No acid so-called functions as an acid *per se*. The compounds *named* acids are all inert—for the simple reason that they cannot conduct electricity, all chemical change being electrolytic in character. This could be asserted fearlessly in Faraday's time; how much more then to-day, now that we worship the electron and regard it as concerned in and guilty of every chemical crime.

The acid takes form only when water is brought to the rescue of the dielectric: as we know, when a man's married, then trouble begins; what happens when a dielectric marries water has long been a subject of debate. Perhaps debate is a wrong term to use. Religions are not established upon a basis of debate: they are accepted as faiths by adoring, unreasoning, credulous believers, in response to dogmatic assertions. In the early eighties, a young prophet arose who appears to have had some training in mathematics and physics but to have aquired no feeling for chemistry; he preached a gospel in which the acids were described as degenerating into the most abandoned of libertines, as becoming drunk with freedom, when cast into solution.

From this time on, the wandering hydrogen atom became in itself the personification of acidity—it s true it was featured as in the leading strings of an adoring opposite positive charge but the bond was admittedly of the weakest and the loose partnership was subject to constant change. The youthful propagandist was properly told by his master that he did not know enough to deal with so serious a subject and that he deserved to be smacked and put back into the nursery; had he been put into a *camisole de force* the world would have been saved much pother and many printers' bills. Unfortunately, as prophets too often are, he was taken at his own valuation and seriously; it was not his ault but a consequence of our lack of logic, of the urvival of our primitive habit of yielding obedience o priests and sorcerers.

As Mr. Arnold Bennett somewhere says, we need o have "an ironic realisation of the humanity of human nature." Science is a new habit which does not fit our human constitution; our mental machinery is a congeries of mechanisms which are only imperfectly correlated; heredity makes us dogmatists and prime worshippers of the Idols of he Theatre. My objection has always been not to he speculation itself but to the maladroit zeal with which it was spread, the unscientific way in which t was rammed down our throats and all discussion burked by people like Ostwald, who obviously did not know what they were talking about and disregarded the findings of chemists in general. Many of the contentions were not only irrational but the ignorance displayed—particularly in the discussion on indicators—has often been astounding; the work put forward was biassed and superficial. Unfortunately, the physicists have not helped us; they have often smiled at our ionic rhapsodies but I have seen no evidence that they have regarded them seriously.

The great chemical blunder made by Arrhenius and his worshippers was in regarding water as hydrone and in representing hydrone as behaving altogether differently from the allied hydride, hydrogen chloride—by their assertion that when the two compounds were mixed, whilst the molecules of the one underwent practically no change, those of the other fell almost entirely to pieces. No reasonable explanation of the suicide was ever offered. Even that great genius van't Hoff, a giant among the pigmies, was carried away by the seeming agreement of fiction with fact. Evil communications corrupt good manners; had he kept other and higher company he would not so easily have been led astray but his vanity was tickled by the way in which his osmotic dreams were apparently made true by "ionic" coincidences. Had he but witnessed a scrum on a football field and considered its applications in chemistry his vision would have been clearer. Unfortunately, he paid no attention to water and yet he loved beer. The Arch-Ionian prophet, perforce of his Scandinavian heredity, was necessarily a Hydrophobe and put no measure of aqueous humour into his Koran. Never yet has justice been done to water, least of all in the U.S.A. Mathematician and physicist, rather than chemist, van't Hoff lacked just that element of feeling, the artist's practical sympathy with his subject and devotion to his studio; we must never forget that the laboratory worker is an artist and that, as a rule, practice comes first; so-called theory is usually but brought to the aid of practice in justification of its acts. This is true of agriculture throughout time and of industry to-day. The fancied explanations that have been given need not be taken too seriously; tentative and provisional for the most part, they but help us on our way and we must often be content to retrace our steps, recognising that the alley up which we are led is a blind one; the exercise, however, serves to keep us fit and is a preparation for the next excursion. Everest is not climbed in a year; many avalanches may wreck us, and

> 'Tis not antiquity nor author
> That makes Truth truth, altho' Time's daughter.

One real service the ionic school has rendered in systematising the application of Faraday's beautiful word *ion* to radicles which do not stand upon the order of their going but go once the chance be given. We now speak of salts generally as composed of positive and negative *ions* and the definition is full of meaning. By implication, it conveys the information that the compound consists of easily mobile radicles. On the other hand, compounds such as chlorethane and chlorobenzene, which do not behave as salts, are sufficiently described as composed of positive and negative *radicles*—the term radicle having a wider but less definite meaning. The distinction is not absolute but sufficient to justify a line being drawn. Why the positive hydrocarbon radicle should exercise so superior an attraction and keep the negative radicle at home and in order we cannot say. The electron worship of the day is too static and simple a faith to satisfy our longing to explain such a mystery.

The second service of the Arrhenists has been in emphasising the difference in the strength of acids and bases, always well recognised but not numerically expressed prior to the advent of the ionic speculation. Unfortunately the service is marred by the way in which the conception has been wrapped up in the term *hydrogen-ion-concentration*, a stilted phrase which is not only caviare to the general public but most misleading. Nothing more was necessary than to distinguish between *acidity* or if you will *apparent acidity*, as meaning quantity of acid; and *effective acidity*, as meaning the proportion of the acid present in the immediately active state. A layman can read such terms, even put some meaning into them and without his ear being offended; hydrogen-ion-concentration is pure gibberish, a chord that cannot be struck upon "the lyre of language clear." It is just a shibboleth which too often covers a pretence of learning; unfortunately, its forbidding presence is to be met with everywhere and it is being shouted loudly in the galleries of the new Babel which more than threatens to overwhelm science and deprive it of all public support. Even the brewing world only recently was entertained with talk on *Hydrogen Ions in Beer*. Fancy Brother Bung's joy at such a topic being under discussion—the query of the Bar Parlour: "What new poison are they putting into our swipes? Is this why beer is now such poor stuff? [*] Hang hydrogen ions, give us a little more body and spirit in our drink." It would comfort them to know that there are no hydrogen ions in alcohol: it occurs to me to ask—Is that perhaps the reason why Glasgow is so fond of petrolised water?

Necessarily I am reminded here of Samuel Butler's story of the conversation he overheard in an inn, summed up in the remark of the speaker to the barman—"Imagination will do any bloody thing almost." Yes, unfortunately, it will, even in the ranks of science—except make us wise.

One unforgivable result of enforcing the doctrine is, that acidity is regarded not as the function of an acid but of just one little bit of the molecule and that split off and away from it! I have sufficient belief in sulphuric acid to feel satisfied that it has a real sense of its own importance and that it acts accordingly—that its positive and negative radicles are equally concerned, directly or indirectly, in all its actions—always bearing in mind that all chemical interactions are electrolytic manifestations and polar phenomena, never unilateral.

Electrolytic conductivity

The position to-day is but little, if in any way, different from that of 1851, when Williamson's most remarkable communication *On Etherification* was made to the Chemical Society—remarkable because of the far-reaching character of his inferences and because of his youth and inexperience. By a stroke of genius he laid bare, probably for all time, the conditions in a solution—by drawing attention to the constant interchange of radicles which it was to be supposed must always be going on, to account for the state of equilibrium at once established whenever two or more salts are brought together. Williamson appears to have contemplated only an interchange of the radicles, never their free existence in solution. Kekulé afterwards suggested that the interchange was preceded by the association of the interacting molecules, a view I advocated in later years when interpreting the formation of substitution derivatives of benzene.

Clausius, in 1857, to explain the behaviour of electrolytes, first suggested that occasional violent molecular encounters in a solution now and then led to the disruption of the molecules. Arrhenius extended the speculation, by assuming that chemical activity was proportional to the degree of disruption and that specially active solutes, such as the strong acids, were all but entirely dissociated. He thus opened up a path for the mathematical treatment of the subject—by directly connecting chemical activity with electrical conductivity in a more definite way than had Clausius, who was merely concerned with electrical behaviour. He thereby did considerable service; but he and his literary body-slave, Ostwald, followed Clausius in regarding the action of the solvent as merely that of a screen; only later did they hedge in face of our protests. By attributing the "dissociation" to the high specific inductive capacity of the solvent they were but paraphrasing our contention that the change was due to an interaction of solvent and solute, brought about by the residual affinities of the associated molecules; but at all times it was useless to argue the point with them on chemical grounds: they would not understand us: a banner with a new device had been found and its possessors hurried on to plant it everywhere—as revolutionaries mostly do, without counting the cost of the doctrine they profess. The one point I am anxious to make is, that whilst we must have imagination, progress being dependent upon its exercise, we must give it always the controlled and guarded use implied in Tyndall's well-known and immortal phrase. An unscientific use may give us music, indeed genius must often operate in disregard to the rules of science; but science is founded upon imagination controlled and tried.

Probably we can assert as indisputable and all will agree, that in aqueous solutions the ions H and OH are ever on guard at the gates of entry and exit, armed and ready for immediate action on receipt of an electric call. The analogy of a corporal's guard is by no means one that is far fetched; in this the units are connected by the invisible link of discipline and are the counterpart of an electrolytic system. An interchange of sentries is not effected at random but by a regulated polar process. This, at present, is perhaps as far as we either can or may see. The whole subject is in need of further experimental study from an H. B. Baker point of view. We have not only to learn to use clear and just language but to labour to be clean. In the light of Baker's recent results, I am now inclined to take up a position more absolute than that I adopted 36 years ago, in March, 1886; to doubt if there be such a thing as a simple electrolyte—a substance which is an electrolyte *per se* in the pure state. Maybe some day a Baker will show that metallic halides—silver chloride, sodium chloride—are not electrolytic conductors and that metals are the only primary conductors of electricity; we have yet to learn where entire prohibition of impurity will carry us. I foresee a physics very different from the present—no longer a physics of freedom but one of slavery to unrestrained residual affinity.

We need to study afresh the passage of matter through its several states. It is already recognised, on the basis of Aitken's observations, that the condensation of hydrone to water involves the presence of "nuclei": the nucleus may act as a catalyst but what of the determinant—is one required? What would be the behaviour of exceptionally purified gases generally in exceptionally cleansed vessels? Might not the Andrew's "critical temperature" be greatly modified? Monatomic molecules of materials such as hydrogen, oxygen, nitrogen, may well persist under "clean" conditions. Rayleigh's observations on nitrogen and R. W. Wood's more recent studies of hydrogen already lend support to the view.

Thus far my dream—I trust I have made clear my vision of the process of change.

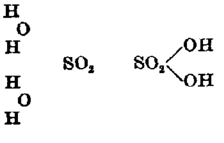
Structure and Basicity of Sulphuric Acid

In my days of early innocence, in 1871, I wrote—"Occupied with an investigation into the constitution of sulphuric acid"—as the opening sentence of the first of my Studies on Sulphonation. The subject still occupies a cell in my mind. It is strange that, excepting perhaps soda and not even that before the advent of the Solvay-Mond process, the compound manufactured on a more colossal scale than any other should to-day be a sealed book to us: it contains but seven atoms, which cannot well be otherwise than simply arranged. Perhaps X-rays will soon melt the seal which chemists have so long left intact. It is the old story—familiarity breeds contempt; and simplicity is the most diffi cult of attributes to interpret. The major riddles of chemistry are carbonic and nitric oxides, CO and NO; *and* sulphuric acid.

---

[*] Beer, too, would seem to be a terribly toxic substance from the point of view of "Colloid Chemistry," to judge from a recent essay presented to brewers on the influence of the "dispersity" of the colloid on flavour. We must abolish such moonshine and speak English.

It is commonly ranked as a *bibasic acid*—what precisely does this mean? What valid evidence have we of its structure? Practically nothing of consequence. Graphic formulæ such as Horace Brown and I constructed on paper, out of our heads, 55 years ago, still prevail over fact. Williamson and Odling, having their minds filled with types, derived the acid symmetrically from the double molecule of hydrone,



$$\begin{matrix} H \\ O \\ H \\ \\ H \\ O \\ H \end{matrix} \quad SO_2 \quad SO_2\begin{matrix} \diagup OH \\ \diagdown OH \end{matrix}$$

Their souls were satisfied, because the acid could be produced from sulphuryl chloride, SO_2Cl_2, and water: this proves nothing more than that it can be so made. Sulphuryl chloride often acts as a mere chlorinating agent; years ago I argued that it was conceivable that in contact with water it gave up ilorine and that this acted as oxidising agent pon its co-partner sulphurous oxide. Sulphuric id or rather the chlorhydrol, SO_2ClH, gives not ilphuryl chloride but pyrosulphuryl chloride, $_2O_2Cl_5$, when subjected to the action of phosphorus entachloride. The behaviour of the supposed cond hydroxyl is peculiar: in fact, there is no roof that sulphuric acid has the symmetric strucire depicted in the formula

$$HO.SO_2.OH$$

n its behaviour, too, the acid is not properly aindful, that this is the reputation to which it has live up: the Batesonians would term it a faculative monogamete; the sulphates of the magnesian eries apparently are all hemi-sulphates of the type

$$HO.X.SO_4H$$

nly the dry elements, such as silver and the lkali metals, insist on keeping undisturbed comany with the acid radicle. Most significant of all, s Worley and I have contended and shown, the ulphonic acids generally have 90% of the hydrortic power of sulphuric acid—and they are formed, is supposed, by the mere displacement of one ydroxyl in sulphuric acid by a hydrocarbon radicle

$$HO.SO_2.OH \qquad R.SO_2.OH$$

n my early days, Kolbe and Würtz quarrelled over ictic acid—"The Mountain called the Squirrel ttle Prig." Kolbe said the acid was uniasic though dihydric; Würtz said it was biasic. Kolbe won the victory and it was settled or all time that the basicity of an organic acid roper is determined by the number of carboxyl roups it contains. I have thrown down my gage, n like manner, in defiance of all comers who seek o rate sulphuric acid as bibasic and I challenge a efinition of basicity. Inorganic chemists to-day re but fainéant fighters: policeman Arrhenius eeps them in order still. Surely someone will adenture his skill against my light weight: if not oon, I shall claim the stakes and insist that basicity s to be defined as the number of times the characeristic acid radicle is repeated in the molecule nd that sulphuric acid is but a mineralised lactic cid. The argument is equally applicable to other nineral acids (including the organic acid, carbonic cid) rated as polybasic.

It is in no wise certain even that sulphuric acid s a hydroxylic derivative: I believe it to be more probable that the original Berzelian conception, embodied in the formula

$$SO_3.OH_2$$

may come to be regarded as the more suitable expression of its structure and behaviour. Perhaps only carboxylic and sulphonic acids are properly represented as hydroxylic derivatives. We must always remember that our structural formulæ are mainly used as shorthand expressions of actual behaviour in terms of a conventional symbolism.

Very remarkable too is the electrolytic behaviour of sulphuric solutions—in no way in accord with the tenets of the ionic school. The stable term is pyrosulphuric acid; this is almost a non-conductor. In the passage from $H_2S_2O_7$ to H_2SO_4, conductivity increases to a maximum, then falls to a minimum which is not so low as the first; it then rises to a high maximum approximately at $H_2SO_4.4OH_2$, after which it gradually drops to zero when water is reached. No other compound is more subversive in its behaviour of the simple ionic faith; but its vicious example has been quietly kept in the background. Altogether the acid is one of the most wonderful of compounds.

My theme is in no wise exhausted; I have but touched the fringes of thionism. Not a little should be said of the manufacture of sulphuric acid, of the part played by the catalyst in the anhydride process and by the determinant in the chamber process. Particularly I should like to consider, using Erasmus Darwin's melodious words—

How nitrous gas from iron ingots driven
Drinks with red lips the purest breath of heaven

and acts as go-between to raise sluggish sulphurous acid to corrosive rank. The neglect of nitrous chemistry by the text books is phenomenal. Something also should be said of the peculiarities of thionic activity in general and of θειον itself but here to-day my drama must end, although the tale of heroes to be borne by the Valkyrie across the bridge into the thionic Valhalla is complete. I have but given you leit-motiven, the undercurrent of melody, perhaps I should say of discord, for which the complete score has yet to be written. The support to my arguments must be given, if not in an appendix, in footnotes, a course for which I have the precedent set by the master mind of inorganic chemistry, Mendeléeff, whose fruitful service to our science we can venerate more than ever now that our countryman Moseley has placed his great imaginative work upon a solid spectral foundation and the elements are taking shape as structural units. We have reason to hold the M's in fond memory in chemistry and a special corner in Heaven or Hades might well be railed off for them — Mendeléeff, Moseley, Mond, Müller, Meldola. To-day we add Messel to their number, as the most skilful user, in our time, of an element which shares its name with the Divinity—probably the element which first attracted the real attention of man, if not the foundation stone of chemical science.

During over fifty years past, as I have watched the progress of chemistry, the advance of the organic workers has been steady and a monumental industry has grown out of their labours: the building is there upon impregnable foundations, only a few towers and turrets and features of ornament remain to be added. The foundations are of surprising simplicity—those laid by Frankland and Kekulé, not forgetting Pasteur—but they were well and truly laid and have been duly and honestly built upon.

In other branches of chemistry, however great the cackle and whatever fuss may have been made, no corresponding progress can be recorded; the progress has been chiefly on the practical side. There has been little conscious, systematic effort tr develop a theory of chemical change; the unassailable foundation laid by Faraday has in no way been properly extended. The careless methods of Society have been made the methods of a pretentious science. The growth of fact has made us mere worshippers of facts—and, as I have already said, the teacher has taken the place of the learner and the teacher can but follow fashion. Whilst claiming to be members of a scientific fraternity, we are not sufficiently developing and using scientific method.

It is only necessary to glance at books like Mellor's comprehensive Treatise or Bayliss's great work on General Physiology to realise the bemuddled condition of our subject. Fortunately there is evidence of a return to an eclectic philosophy, to what Jacques Loeb naïvely calls "the classical chemistry as contrasted with Colloid Chemistry," exemplified by Loeb's own praiseworthy efforts to raise the character of the proteins from mere indeterminate lumps of jelly to a status of definite materials behaving in a simple and definite, orderly manner, if only put under comparable conditions: then all the rhodomontade of the glue-stuff school can be put aside and translated into a few common-sense, simple propositions.

Let us recognise that Chemistry is Chemistry, one and indivisible; let us put all pretence aside and abolish sects and sectarianism.

Il faut cultiver notre jardin

If I quote from *Candide*, following the example of that most delightful of Bohemians, whose name alone should recommend him to Catalysts, Berzélius Nibbidard Paragot, it is with emphasis upon our need *to cultivate*—first the Cabbage Patch, the vegetable section, which will give us all necessary advitants. If we be good gardeners the flowers will follow naturally and will be well placed; but let us always give care to the garden as a whole, that all be well ordered in it, planted in due season; never over-fertilised and so made to yield overgrown fruit of poor flavour and substance, as is too much of our modern produce; constantly tilled and weeded most carefully, this last especially: then will it yield crops in full measure and of good quality.

> "By our proficiency we know that we are in the way to heaven, as we know a tree is alive by its daily growth."

Prof. G. G. HENDERSON, in proposing a hearty vote of thanks to Professor Armstrong for his lecture, said that the meeting would be memorable for at least two things. One was that for the first time in the history of the Society a Canadian chemist occupied the presidential chair. Another was that they had witnessed a brilliant inauguration of the series of Messel Memorial Lectures. The Society had been indeed fortunate in its lecturer. The brilliant, exhilarating, and characteristic address to which they had just listened had set a standard for future Memorial Lectures which would ensure that they were worthy of the man whose memory they recalled. They owed Professor Armstrong a very great debt of gratitude, not merely for his lecture but also for the fact that he had provided the Society with a new President in the shape of his own son. More than this, he would like to associate himself with every word that Sir William Pope had said and to add what could not be denied, that not only every chemist in this country but every chemist in the civilised world, had profited largely by his work and example. He, therefore, asked them to accord Professor Armstrong the vote of thanks with acclamation.

The vote of thanks was accorded enthusiastically.

Professor ARMSTRONG briefly expressed his thanks.

Canadian Sections.

Meeting held at Ottawa on May 16, 1922.

MR. F. J. HAMBLY IN THE CHAIR.

ANALYTICAL PROBLEMS IN THE METALLURGY OF NICKEL.

BY FRANK E. LATHE.

The main object of this paper is to show how the requirements of both speed and accuracy have been fulfilled in the selection and development of the principal methods used in the laboratories of the nickel plants. Where several methods have been available reasons will be stated for the choice of a particular one. Details will be given only of those procedures which may not be generally known or widely applied.

At the outset I wish to disclaim any considerable share in the development of the methods now in use. To each of the many chemists who have worked in the laboratories of the nickel companies belongs some of the credit for such efficiency as has been attained.

Decomposition for the determination of copper and nickel.

The ore of the Sudbury district consists of pyrrhotite, chalcopyrite, pentlandite, and other sulphides in a gangue of norite and greenstone which is very resistant to the action of acids. Its decomposition for the determination of copper and nickel is usually effected by a short fusion with sodium or potassium bisulphate. Nitric and sulphuric acids may also be used satisfactorily, and if a naked flame be employed to expel the nitric acid this method is probably the more rapid of the two, but when used for air-cooled slags and roasted products a little hydrofluoric acid should be added to insure complete solution of the two metals.

Copper.

The commoner methods in use at copper plants are the electrolytic, iodide, cyanide, colorimetric, and permanganate methods. Of these the cyanide and colorimetric processes are excluded because the presence of nickel interferes. The permanganate method would not give a solution suitable for the determination of nickel, which is almost invariably required. The result is that only the electrolytic and iodide methods are used for copper in the nickel district, the separation of copper in the former being made by electrolysis in acid solution and in the latter by precipitation with hydrogen sulphide gas. Both methods, in the hands of experienced men, are quick and accurate. Each has its advocates. In general, it may be said that the electrolytic method is to be preferred for accurate results on high-grade samples. For those of low and medium grade it probably requires more time (unless gauze electrodes and rotating anodes are used) but less manipulation.

In the electrolytic method, on account of the amount of iron present in Sudbury ores and furnace products, it will usually be found best in accurate work to deposit in sulphuric acid solution, then dissolve and re-deposit in nitric acid. The metal first deposited can often be rapidly and completely dissolved by simply reversing the current in the nitric acid solution.

In the iodide method the precipitated copper sulphide is dissolved in bromine water and nitric acid, the solution evaporated almost to dryness to coagulate the sulphur and expel the bromine, then mixed with water and finished as usual. The greatest danger of loss is by spattering when the evaporation is nearly finished.

Nickel.

The best methods available are (1) electrolysis, (2) titration with cyanide, and (3) precipitation with dimethylglyoxime.

The electrolytic method is used principally on high-grade samples, such as refined nickel and converter matte. For low-grade samples it is not more accurate than precipitation by dimethylglyoxime, and it takes much longer. For electro-deposition the nickel should be present in sulphate solution, strongly ammoniacal, and containing little or no chloride or nitrate. Iron causes some trouble by adsorption of nickel when precipitated with ammonia. If filtered off the precipitate will always retain some nickel, so the best method is to precipitate in such a way as to reduce adsorption of nickel to a minimum, and then to leave the ferric hydroxide in the solution during electrolysis. The following procedure, worked out at Deloro, Ont., is satisfactory: Sufficient ammonia is added to produce a slight precipitate, and this is dissolved with a few drops of dilute sulphuric acid. After cooling, 25—50 c.c. of ammonia is added, and the solution stirred. When these precautions are observed accurate results may be obtained even in the presence of a considerable amount of iron.

In accurately determining the nickel content of high-grate material which is fairly uniform it is customary to take a sample of 1·0—2·0 g. and electrolyse. If the sample be "spotty," however, a larger portion must be used. The usual method is to dissolve 100 g., dilute to one litre, and measure out 10—25 c.c. of the solution with a pipette standardised against the flask used. This method is accurate only if the greatest precautions are taken, and the average chemist will secure far better results by modifying it as follows: The sample is dissolved in a flask of which the dry weight, with stopper, is known to the nearest 50 mg. The rate of solution should be regulated by the gradual addition of acid so that spattering may be avoided, and a small funnel should for the same reason be kept in the mouth of the flask. When solution is complete, it is cooled somewhat, diluted to about one litre, and mixed well in the stoppered flask. The outside of the flask is dried and it is then weighed to the nearest 50 mg. Into each of three previously weighed weighing-bottles about 25 c.c. of the solution is poured, the bottles are at once stoppered, and weighed accurately. The contents are transferred to beakers, evaporated with sulphuric acid to remove the nitric acid, and finished as usual. By thus weighing the solutions no close attention need be paid to measurements or temperatures, which introduce the more serious errors into the usual method. The only special requirement is a balance, sensitive to 50 mg., which will weigh a litre flask. The results are excellent.

Nickel deposited by electrolysis always contains the cobalt as well, and if the percentage of nickel alone is required the cobalt must be determined, as below, and deducted. It is customary to make only occasional determinations of cobalt, and as a rule to report the total of the two as nickel, because only a small percentage of cobalt is found in the Sudbury ore.

The standard rapid method for nickel is by titration with cyanide in alkaline solution, using a little silver iodide as internal indicator. Results are accurate in the hands of a careful and experienced operator. As text-books do not make sufficiently clear all the points to be observed, this method will be given in detail.

The following solutions are required:—Sodium citrate, about 140 g. per litre. Silver nitrate, 1·0 g. per litre. Potassium iodide, about 40 g. per litre. Potassium cyanide, 23 g. per litre for samples containing 0·1 g. of nickel or more, and 11·5 g. per litre for lower-grade samples, the latter reading directly in percentage on 0·5 g. To standardise the potassium cyanide it is usual to employ 0·5 g. of converter matte in which nickel has been determined by electrolysis. It is much quicker, however, and at least equally accurate, to use a nickel salt, such as the carbonate, free from copper and of known nickel content. The treatment of the standard should be the same as that followed in the determination—after separation of the copper—but excess of cyanide should be avoided, for, owing to the absence of iron, there is great danger of over-titration.

The solution to be used for the determination is either the electrolyte from plating of the copper or the filtrate from the copper sulphide. The latter will have been freed from hydrogen sulphide by boiling. In either case the solution will contain, besides nickel, whatever cobalt, iron, and aluminium passed into solution in the decomposition. The presence of any of the ordinary acids is permissible, and if the solution contains no sulphates or free sulphuric acid, a few c.c. of the latter should be added, as it greatly aids the subsequent titration. The iron must first be oxidised, and this is usually done by the addition of a few crystals of potassium chlorate, with subsequent boiling. Many chemists prefer to separate the iron and nickel if there be over 0·3 or 0·4 g. of the former in solution, on account of the greater ease of titration, though it is neither necessary nor more accurate. If desired a good separation may be effected by Rothe's ether method, as follows:—Iron and aluminium are precipitated with ammonia, filtered off, and washed once or twice. The filtrate is retained. The hydroxides are dissolved in a little hydrochloric acid, and the solution evaporated to a few c.c., cooled and washed, by means of dilute hydrochloric acid (sp. gr. 1·13) in a wash-bottle, into a small separating funnel. A volume of ether equal to that of the solution is added and the mixture shaken thoroughly while cooling under the tap, and then allowed to settle for a few minutes. The lower solution containing the nickel and cobalt is drawn off, a few c.c. of the dilute hydrochloric acid is added to the ether in the funnel, the mixture again shaken, cooled, allowed to settle, and the lower layer separated and combined with the other acid solution. The ether is expelled by warming and finally boiling the liquid, which is then combined with the ammoniacal filtrate for determination of the nickel.

Whether or not the ether separation has been made, the nickel solution requires the addition of sodium citrate or similar reagent to prevent the precipitation of iron and aluminium on the subsequent addition of ammonia, and to make the solution clear enough for titration. A minimum of 5 c.c. is recommended, and as much more than this as will make 1 c.c. for every 10 mg. of iron in solution. Thus 2 g. of slag with 40% of iron will require 80 c.c. if the ether separation has not been made. After the addition of a sufficient volume of sodium citrate solution, the liquid is made just alkaline with ammonia, and about 1 or 2 c.c. added in excess. If as much as 5 c.c. in excess be added the end-point will be indistinct and the result slightly low on account of the solvent action of ammonia on silver iodide. After cooling thoroughly, preferably below 10° C., 5 c.c. of the silver nitrate solution is added from a burette or pipette. If a precipitate of silver chloride be produced enough ammonia is added to dissolve it, then 5 c.c. of the potassium iodide solution, when silver iodide will be precipitated at once. This amount of potassium iodide is much more than the theoretical quantity necessary to combine with the silver nitrate, but is essential to a satisfactory titration. Many chemists add the potassium iodide before the silver nitrate, but if that procedure be followed an insufficiency of ammonia may be overlooked and the true end-point will occasionally be passed. The solution is now ready for titration, and if several determinations are to be done at once it is best to have a separate burette for each, to avoid a multiplicity of burette readings with consequent liability to error. It is usually necessary to make several additions of cyanide to each. If much nickel be present in the solution the change in colour will indicate when the end-point is being approached. Great caution must then be observed not to add an excess, especially if little or no iron be present. When the solution contains much iron it is safe to add several drops at a time until the solution is perfectly clear, the silver iodide having been dissolved by the excess of cyanide. On standing for a few moments, however, the turbidity will reappear, and it must be destroyed by the addition of more cyanide until the solution remains clear for 15 minutes. Not more than two additions will usually be necessary for converter matte or other samples low in iron. When finished, deduction must be made from the burette reading of a volume sufficient to titrate a blank to which 5 c.c. of silver nitrate has been added. The result, calculated to nickel, includes cobalt as well. If the end-point be passed, sufficient silver nitrate may be added to restore the turbidity, and the titration again finished, with a correspondingly large deduction, but this is not recommended for the most accurate work. In titrating solutions high in nickel the volume should be increased and the cyanide added rapidly till near the end to prevent the precipitation of nickel cyanide, $Ni(CN)_2$, which does not readily redissolve.

The determination of nickel by precipitation with dimethylglyoxime possesses the advantage that it gives the nickel only, without cobalt. It is both quick and accurate, and its greatest disadvantage lies in the fact that the reagent is very expensive. Its use is therefore limited chiefly to checking cyanide results on weekly or monthly samples of ores and slags. Iron is retained in solution or is separated as described under the cyanide method. The degree of alkalinity there recommended is also correct for the dimethylglyoxime precipitation. Five times as much reagent—in 1% alcoholic solution—should be added as the total of nickel and cobalt present. The precipitate is filtered on a Gooch filter, preferably using a small disc of strong filter paper instead of the usual asbestos mat. A small amount of copper in the solution does not interfere with the dimethylglyoxime precipitation of nickel, but if much be present it may give trouble by coming down as hydroxide.

Cobalt.

There is not, so far as I am aware, any method for the determination of cobalt which is both quick and accurate in the presence of nickel, copper, and iron. This determination is not a part of the daily routine at the nickel plants, but when required is accurately made as follows: Nickel and cobalt are separated from all other elements by electrolysis, as already described. The deposit is dissolved and the cobalt precipitated by either potassium nitrite or nitroso-β-naphthol, as described in the text-books. I prefer the latter method, as the cobalt precipitate is more readily washed free from nickel. In either case it is well to ignite the cobalt precipitate, dissolve in acids, and electrolyse the sulphate solution, testing the deposit for nickel with dimethylglyoxime.

When the ratio of nickel to cobalt is approximately 1:1 (this does not apply to the Sudbury ore) the above method may well be modified by dissolving the electrodeposited nickel and cobalt and precipitating the former with dimethylglyoxime, obtaining the cobalt by difference. This is much quicker, and, I believe, more accurate.

The error introduced by reporting cobalt as nickel in Sudbury products is seldom a large one, and generally decreases as the metallurgical treatment proceeds, due to the fact that cobalt is the more easily oxidised and slagged, in both the furnaces and converters. The converter slag produced during the latter part of the blow is relatively the highest in cobalt of any smelter product.

Silica.

This is one of the determinations most frequently made at the nickel smelters, but it is safe to say that very few results reported are really accurate. Accurate determinations are possible only by the free use of platinum dishes, repeated evaporations of filtrates to dryness, correction for impurities in the weighed silica, and various other precautions which are fairly well known but rarely exercised. Fortunately great accuracy is seldom necessary, and even quick results may be approximately correct through the balancing of dissolved silica against the impurities weighed.

Most silicious slags which have been properly granulated are readily decomposed by ordinary acids. Those produced at the nickel plants are fairly low in silica, however, and the metallurgists in charge require carbonate fusions for all routine work. It may be of interest to mention the methods adopted in two of the laboratories for securing quick results.

Plant No. 1.—0·5 g. of sample is fused over a flame with about 2 g. of mixed sodium and potassium carbonates in the "corner" of a large platinum evaporating dish. When well fused the mixture is cooled somewhat, a small excess only of hydrochloric acid over that necessary to decompose the melt is added, and the liquid evaporated to dryness in the same dish; after cooling, the residue is extracted with acid, the solution diluted, and the precipitate filtered, ignited, and weighed. Results are regularly reported in 1—1¼ hours.

Plant No. 2.—Here neither gas nor large platinum dishes are available, so the method is modified as follows: The sample is fused in a muffle for six minutes at a high temperature with mixed carbonates, using a 25 c.c. platinum crucible. After removal from the muffle, the crucible cover is placed in position on a small porcelain crucible, and as soon as the melt has cooled to a dull red heat it is poured into the lid. When properly done it does not adhere to the metal. Both crucible and cover, with the melt, are placed in a small casserole, which is covered with a watch glass, and a small stream of 1:1 hydrochloric acid is directed into the crucible through the lip from a wash-bottle. When the action decreases the watch-glass is removed and the crucible and cover are washed down with diluted hydrochloric acid. The solution and separated silica are transferred completely to an eight-inch porcelain crystallising dish, with flat bottom, keeping the total volume down to 25 c.c. if possible. The solution is evaporated to dryness on an asbestos ring on a hot plate, the time occupied being not more than 7—8 minutes. The residue is cooled, and about 15 c.c. of hydrochloric acid added, and then 25 c.c. of water. The solution is filtered at once by suction, and the paper containing silica is placed in a platinum or nickel crucible and set just inside the muffle door. The burning of the paper may be greatly hastened by directing into the crucible through a tube a very gentle stream of oxygen or air. When the paper is burned the crucible is moved to the hottest part of the muffle for a couple of minutes, then removed, cooled in ater, and the silica weighed. This method equires the almost constant attention of the hemist, but results have been reported regularly from 30 to 40 minutes, and with all the accuracy ecessary for plant control.

Iron.

The ordinary bichromate method is the one enerally employed. One interesting point is that the analysis of samples like converter matte, hich contains an appreciable amount of the metals the platinum group, stannous chloride does not ake the iron solution colourless. It becomes early so, then the addition of more stannous loride darkens it somewhat, and no amount in cess will clear it. The brownish coloration persts even after the addition of mercuric chloride.

Alumina.

The phosphate method is used exclusively, it ing found impossible completely to free an ammonia precipitate of ferric hydroxide and alumina from nickel and other salts, even by dissolving and reprecipitating several times. It is of course necessary to remove copper with hydrogen sulphide prior to the precipitation of aluminium phosphate.

Lime and magnesia.

The usual methods for these bases are employed. Neither one occurs in large amount in the Sudbury ore.

Sulphur.

The accurate determination of sulphur in many ores is a comparatively easy matter, but it is rendered difficult at the nickel smelters owing to the strong tendency of free sulphur to separate during the decomposition of the Sudbury pyrrhotite. After numerous experiments I have found the best method of decomposition to be by means of a saturated solution of potassium chlorate in nitric acid, using about 30 c.c. per 0·5 g. sample. Even then it is necessary to watch for separated sulphur; when this is found, as it occasionally will be, the determination must be begun anew.

The ordinary precipitation of barium sulphate in acid solution, in the presence of ferric salts, will almost invariably result in the inclusion of iron. This may give a low value for sulphur, due to iron replacing barium, or a high one, if iron salts other than the sulphate be retained. These difficulties may be avoided by making the filtrate from the "insoluble" alkaline with ammonia, following this with the necessary amount of barium chloride solution, heating for a few minutes, and then acidifying with hydrochloric acid, using only a small xcess.

Acidity.

This is required only at the refineries. Three different methods are used, depending upon the egree of acidity to be determined:

(1) Strongly acid solutions from the copper re-ning department, by titration with sodium ydroxide or carbonate, either in the cold, using methyl orange as indicator, or hot, when the indiator may be dispensed with and the first permanent ydroxide precipitate taken as the end-point. I refer the former.

(2) Feebly acid solutions from the electrolytic ickel department, containing sulphuric acid up to few grams per litre, and with copper and iron ractically absent, by the iodate method. As this not very well known the details are given:—olution required: Sodium thiosulphate, about 75 g. per litre; 1 c.c.=0·005 g. Cu. The acid quivalent, expressed as sulphuric acid, is 0·00385 g. he method is based on the following reaction:

$$KIO_3+5KI+3H_2SO_4=3H_2O+3K_2SO_4+6I.$$

he iodine thus set free is titrated with sodium thiolphate. To 10 c.c. of sample in a beaker a few crystals of potassium iodide and a little starch solution are added. If any colour appears the solution is titrated with sodium thiosulphate, the volume of which indicates the amount of copper present. A few milligrams of potassium iodate is then added, when the blue colour will reappear if any acid be present. The solution is at once titrated with thiosulphate until colourless. If ferric salts be present the colours will always reappear. The first clearing of the solution therefore represents the end of the reaction. In spite of the slight interference of iron this method is an excellent one, and it may be used for acidity as low as 10 mg. per litre.

(3) When the acid is much lower than 10 mg. per litre, and an accurate determination is required, the potentiometer method of measuring hydrogen-ion concentration should be used. As a detailed discussion of this method would require too much space a few points only need be mentioned. The most common impurity which interferes with the electrometric determination of acid in nickel solutions is copper. About the only satisfactory method of removing it without changing the acidity is to "cement" it out with sheet nickel. If present it will be easily detected by the steady lowering of successive voltage readings, though arsenic may cause the same trouble. The presence of hydrogen peroxide or similar strong oxidising agent in the solution will lower the readings and make them irregular, owing to action on the hydrogen electrode. Both temperature and barometric pressure have some effect on the readings, by changing the concentration of hydrogen on the electrode. For the most accurate work correction should always be made for them unless the conditions are standard. It is essential that the instrument be standardised frequently. For this purpose a solution of sodium or potassium hydrogen phthalate has been found satisfactory.

Precious metals.

No review of the analytical problems in the metallurgy of nickel would be complete without mention of the most difficult of them all—the determination of silver, gold, platinum, palladium, iridium, rhodium, ruthenium, and osmium in Sudbury ores and products. A discussion of these, however, would in itself be sufficient for a paper of considerable length. So far as I know, none of the large companies handling these metals has published details of their analytical methods. It is to be hoped, however, that this conservative policy will not be indefinitely maintained.

Yorkshire Section.

Meeting held at Queen's Hotel, Leeds, on May 8, 1922.

MR. S. H. DAVIES IN THE CHAIR.

FACTORS INFLUENCING THE AMMONIA YIELD IN THE CARBONISATION OF COAL.

PART I.—THE ROLE OF OXIDATION.

BY H. D. GREENWOOD, M.SC., AND H. J. HODSMAN, M.B.E., M.SC., F.I.C.

(Department of Coal Gas and Fuel Industries, The University, Leeds.)

INTRODUCTION.

Prior to 1914 the supply of ammonia compounds was dependent mainly on the industries using fuel in by-product recovery processes, but the development of the production of synthetic ammonia, with output and selling price largely independent of the circumstances of the fuel industries, has abolished the virtual monopoly of by-product processes. A new interest is given to methods of increasing the yield of ammonia per ton of coal handled, therefore, whether by increasing the proportion of the nitrogen of the coal liberated as ammonia, or by preserving the ammonia once formed from destruction in or after leaving the retort or oven.

The ammonia obtained in normal carbonisation practice represents 15—20% only of the nitrogen of the coal. A similar proportion is obtained as free nitrogen in the gas, and it is important in considering the development of by-product processes to know how much of this results from destruction of previously formed ammonia. It is, however, possible that a part of this free nitrogen is liberated as such from the coal, and is therefore an inevitable loss.

The first problem is being dealt with by A. C. Monkhouse and J. W. Cobb (Trans. Inst. Gas Eng., 1921; J., 1921, 760 A; 1922, 532 A). The experiments recorded in this paper were initiated to study the conditions of destruction of ammonia by oxidation as distinct from dissociation, because it has been recently suggested that the former is the more important. On account of dissociation, the ammonia in a hot crude gas (even if free from oxygen) from coal is in an unstable condition, and progressively reverting into its elements. A calculation based on the known equilibrium conditions at 800° C. shows that, given time, practically the whole of the ammonia present in crude coal gas could be decomposed at that temperature. This decomposition, however, proceeds slowly enough for a considerable proportion to survive. At a temperature at which the loss in this way may still be small—say 600° C.—oxidation of ammonia in air may occur at an appreciable rate. A knowledge of the conditions conducing to loss of ammonia in the retort, oven, or producer, by oxidation by indrawn air is clearly important, and in particular, information as to the part played by water vapour and materials used in the construction of the plant. While an extensive literature has been compiled dealing with the oxidation of ammonia for the production of nitric acid, this other aspect has received no great amount of study. Data respecting the production of nitric acid from ammonia where conditions are so unlike those found in gas production are of limited application. There is a particular obscurity as to the influence of moisture on the oxidation of ammonia. Although the contrary opinion has been stated, it is regarded as being unimportant in the catalytic formation of oxides of nitrogen (Partington, "The Alkali Industry," p. 229) and moisture is ignored in practice. On the other hand, there is in the carbonisation industries a widespread impression that water vapour exerts a definite preservative action on the ammonia in coal gas. This view is frequently held to account for the higher average yields of ammonia obtained in coke oven practice, where wet slacks with 10% or more of water are carbonised. An attempt has been made to give a quantitative evaluation of the effect of moisture, and Foxwell[*] (J., 1921, 193 T) states that 9% of moisture in the slack gives the conditions most favourable to high ammonia yields. Foxwell seems to have in mind several effects traceable to the water, the increase in ammonia formation, retardation in ammonia destruction due to dilution with attendant accelerated flow of the gases, or to some specific action of the water. Of the first influence—increased production of ammonia—there is no doubt, both as a result of experience in practice and the experiments of Monkhouse and Cobb (*loc. cit.*). Respecting the other two, there seems to be less certainty. Sommer (Stahl u. Eisen, 1919, **39**, 261, 294, 349; J., 1919, 350 A) has gone further, and drawn definite conclusions as to a distinct preservative influence exerted by water vapour. He also appears to regard oxidation as more important than dissociation in causing losses of ammonia. In his experiments, ammonia in admixture with air, dried or saturated with moisture at 20° C. (about 2·3% of moisture), was passed through a heated porcelain tube packed with broken firebrick. The mixture contained 1·5—2% of ammonia as in carbonisation practice. Even at 250° C. under this treatment, loss of ammonia by oxidation was detected. The presence of moisture did appear to exert a specific preservative action. At 450° C. the effect of moisture was apparently profound. In the dried mixture a loss of 12·89% of the ammonia was observed and one of only 2·01% when 2·3% of water vapour was present.

In order to account in some way for the results, he postulated the formation in moist gases of a hydrated ammonia molecule—say NH_4OH—possessed of increased stability as compared with ammonia at high temperatures. The theoretical interest and practical importance of such results reposing on so slender an experimental basis seem to justify a critical examination. Sommer appears to believe that these results are applicable to the carbonisation process, though quoting no experiments made in coal gas mixtures, but from our experience these observations cannot be transferred directly to the very different conditions found in a crude coal gas.

Thau has endeavoured to ascertain the relative importance of oxidation and dissociation of ammonia by experiments on a working coke oven (Brennstoff-Chem., 1920, **1**, 52, 66; J., 1921, 137 A). He compared the ammonia content of the gas when the oven was carefully sealed and when oxygen was admitted from a cylinder into the space above the charge, in which case the yield was much reduced. Owing to heat developed here by combustion of the gas with oxygen, the temperature was considerably raised, so that the comparison of dissociation and oxidation was not made under identical temperature conditions. The results, however, do bring out the deleterious action of indrawn air on the yield of by-products, if the oven temperature exceeds 600°. The conditions in an oven at work are so complex as to make it difficult to associate effect with cause. Nevertheless, Thau appears to regard oxidation as the main cause of ammonia loss in the oven.

The oxidation of ammonia, as is well known, is very sensitive to the influence of catalysts, both as regards speed of reaction and nature of products, which may be either free nitrogen or oxides of nitrogen.

The reactions may be written thus:—

(1) $4NH_3+3O_2=2N_2+6H_2O+237{,}600$ cals.
(2) $4NH_3+5O_2=4NO+6H_2O+215{,}600$ „

Reaction (1) would represent the reaction which might conceivably occur in carbonising practice, but by the use of suitable catalysts under the proper conditions, a yield of nitric oxide can be obtained almost quantitatively, according to (2), even on a large scale. Neither reaction is reversible under any known conditions. Ammonia appears to be completely unstable in presence of oxygen at all temperatures. This is in agreement with theoretical requirements. Rideal and Taylor

---

[*] Foxwell returns to this subject of ammonia losses in carbonisation in a recent paper (J., 1922, 114 T) but does not take oxidation within his purview.

"Catalysis in Theory and Practice," p. 91) calculate, by means of Nernst's heat theorem, the values f the equilibrium constants of the second reaction, f assumed to be reversible. The partial pressures f ammonia which must exist at the equilibrium o satisfy the Nernst equation are inconceivably small. The circumstances are similar as regards reaction (1). The decomposition of ammonia by xidation cannot then be regarded as limited by the attainment of any equilibrium or, in accordance with the law of mass action, by the operation f the reaction in the reverse sense. This is important in considering any theories to account for a retarding influence of water vapour.

For a given catalyst and set of conditions, there is an optimum temperature at which the yield of nitric oxide is a maximum. Above and below this temperature, the production of free nitrogen increases. At the lower temperatures this is ascribed to the sluggishness of the reaction, unchanged ammonia being left to react with nitric oxide formed thus:—

$$4NH_3+6NO=5N_2+6H_2O$$

This alone would suffice to account for the fact that nitrates and nitrites are never observed in gas liquors. Moreover, the time of contact in commercial oxidation of ammonia is very small—say one-hundredth of a second—whereas in carbonisation it is probably several seconds. This is also true of the experiments dealt with in this paper, and it is easy to understand why no large quantity of oxides of nitrogen has been observed in the presence of the most active contact substance employed.

The object of the experiments now recorded was to ascertain the conditions under which oxidation of ammonia would occur, comparable with those current in carbonisation and gasification practice. The effect of substances of varying catalytic power was examined and also what influence, if any, could be traced to the presence of water vapour.

A time of contact was chosen which was believed to be of the same order as that of the gases with the charge in vertical gas retort practice. In the calculation of this time of contact a number of arbitrary assumptions must be made, for the process by which the gas escapes is complex, and the exact mechanism uncertain (*cf.* Foxwell, *loc. cit.*, on this subject). For a given gas delivery in the following experiments the time of contact will depend on the temperature to which the gas is heated. In the calculation, a mean temperature of 600° C. was assumed, and the time of contact in the experiments adjusted to seven seconds, unless otherwise stated.

EXPERIMENTAL.

The apparatus (Fig. 1) consisted essentially of an arrangement for producing a constant stream of air, or other gas, and ammonia, and of suitable devices for sampling the mixture, before and after it had traversed the reaction tube.

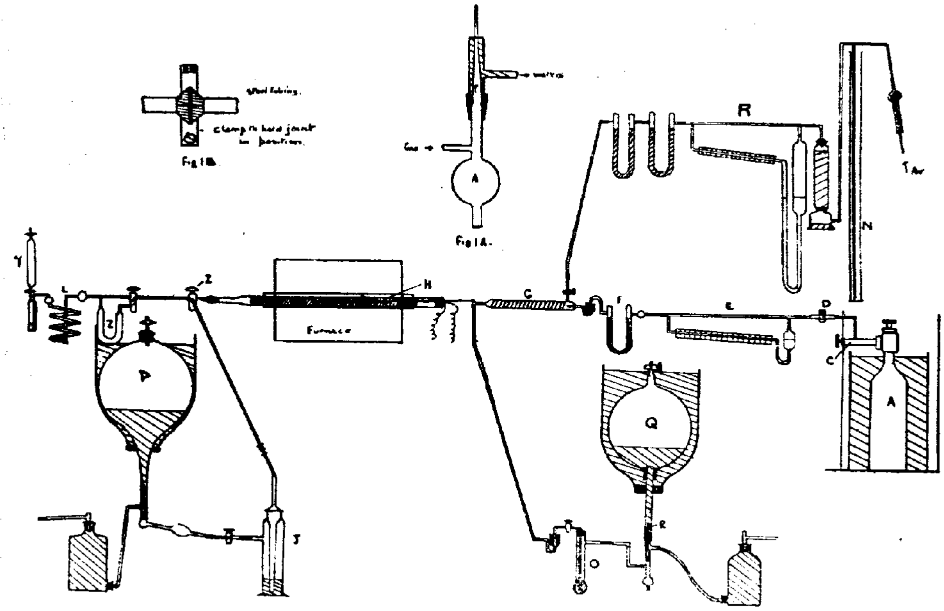


FIG. 1.

Method of producing the mixture of air and ammonia.

The ammonia was obtained from liquefied ammonia gas contained in the small steel cylinder, A, fitted with a coarse valve and a fine needle valve, C, for an accurate adjustment of the stream.

The steel capillary from C was connected to the gauge E by a special steel-faced joint, D, the construction of which will be understood from the enlarged section (Fig. 1 B). The ammonia gauge was a modification of an ordinary differential manometer, the one limb being nearly horizontal, and the other enlarged into a bulb. In this way a magnified reading could be obtained.

The ammonia, dried by the soda-lime tube, F, passed viâ a mercury-sealed joint into the mixing tube, G, consisting of a glass tube 20 cm. long and 2 cm. in diameter, loosely packed with glass wool. The air (or other gas) was drawn from a steel cylinder charged at 50 atmospheres pressure.

In order to maintain a constant rate of flow, the excess air was allowed to bubble continuously through the water seal, N. The air passed through a tower containing pumice and sulphuric acid and then via the gauge, R, for measuring the rate of flow to the final drying tubes containing calcium chloride and phosphorus pentoxide.

The air gauge was similar in construction to the one previously described, with the exception that the ammonia gauge was filled with paraffin oil, whereas for the air gauge concentrated sulphuric acid was used.

After leaving the mixing tube the gas mixture could be diverted through the absorption tube, O. The ammonia is here absorbed by $N/10$ sulphuric acid, the remaining gas passing forward to the gas holder, Q, of capacity about 700 c.c. The gas enters the holder through the capillary, R, whereby a pulsating flow is avoided. The narrow tube at the base of the holder (Fig 1 A) is calibrated so that the gas volume can be read off to within 0·2 c.c.

When the mixture was not being sampled as above, the gases passed directly through the reaction tube, H, then through a second absorption vessel, J, where any unoxidised ammonia was absorbed, the residue being collected in the gas holder, P. This was similar to the one previously described, though of capacity 1700 c.c.

Alternatively, the mixture could be passed through the Winkler worm, L, containing dilute caustic soda solution to absorb oxides of nitrogen, followed by a guard-tube containing a solution of diphenylamine in concentrated sulphuric acid, to indicate incomplete absorption. The gases then finally left the apparatus through the detachable sampling tube, Y.

When desired, the oxidation products could be by-passed through the soda-lime tube, Z, to determine the amount of water formed in the reaction.

In order to compare the oxidation with dry and moist gases under identical conditions, a three-way tap was later inserted after the air gauge (Fig. 2). The air (or other gas) could then be passed either through the drying system as above, or else through a Claisen flask, where the gas was saturated with moisture at a known temperature. To prevent condensation of moisture, the succeeding portions of the apparatus were maintained above this temperature by suitable heating devices.

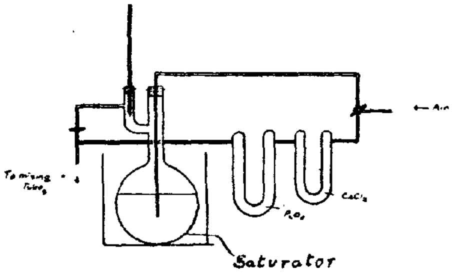


FIG. 2.

The reaction tube was made from hard glass tubing, and connected to the three-way cock, I, by a sleeve joint, the packing consisting of a mixture of finely powdered silica and water-glass. The other end of the reaction tube was closed by a rubber stopper, through which were inserted the tube conveying the gas mixture and also the thermocouple sheath. The junction of the thermocouple could thus be placed within the contact mass, enabling the temperature of the latter to be measured and kept constant within ±5° C. The reaction tube was heated in an electric furnace wound so that the zone occupied by the contact mass was uniformly heated.

The tube was normally packed over a length of 6 in. with the material on which experiments were to be made, the volume of the material being such that the time of contact of the gases in this zone was approximately the same with each type of material.

Uniformity of flow of the ammonia was maintained by keeping constant the temperature of the cylinder, A, and therefore the vapour pressure of contained ammonia. The cylinder was placed in a bath of water, and the whole surounded by a cardboard box, the intervening space being loosely packed with cotton wool. The back pressure thrown by the various absorption systems was so regulated that the rate of flow was unchanged when the gases were passed through any one of these systems.

Method of experiment.

The streams of air and ammonia having been regulated to give the desired percentage of ammonia, the mixture was passed through the apparatus for about three-quarters of an hour. The gases were then passed directly into the holder, Q; when this was full the stream was diverted through the reaction tube and again collected, on leaving, in the holder, P. When this was filled, the stream was diverted again into the smaller holder, Q. Thus the initial percentage of ammonia in the gases could be determined at the beginning and end of an experiment. The acid in the absorption tube, O, was titrated directly with standard alkali, but the ammonia in the second tube, J, was determined by distillation in the usual manner, since the presence of oxides of nitrogen in the oxidation products would vitiate the results of a direct titration.

The traces of oxides of nitrogen were estimated by matching the colour obtained with phenylenediamine hydrochloride against a standard nitrite solution.

Oxidation in contact with fused silica.

In order to obtain some idea of the range of temperature over which oxidation takes place when catalytic influences are minimised, the reaction tube was packed with fragments of fused silica taken as an example of a relatively inactive contact material.

In the initial experiments, these fragments filled the whole tube, but in all the succeeding work only the central uniformly heated zone as already stated was filled and the rest of the tube was occupied by cylindrical distance pieces of fused silica.

The time of contact of the gases was materially greater in the initial experiments, and hence a greater oxidation was found (Table I.). Below 500° C. small quantities of nitrous acid were detected in the absorption apparatus, but never nitric acid. Above this temperature the ammonia oxidised was all converted into free nitrogen. The absence of nitric acid is presumably due to the small velocity of the reaction $2NO+O_2=2NO_2$. Using the figures given by Lunge and Berl (Z. angew. Chem., 1907, **20**, 1716) we find, assuming that 3% of the ammonia is converted into nitric oxide, that the minimum time necessary for its further oxidation to nitrogen peroxide would be about 2 minutes at 20° C., whereas the time available in these experiments was not greater than 5 seconds.

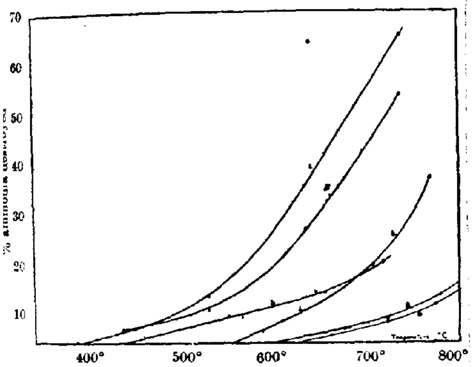
A series of experiments was also carried out with nitrogen containing about 1—2% of oxygen, instead of the air, without altering the packing in the reaction tube. The results given in

TABLE I.

	Temperature, ° C.	Rate of flow, litres per hour.	% NH_3 entering.	% NH_3 leaving.	% NH_3 oxidised.	Water formed by the oxidation per hour.		% O_2 in in gases leaving furnace.	% O_2 in in gases leaving calc. on NH_3 oxidised.	Remarks.
						Found.	Calc.			
action tube packed entirely with silica chips.	460	3·94	2·044	1·981	3·1	0·0015	0·0011	20·71	20·76	Trace of HNO_3, no trace of HNO_2.
	510	3·97	2·000	1·863	6·5	0·0056	0·0063	20·70	20·71	15% of oxidised NH_3 present as HNO_2.
	550	3·98	2·030	1·830	9·5	0·0081	0·0084	20·70	20·66	No HNO_3 or HNO_2 could be detected.
	670	3·90	1·800	1·224	31·0	0·0140	0·0135	20·30	20·35	do. do.
	750	3·97	1·790	0·885	51·0	0·049	0·0477	Not estimated		do. do.
be only packed over 6 in. with silica chips.	400	3·79	2·008	2·000	nil	Not estimated		Not estimated		Gases sat. 23° C. Moisture=2·8%.
	560	3·800	1·790	1·680	6·1	0·0050	0·0065	„	„	Dry gases.
	560	3·89	1·951	1·826	6·4	Not estimated		„	„	Gases sat. 23° C. Moisture=2·8%.
	660	3·78	1·879	1·705	9·2	„	„	„	„	Gases sat. 23° C.
	720	3·78	1·827	1·512	17·2	0·0140	0·0120	„	„	Dry gases.
	720	3·90	1·924	1·645	14·5	Not estimated		„	„	Gases sat. 23° C.

TABLE II.

Temp. ° C.	Rate of flow, litres per hr.	% NH_3 entering.	% NH_3 leaving.	% NH_3 oxidised.	% O_2 entering.	% O_2 leaving.
595	4·10	1·602	1·570	2·4	1·85	1·86
615	4·10	1·505	1·432	4·7	1·97	1·95
710	4·09	1·762	1·474	16·3	Not estimated.	
770	4·01	1·500	0·935	35·0	1·89	1·30



1. In dry air in contact with fireclay.
2. In moist air in contact with fireclay.
3. In dry air in contact with silica.
4. In N_2+1–2% O_2 in contact with silica.
5. In coal gas+1–2% O_2 in contact with firebrick.
6. In coal gas+1–2% O_2 in contact with silica.

FIG. 3.

Table II. and Fig. 3 show that the oxidation of ammonia is retarded by a decrease in the concentration of the oxygen, but the influence of this factor becomes less pronounced at higher temperatures. The absence of oxides of nitrogen from the reaction products is in agreement with theory. Their formation in the absence of an active catalyst is slow and decomposition follows by reaction with the excess of unchanged ammonia.

Destruction of ammonia in coal gas.

On substituting coal gas containing oxygen for air, the loss of ammonia was greatly reduced (Table III. and Fig. 3), and was much less also than the loss in the presence of nitrogen with a similar low concentration of oxygen. These results show that below 800° C. under the conditions obtaining, though the ammonia passes through the apparatus practically unchanged, the whole of the oxygen is removed, presumably by reaction with hydrogen or hydrocarbon constituents of the gas. If the whole of the ammonia lost had been removed by oxidation, it would have consumed only a fraction of the oxygen actually disappearing. Even at 600° C., a temperature at which the oxidation in air and (nitrogen + oxygen) was considerable, the whole of the oxygen was removed in the reaction tube, while the ammonia passed through unimpaired. This points to the conclusion that in a coal gas the oxidation of the hydrogen or hydrocarbons takes precedence over that of ammonia, and that if any of the latter is decomposed at all, it must be due rather to a dissociation phenomenon.

TABLE III.

Temp. ° C.	Rate of flow, litres per hr.	% NH_3 entering	% NH_3 leaving.	% NH_3 loss.	% O_2 in gases entering.	% O_2 in gases leaving.
625	4·600	1·340	1·340	nil	1·08	nil
725	4·595	1·445	1·380	4·5	1·08	nil
775	4·21	1·400	1·291	8·0	1·07	nil

TABLE IV.

Temp. ° C.	Rate of flow, litres per hr.	% NH_3 entering.	% NH_3 leaving.	% NH_3 oxidised.	Total vol. of air +NH_3 passed over firebrick.	Remarks.
635	3·71	1·591	0·148	96·4	6·7	Gases saturated at 24° C. to 30° C.
640	3·65	1·664	0·643	61·5	20·0	
640	3·70	1·709	1·164	32·0	67·3	
640	3·63	1·630	1·233	24·4	93·0	
665	3·70	1·770	1·271	28·8	103	

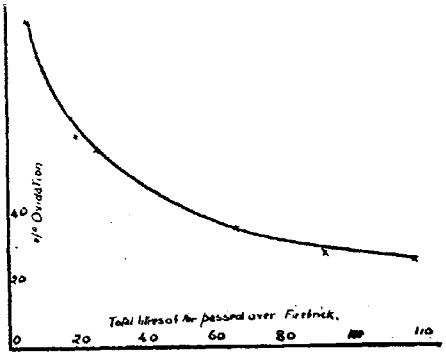


FIG. 4.

Loss in activity of firebrick.

Oxidation in contact with firebrick.

As contact material, the silica was replaced by fragments of unused fireclay brick, which is porous and contains iron or other oxides which display marked catalytic activity towards these reactions. Firebrick from the Leeds district containing 1·4% of ferric oxide was used.

Though the material at first displayed marked activity this was found, on repeating experiments at any one temperature, to fall off rapidly. The results in Table IV. (Fig. 4) clearly show this decrease in activity. Other samples of firebrick from the same source gave almost identical results. Further, the oxidation fell off at the same rate with mixtures of ammonia with either air or coal gas.

The passage of dry air alone had a similar effect which cannot, therefore, be attributed to any reactions involved in the actual oxidation of the ammonia. The cause of this decay of the catalyst remains unexplained. The results obtained when the firebrick had attained a stable condition are collected in Table V., and for the purposes of comparison have been plotted in Fig. 4, along with the figures obtained with fused silica.

TABLE V.

Temp. °C.	Rate of flow, litres per hour.	% NH_3 entering.	% NH_3 leaving.	% NH_3 oxidised.	Temp. of saturation.	% H_2O in gases.	Remarks.
450	3·65	1·620	1·570	3·1	23° C.	2·8	
540	3·69	1·659	1·545	6·8	23° C.	2·8	—
540	3·71	1·805	1·632	9·5	Dry	nil	—
640	3·66	1·801	1·370	23·9	23° C.	2·8	A small percentage of NH_3 was oxidised to NO, usually about 2·5% of the total NH_3 oxidised.
640	3·67	1·753	1·181	32·7	Dry	nil	
740	3·70	1·732	0·827	52·3	23° C.	2·8	
740	3·59	1·613	0·568	64·9	Dry	nil	
785	3·50	1·802	0·100	94·5	Dry	nil	
Influence of rate of flow.							
740	4·90	1·356	0·682	50·0	Dry	nil	—
740	3·59	1·613	0·568	64·9	Dry	nil	–
740	3·00	1·976	0·395	80·0	Dry	nil	—

Destruction of ammonia in coal gas mixtures.

The loss of ammonia in the presence of stabilised firebrick was similar to that observed in the presence of silica, and as before, the products were practically free from oxygen after contact. Contact material in its originally more active condition caused a considerably greater decomposition. An increase in the percentage of oxygen from 1% to 2% had no appreciable effect on the rate of decomposition of ammonia. Here again, at 600° C. the oxygen is taken up by some constituent of the coal gas while the ammonia remains intact, as in the experiments of Table III. There are, then, no grounds for ascribing any loss of ammonia in a coal gas under the conditions of these experiments to oxidation at all. If this is correct, then Sommer's conclusions are unsound, and experiments on mixtures of air and ammonia are irrelevant to the phenomenon in coal distillation.

TABLE VI.

Temp. °C.	Rate of flow, litres per hr.	% NH_3 entering.	% NH_3 leaving.	% NH_3 loss.	Sat. temp. °C.	% H_2O in gases.	% O_2 entering.	% O_2 leaving.
600	3·87	1·509	1·508	nil	23	2·8	2·1	0·1
680	4·35	1·399	1·360	2·9	23	2·8	0·85	nil
780	4·41	1·202	1·098	8·7	26·5	3·45	0·98	nil
775	3·63	1·476	1·353	8·3	26·5	3·45	2·1	nil
780	3·62	2·010	1·810	9·7	Dry	—	2·2	nil

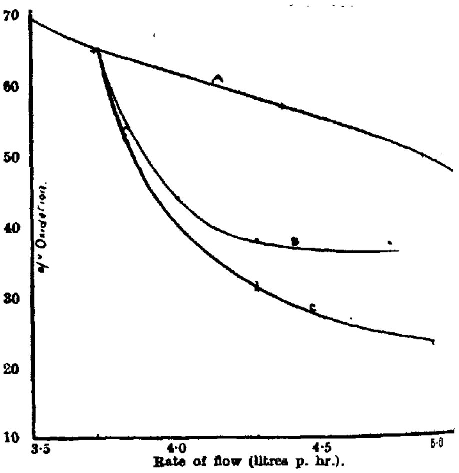
Influence of water vapour on the oxidation in air.

The experimental figures are given along with those for the dry gases in the various tables to which reference has already been made.

When mixtures of ammonia and air were heated in contact with silica (Table I.) the influence of moisture was negligible at the lower temperatures, and a reduction of 2·5% only was observed in the oxidation at 700° C. In coal gas (Table VI.) no appreciable difference was observed in the experiments made.

In the presence of the firebrick already mentioned, the oxidation in a mixture of ammonia and air was materially influenced by the presence of moisture, *e.g.*, 2·8% of water vapour caused a decrease in the percentage oxidation from 64% to 52·3% at 740° C. (see Table V., Fig. 3).

In view of these results, the experiments were extended to higher percentages of moisture (Table VII.), but the difficulty of preventing condensation limited the saturation temperature (65° C. corresponding to 25% H_2O). The greater stability of the ammonia observed in the presence of water vapour may be attributed, generally speaking, to two factors, viz., the increased rate of flow with consequent shortened time of contact, and some specific action—chemical or physical—of the water vapour.



Influence of moisture on oxidation of ammonia.

FIG. 5.

Curve A (Fig. 5) shows the influence on the degree of oxidation at 740° C. of the rate of flow alone in the dry mixture of ammonia and air. In curve C the percentage oxidation is plotted against rate of flow when the gas mixture contains water vapour in proportion depending on the temperature of saturation employed. The percentage of water vapour is also indicated. By subtracting curve A from curve C, we are left with curve B, which may be regarded as showing the specific effect due to the water vapour.

This "specific influence" of the water vapour increased with the water content at first, but when 12% was reached, the observed effect can be accounted for by the smaller time of contact due to increasing percentages of moisture.

These results, then, confirm qualitatively Sommer's experiments at lower temperatures, although no such powerful influence as recorded by him has been observed. Thus, at 450° C. his loss of ammonia by oxidation fell from 12% to 2% with the addition of 23% of water vapour.

TABLE VII.

Temp. °C.	Rate of flow, litres per hr.	% NH_3 entering.	% NH_3 leaving.	% NH_3 oxidised.	Sat. temp. °C.	% H_2O.	Rate of flow of air + water vapour per hr.
740	3·72	1·613	0·568	64·9	Dry	nil	3·72
740	3·70	1·732	0·827	52·3	23	2·8	3·82
740	3·76	1·936	1·348	30·4	50	12·3	4·28
740	3·70	1·930	1·470	23·6	65	25·0	4·93

In mixtures of coal gas and ammonia up to 800° C. the moisture appeared to have no appreciable effect, but the total amount of ammonia decomposed is small, and at higher temperatures the results might differ.

From a general survey of these results, as regards mixtures of air and ammonia, we see that a marked preservative effect of moisture only occurred in the presence of substances displaying a considerable catalytic power. The activity of the catalyst is only partially impaired by the moisture, since the oxidation in presence of firebrick and 15% of moisture is considerably greater than with silica in the absence of moisture.

It is common knowledge that the presence of moisture is important in many reactions, but its effect is usually accelerative and the inhibiting action observed here, and by Sommer, is difficult to explain. As just shown, it is greater than can be accounted for by mere dilution, and consequent increase in rate of flow. Moreover, the effect is more intense with the first additions of moisture, which have a small effect on the rate of flow. Nor can it be ascribed to an accumulation of the reaction product on the basis of the law of mass action, for the reaction, as indicated at the outset, is in no appreciable degree reversible. The observation that the influence of moisture was not marked when the relatively inert fused silica was used as contact material, suggests that in some way the catalyst is involved. The most helpful conception has been obtained from Langmuir's theory of the unimolecular film at the catalyst surface. If we suppose that the oxidation occurs between ammonia and oxygen, possibly atomic, adhering to the contact mass, but not covering it entirely, we can see that the introduction of any other gas or vapour capable of sticking to the surface, and therefore restricting mutual access of oxygen and ammonia, will have a preservative effect towards the latter. Any gas or vapour prone to adhere to the catalyst would have the same effect which might be caused if the proportion present were only small.* The available catalyst area once tenanted by water molecules, the addition of further water vapour would apparently have no influence. There is a difficulty, however, as it would appear that the water vapour resulting from the oxidation of ammonia in dried gases should also have this "blanketing" effect.

It is also necessary to reconcile the apparent importance of water vapour here with its unimportance in the commercial oxidation of ammonia. This may, however, possibly account for the apparent paradox just mentioned. In the experiments chronicled here, in dry mixtures of air and ammonia the proportion of ammonia was low (1—2%), and as this was only partially oxidised, the proportion of water vapour in the product was also small, and added water vapour might make itself appreciably felt. In commercial oxidation 10—15% of ammonia is employed and completely oxidised, yielding a corresponding proportion of water vapour large enough to render unimportant the presence or absence of water vapour in the air employed.

Conclusions.

The destruction of ammonia at low partial pressures and in atmospheres of air, of nitrogen containing 1—2% of oxygen, and of coal gas containing oxygen, at temperatures up to 800° C. both in presence of fused silica and unused fireclay brick, has been examined.

The oxidation of ammonia in air and in contact with the fireclay brick under the conditions of the experiments is distinctly retarded by water vapour present even in small proportions.

In coal gas containing oxygen, the destruction of ammonia is much less marked at corresponding temperatures than with air, and this destruction, owing to the preferential union of the oxygen with the hydrogen etc. present in the coal gas, is due not to oxidation, but to a process of dissociation. In these experiments no marked influence of water vapour was observed.

It is doubtful whether direct oxidation of ammonia occurs to an appreciable extent during carbonisation even when oxygen is present. The known deleterious effect of air indrawn during carbonisation and gasification is then presumably due to the local overheating of the gas following upon the union of the oxygen with combustible constituents. The rise in temperature then facilitates dissociation. It remains to be proved that a preservative effect can be ascribed to the large volume of water vapour in coke oven gas, *i.e.*, as distinct from that due to dilution and shortened time of contact of the ammonia.

The experimental work on this subject is being amplified and will be the subject of a further communication.

DISCUSSION.

PROF. J. W. COBB said that he had seen this work in progress and appreciated the way in which experimental difficulties had been overcome. If air was drawn or forced into a gas-retort, coke-oven, or gas-producer (at the wrong point) it undoubtedly lowered the ammonia yield. Presumably from this work this loss was not due to direct oxidation of the ammonia, but resulted from local combustion of the gas and a dissociation of ammonia, intensified by rise of temperature and catalytic action along the solid surfaces of brick-work or coke.

MR. W. McD. MACKEY said that the introduction of steam or water vapour into the by-product coke oven had often been advocated, but the difficulty was that the steam would intervene between the walls of the oven and the mass of coal in course of coking and prevent the passage of heat from the flues to the coal.

MR. AUTY said that the effect of water vapour was rather similar to the effect of charcoal on phosgene. If the charcoal used and the mixture of phosgene and air were dry, hydrochloric acid was produced, but if the charcoal contained 5% of moisture, the phosgene was absorbed without the formation of hydrochloric acid.

MR. HODSMAN, replying to an inquiry as to the effect of carbonising in iron retorts on the yield of ammonia, said that the temperatures attained in such apparatus were much below those of current practice and in consequence no just comparison was possible. Referring to Mr. Mackey's remarks on the effect of water vapour, he did not wish to imply that water vapour was without benefit to the yield of ammonia. On the contrary, he believed that it did operate favourably, but thought caution desirable when accounting for this effect. The conditions in practice were complex, and even under the simplified conditions of laboratory experiment the expected result was often not attained. The reactions of ammonia were very sensitive to catalysts and to temperature under the conditions of practice.

---

* *Cf.* Decarrière (J., 1922, 291A), who discussed the poisoning effect of small quantities of hydrogen sulphide, acetylene, etc.

Communications.

THE PREPARATION OF COD LIVER OIL AND THE EFFECT OF THE PROCESSES ON THE VITAMIN VALUE OF THE OILS.

BY J. C. DRUMMOND, D.SC., F.I.C., AND S. S. ZILVA, D.SC., PH.D., F.I.C.

From the Biochemical Laboratories, Institute of Physiology, University College, London, and the Biochemical Department, Lister Institute, London.

In the early summer of 1921 we spent several weeks in Norway visiting the chief centres of the cod liver oil industry, on behalf of the Medical Research Council, in order to study the cause of the variations in the medicinal value of this valuable oil. During the trip a considerable number of factories of one type and another were visited, and a large number of oil samples of known origin were collected and brought home for testing their vitamin content. We were accompanied throughout by Professors Hjort and Holst, of the University of Christiania, who were also interested in the problem under investigation and who gave us very great assistance in every way.

Cod fisheries.

The Norwegian cod fishing can be broadly divided into two seasons which are usually named the Lofoten or "Skrei" fishing, and the Finmarken fishing. The reason for this differentiation, which is a fairly sharp one, is apparent from a study of the valuable memoirs published by Hjort and other investigators on the life history of the cod (Vol. 20, Rapports, Conseil Permanent International pour l'Exploration de la Mer, Copenhagen, 1914). Their investigations covering a number of years have shown that the spawning grounds of the cod in Norwegian waters are on the coastal banks at depths of 10 to 40 fathoms, extending right up the coast as far north as Sörö in the western part of Finmarken, but in particular on the famous Romsdal and Lofoten banks. The mature cod termed "Skrei" visit these banks in enormous numbers at the spawning season from January to April and are fished there during the "Skrei" fishery. The ova develop over the banks, and by June the small fry are drifting with the current northwards along the Norwegian coast so that by August and September they are found in far northern waters. The "Skrei" fishing, which has its chief centre at the Lofoten Islands, therefore covers the whole time during which the fish are on the spawning grounds (January to April or May) and the fish caught are almost solely mature cod; the other gadoids from which liver oils are prepared elsewhere—the haddock, *G. aeglefinus*, and the coal fish or saithe, *G. virens*, etc.—have different spawning habits (see Meek, "Migrations of Fish," 1916, p. 212; also Howell, "Ocean Research and the Great Fisheries," Oxford, 1921). It is probably for this reason chiefly that the cod liver oil produced at the Lofoten Islands has acquired a high reputation, for the makers have been able to claim that it is prepared from cod livers only.

The later fishing, the Finmarken season, sometimes termed the "lodde" fishing (from "lodde" the local name for the caplin) lasts from May to as late as August and is quite different in character from the "Skrei" fishery. In the spring as the light becomes more intense there is a remarkable outburst of plant life in the sea (Moore, Chem. Soc. Trans., 1921, 149, 1555), which is followed by an equally remarkable increase in the minute animals, copepods, amphipods, larval decapods, and molluscs, which feed on the microscopic plants and which in their turn form the food supply of large numbers of small fish and other marine animals, salps, squids, and certain mollusca which are the food of the cod. On the northern shores of Norway the appearance of these vast swarms of living organisms, sometimes so massed as to give the water a cloudy or muddy aspect, usually occurs just before great shoals of a small fish called the capelan or caplin (*Mallotus villosus*) migrate in from the more notherly waters to spawn on the Finmark coast, after which they proceed in a general direction eastwards along the coasts of Finmarken and Murmansk as far as the White Sea, eventually turning northwards in the Barents Sea. Their appearance at the coast is a signal to the fishermen that the cod will soon appear, for they form an attraction for enormous numbers of larger fish, chiefly cod, haddock, coal-fish, and pollock, which pursue and devour them in great quantity. These shoals of cod and other fish are, however, not all of one origin, as Hjort has shown (1914, *loc. cit.*). To some large extent they are the immature cod of various ages and size which have followed the caplin from Arctic waters but these are joined by large numbers of spent "Skrei" which have spawned on the more southerly banks and which, since they feed little during spawning, have proceeded up the coast to intercept the caplin migration and "fatten up." The Finmarken fishing usually moves along the coast in an easterly direction as the caplin move along and the fish caught are chiefly mixed gadoids. One consequence of this is that mixed cod liver oils are frequently and indeed somewhat generally prepared along this littoral. The composition of these mixed oils is very variable but it would appear that those prepared in the early part of the season (June) in western Finmarken are mixed oils from cod, haddock, and coal-fish but with a strong preponderance of cod. Later in the season on the eastern grounds the proportion of haddock may become very high.

*Manufacture of cod liver oil.**

The general methods employed in the preparation of cod liver oil are well known (Möller, "Cod Liver Oil and Chemistry," London, 1895; Lewkowitsch, Vol. II., 5th edn., London, etc.).

Rotting process. There are few places in Norway where oil is still prepared to any appreciable extent from the fresh livers by the old rotting process, which was the general method of preparation prior to the introduction of the steaming methods in 1853 by Möller (Möller, "Cod Liver Oil and Chemistry"). Occasionally in the very small fishing hamlets where the supply of livers is not worth the introduction of modern methods this process may be seen in operation. The livers are thrown into large wooden vats as they are collected from time to time and allowed to rot for long periods, the oil rising to the surface as the liver tissue slowly disintegrates. In some cases the vats may remain for as long as 2—3 years before sufficient oil has been prepared or an opportunity to sell the oil arises. The oil yielded by this process is usually a clear golden-brown coloured product, the depth of colour being to a large extent dependent on the length of time the contents of the vat have been standing. It also tends to possess a rather objectionable odour owing to the presence of traces of products of putrefaction. As far as we could ascertain such oils are seldom if ever sold or refined for medicinal purposes, but are used for cattle oils, tanning, and the other uses of ordinary cod oils. We were especially interested to find survivals of this process because there appears to be a general impression prevalent in medical circles that the results of the therapeutic use of modern liver oils are less striking than those formerly obtained when the dark and "black" oils were used, for it must be remembered that cod liver oil achieved its reputation when no other than the products of the rotting process were available and that for some time the introduction of the white "steamed" oil was regarded with disfavour both by merchants and users.

---

* In the descriptions of the processes we have eliminated all details which may be regarded as confidential and have given only the broad outlines which are generally known.

It was impossible for us to ascertain the extent of destruction of the vitamin A during the preparation of a rotted oil, for the only samples we were able to obtain were many months old and represented a miscellaneous collection of livers throughout that period. The samples we tested for vitamin-A value showed that they were valuable sources of that factor, although there could be little doubt that long standing of the oil with a considerable surface exposed to air and light must have reduced the amount of vitamin. The rotted oils will be discussed in dealing with oils produced from rotted "Graxe."

"Steaming" processes. The introduction of a steaming process about 1850 revolutionised the cod liver oil industry, and to-day there are few factories which do not employ one or other modifications of this method.

Broadly these may be classified into those methods in which the oils are melted out in steam-jacketed pans and those in which the liver tissue is broken up by direct steam. Generally speaking there are more of the former type of plant in the Lofoten Island area, and it is sometimes spoken of as the Lofoten process. The direct steaming is on the other hand more frequently employed along the Finmarken coast. The two processes are widely used, and almost every village has one or more "Tranfabrik."

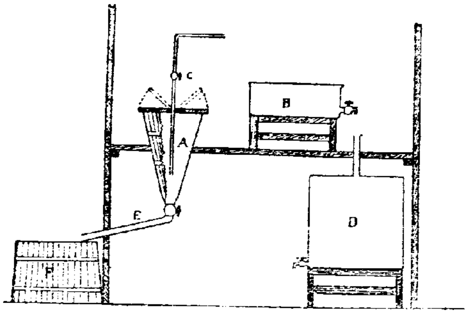
Steam-jacketed pan process or "Lofoten process." The fish, which are absolutely fresh and in fact usually alive when brought to shore, are gutted on the quay and the sound livers after stripping the gall bladders are placed in barrels. All discoloured or spotted livers are discarded. At the larger centres the guts and entrails are used for manufacture of fish guano, but where there is no facility for this they are thrown overboard. In the Lofoten Islands since the fish are then in spawn the roes are often collected and salted. The barrels of livers are taken to the factory and tipped into the jacketed vats, which are heated by low-pressure steam. When in the opinion of the operator the oil has separated satisfactorily the protein matter is removed by passing the liquid through a sieve ladle whilst the oil is kept warm and allowed to stand and separate. The product, which is a clear white oil, constitutes the first fraction and on cooling it tends to deposit crystals of "stearine." The residue is again heated and yields a second fraction of high-grade oil of slightly inferior taste, but this fraction is frequently mixed with the first. The hot residue is then usually allowed to drain through a number of cloth filtering bags hung up over a tinned gutter which collects the oil as it drops through. This oil, termed "posetran," is usually of a clear yellow colour and possesses a more pronounced taste owing probably to contact of the drops with air as they fall from the bags. This oil is sometimes mixed with the other two fractions, but more generally it is sold directly for cattle oil or industrial use. The residue from the filtering bags is termed "graxe" and is treated by one of three methods.

In some cases it is put back into the steam kettles and afterwards passed through a hand press which yields a dark yellow oil mainly used for technical purposes. The advantage of this method of treating the "graxe" is that it leaves a residue suitable for drying into a commercial liver meal for which there is now an increasing demand as a cattle food. The second method consists of heating the "graxe" over an open fire in pans with stirring, until all the water is driven off with the formation of a dark brown oil termed "brandttran."

More frequently, however, the graxe is thrown into vats outside the factory and allowed to rot for 2—3 months with the formation of a deep golden-brown oil which is skimmed from the top when enough has accumulated.

During the season a small factory will turn out 5000 litres daily.

The direct steam process. The general arrangement of this plant, which is usually of the simplest type, is shown in the accompanying figure. The handling of the fish is similar to that already described and the selected livers are thrown into the conical vat, A, until it is about three parts full. A simple lid hinged at its diameter and perforated to permit the steam pipe, C, to enter the vat, is then fastened down on the vat by means of clamps at the sides. Steam is then blown into the livers until they are in the opinion of the operator "cooked." The steam is turned off, the lid is opened, and the contents are allowed to stand, after which the deep layer of oil at the top is ladled off and poured through an unbleached linen filter to remove protein matter, into the tank, B. The protein remaining on the filter is thrown back into the vat. The crude oil in B is allowed to settle to allow the small amount of moisture and traces of protein to settle out, after which it is run into storage tanks, D. The liver pulp remaining behind in the vat is generally run off by means of the outlet, E, into rotting vats, F, outside the factory and there allowed to yield after some months the usual type of golden brown oil often termed "surtran." Sometimes in the better factories the pulp is subjected to pressure to yield the second grade of oil and the residue is dried for liver meal.



Other methods. In addition to the very many factories where these widely-employed methods are used there exist some in which the processes are highly elaborated and scientifically controlled and in which oils are carefully prepared under conditions (use of vacuum, atmosphere of carbon dioxide etc.) which protect against oxidation (*cf.* Harrison, Wild, and Robb, E.P. 25,683 of 1907; Heyerdahl, E.P. 137,514 of 1919).

Present trend of the manufacture of cod liver oil.

The production of high-grade marketable medicinal oils as free as far as possible from pigment and unpalatable constituents is the general aim of the manufacturers, but there is at present in certain cases a revival of the interest in the actual medicinal or therapeutic qualities of the oils.

The lack of knowledge as to what constituents of cod liver oil actually are responsible for its therapeutic value is reflected in the opinions of the manufacturers, of whom many accept what is perhaps the most general view, apart from modern vitamin theories, namely, that the high digestibility and absorbability of the cod liver oil together with the peculiar nature of the highly unsaturated fatty acid which it contains are the chief factors concerned. Accordingly it is found that one of the chief aims of the more progressive of these people is to protect their oil from oxidative changes, and their efforts in this direction may range from the simplest precautions up to the elaborate use of atmospheres of carbon dioxide and vacuum vessels referred to above. It is is also considered by the practical people that contact with air or oxidative change generally tends to impart an undesirable flavour and render the oil unpalatable.

Refining.

(1) *Crude oils.* As remarked above there is a somewhat general impression prevalent especially in medical circles that the dark brown cod liver oils are, or were at one time, more effective as therapeutic agents than the clear water-white oils, and one of the chief problems with which we were faced was to discover the actual truth on this matter. It is also a popular belief in many quarters that the "brown" oils represent the crude cod liver oil, the "real thing," and that the white oils offered for sale by the retailers are highly refined products obtained from the crude oils by processes analogous to those employed in the refining of a vegetable oil. Indeed it is not infrequent to hear it stated that the "white" oils have lost much of their medicinal value during the refining to which they have been subjected.

After personal examination of many factories and careful interrogation of many sources of information we came to the conclusion that very small and quite negligible quantities of crude "brown" oils are refined to produce medicinal oils. Several processes for this refining have at one time or another been put forward in patents, but as far as we are aware none has proved of any commercial value on a large scale. The removal of free acid by the usual method would scarcely be likely to reduce the vitamin value of the oil, but all bleaching processes for reducing pigmentation which are based on oxidative changes, ozone, chlorine, sunlight, and aeration would be harmful. Such processes were also condemned years ago by Möller (*op. cit.*) on the grounds that they spoilt the flavour and palatability of the oils.

(2) *Medicinal oils.* The medicinal oils prepared in Lofoten, Finmarken, and other zones are usually bought in bulk and brought south to the larger town such as Bergen for the final refining processes. This refining essentially consists of freezing to effect removal of stearine, and in some cases the removal of a certain amount of pigment by mixing with an adsorbent and passing through a filter-press. The refining is practically always done the same year that the oil has been prepared and oils with a tendency to a high acid value are seldom if ever touched by the better class refineries.

The crystallisation of "stearine" is usually carried out in tanks at low temperature (0° to −10° C.) and the oil is then passed through filter-presses, to yield the first-grade oil, which is run off into storage tanks from which are filled the metal-lined barrels in which it goes to market. The residue from the filter presses may or may not be expressed under pressure to yield a second-grade medicinal oil, which is usually handled separately. The stearine is sold largely for technical use and varies in its content of oil a great deal with the different factories.

The highest grades of oil find the best market in England, whereas the lower grades not only sell well in Germany and France but actually appear to be preferred there, especially in the former country where a marked yellow colour is favoured.

Influence of processes on vitamin value of liver oils.

The difficulty of investigating satisfactorily this problem was considerable because of the variations in the vitamin value of the liver oils which occur naturally. As we have shown (Biochem. J., 1922, **16**), the food of the cod is responsible for the presence of vitamin A in the liver oils, its ultimate origin being the unicellular marine plants, diatoms, etc. (Jameson, Drummond, and Coward, Biochem. J., 1922, **16**, in the press).

Some variations in the vitamin value of liver oils may be traced to differences in the food supply, but also we are considering the view that to some extent the variations are associated with definite physiological changes in the tissues of the fish at the different seasons. We hope before long to be able to publish more fully our views on this important question. In view of this difficulty we have only been able to study the effect of the processes with accuracy when it has been possible to obtain samples of the same preparation before and after they have been treated.

We have throughout employed the technique described by Zilva and Miura (Biochem. J., 1921, 15, 654) for the quantitative estimation of the vitamin A in oils. This method is capable of yielding results of considerable accuracy in the hands of skilled workers, and during the whole course of this work the results obtained independently in our two laboratories on the same sample of oils have shown remarkably close agreement.

(a) "*Rotted*" *oils.* It was of course impossible to estimate the extent of destruction of vitamin A which had occurred during the preparation of the samples of these oils which we investigated, for we had no means of judging what was the potency of the oil in the original fresh livers. The alternative was to compare the value of these "rotted" oils with average oils prepared by the "steaming" process in the same locality. The results are given below; the dosage is that which just gives marked growth in a test animal (rat) of approximately 100 grams weight.

Sample.	Origin.	Locality.	Growth dosage in mg.
K_1 raw oil	Rotting of "graxe" after steaming out 1st fraction.	Finmarken	5
H_2 surtran	Do. Do.	Do.	2–3
H_{11} Do.	Do. Do.	Do.	3
N_4 Do.	Rotting of "graxe."	Do.	3
L_1 rotted	Rotting of fresh livers.	Lofoten	20

These values are all well within the limits we have found for oils prepared in these localities by the steaming process, so that although the exposure to air and sunlight must to some extent destroy vitamin A in the rotted oils the amount of inactivation is not as serious as we had expected to find.

(b) "*Steamed*" *oils.* From a consideration of the steaming processes as we saw them in Norway we formed the opinion that very little destruction of vitamin A would take place in the extraction of the oils from the livers. This opinion was borne out by the results of our experimental tests, in that oils prepared with the greatest care in the laboratory in an atmosphere of carbon dioxide as well as those prepared commercially by similar methods were not appreciably superior to oils prepared at the same time and from similar livers by the "Lofoten," or steam-jacketed pan method.

Sample.	Origin.	Locality.	Growth dosage in mg.
L_4	Steam-prepared oil, May, 1921	Lofoten	20
L_5	Steam-prepared oil, 2nd fraction, May, 1921.	„	Approx. 20
L_6	Oil prepared in CO_2 in laboratory, May, 1921.	„	15–20
L_7	Commercial oil prepared in CO_2, 1921 season.	„	15
L_8	Do. Do.	„	15

At one station in the Finmarken area, there were two factories in close proximity one of which employed the steam-jacketed pans and the other direct steam. Arrangements were made, therefore, for batches of oil to be made at the same time from similar batches of fish (mainly cod, but also coal-fish and haddock) by the two processes. The results of the tests on these oils was as follows:

Sample.	Origin.	Locality.	Growth dosage in mg.
K_1	Direct steam, June, 1921, unfiltered.	Finmarken	5
K_2	Ditto, filtered.	„	5
K_{10}	Jacketed-pan, June, 1921, unfiltered.	„	3–4
K_{11}	Ditto, filtered.	„	3–4

These figures appear to indicate that the steam-jacketed pan may be slightly the better method for preserving the vitamin, although it is questionable whether the differences are outside the range of experimental error.

(c) "*Posetran.*" As described above, the second fraction of the oils prepared by the Lofoten process is termed "posetran." The preparation of this fraction, although it involves slow passage of the oil drop by drop from the bags, does not appear to cause appreciable loss of vitamin. Several samples of posetran had approximately the same growth-promoting power as that of the first fractions.

Sample.	Origin.	Locality.	Growth dosage in mg.
K_{20}	Lofoten process	Kjelsvik (Finmarken)	3–4
K_{21}	Posetran of K_{20}	„	2–3
K_{22}	Haddock oil, Lofoten process	„	10
K_{24}	Posetran of K_{21}	„	10

(d) *Refined oils.* The influence of freezing out the "stearine" on the vitamin value would appear to be almost negligible from our studies of the growth-promoting potency of oils before and after being subjected to that process. This is more or less what would be expected from the nature of the process. The following experiments refer to a typical Lofoten oil refined at Bergen:

Sample.	Origin.	Growth dosage in mg.
B 1	Before any treatment	15–20
B 2	After freezing..	15–20
B 3	Refined, non-freezing	15–20

(e) "*Stearine.*" Different refiners of cod liver oil remove the "stearine" to different extents, or rather some press the "stearine" until a comparatively hard product is produced whilst others send it on to the market in a semi-liquid form. We have tested several samples of cod liver oil "stearine" and find that it may be a valuable source of vitamin A. A daily dose of 0·1 g. will usually give better growth than an equal amount of an average sample of dairy butter, so that the present practice of using the stearine for technical uses would appear to be wasteful. From a scientific standpoint it is difficult to understand why the removal of the "stearine" is insisted on by many authorities. Professor E. Mellanby has informed us that some two years ago he observed the high value of cod liver oil "stearine" in the prevention and cure of experimental rickets in dogs. This result has not been published but is confirmed by our results.

Conclusion.

From our exhaustive investigations of the effect of the modern processes of the preparation of cod liver oil on its vitamin value we have formed the opinion that the "steaming" methods yield oils of as high, if not actually higher potency than were yielded by the old and almost extinct "rotting" process.

Further, the modern methods of refining, if we exclude, as we justly may, the almost negligible amount of bleaching of dark oils which occurs, scarcely affect the vitamin value at all.

In the light of these observations it is obvious either that the popular belief that the "dark" oils are more valuable as medicinal products than the modern "white" oils is erroneous or that such belief arose at a time when some actual difference existed. To this we will return in a later paper.

There is no doubt that fairly wide variations in the vitamin content of liver oils do occur, and we believe that these variations are a reflection of changes in the diet or the physiological state of the fish at different seasons. Our information is as yet insufficient for us to advance our views on this matter, but we hope before long to present evidence which will throw considerable light on these changes.

The trend of modern methods of liver oil preparation is all in the direction of the exclusion of oxidative changes, chiefly on the grounds of improving flavour and palatability. Fortunately, these aims are just those which will tend to improve the vitamin value of the oil, although even now very little loss appears to take place, as far as the methods of testing at our disposal can detect. The introduction of any methods for bleaching or refining liver oils intended for medicinal use which involve oxidative changes are strongly to be deprecated. On the other hand, from a purely scientific standpoint there appear to be no adequate reasons why cod liver oils should not be mixed with oils from other fish livers. Indeed, we have found the oil from the coal fish (*Gadus virens*) to be usually markedly richer in vitamin A than the average samples of cod liver oil (Zilva and Drummond, Lancet, 1921, 2, 753; also Lancet, 1922). Further, from the same standpoint it would appear unnecessary to remove the "stearine" as is now done in the better quality oils. If, however, there are technical or other considerations which make the removal advisable, it seems a pity that so valuable a source of the vitamin should be used for technical and non-dietetic use.

In conclusion we wish to express our deep appreciation of the great hospitality and kindness extended to us throughout our visit to the Norwegian fishing grounds. In particular we would like to thank Prof. J. Hjort, F.R.S., and Prof. Axel Holst for valuable information concerning the life history of the cod, and Mr. Fredricksen and Mr. T. Lexow, of Melbö, Vesteraalen, Consul Robertson of Hammerfest, and Mr. Bruhn of Kjelvik, Magerö, for the untiring assistance they so readily gave us in studying the technical side of the problem.

We also desire to thank the Medical Research Council for a financial grant which enabled this visit to be made and covered the cost of the later experimental work.

THE DETERMINATION OF SMALL QUANTITIES OF SILICA IN THORIUM NITRATE.

BY H. V. HODGSON.

It has long been known that if the ash content (consisting of silica and silicate of iron) of the fabric used for the manufacture of incandescence gas mantles exceeds about 0·02%, the finished mantles are unduly brittle. It does not, however, appear to be generally known that a still lower percentage of silica in the thorium nitrate produces a similar effect, which is particularly noticeable and undesirable in those mantles where considerable flexibility is required.

The absence of any mention of this in the literature on gas mantle manufacture and the rare earths, and the fact that on both theoretical and practical grounds silica should not be present—especially in a soluble form—are doubtless the reasons why silica is not included in the list of possible impurities in technical thorium nitrate, and why, therefore, no method appears to have been devised for its detection and determination. It is rather remarkable that heating the nitrate to 150° C. does not render the silica insoluble, but conversion to the chloride—a somewhat tedious process—does so, and at a considerably lower temperature.

The brittleness of the mantles made from some thorium nitrate, which the author tested recently, was found to be due to the presence in the latter of silica, and the following method was devised and successfully used for its determination.

Fifty grams of thorium nitrate is dissolved in 150 c.c. of distilled water, and precipitated by the addition of 30 g. of pure oxalic acid dissolved in about 150 c.c. of hot distilled water. The precipitated thorium oxalate is well shaken or stirred and allowed to stand for several hours, preferably overnight. It is then filtered off and well washed with hot distilled water. The filtrate is evaporated to dryness, the excess of oxalic acid sublimed, and the residue heated nearly to dull redness. When cool, 4 or 5·c.c. of pure hydrochloric acid is added and about the same amount of distilled water, and the whole boiled till all that is soluble has dissolved. It is then diluted with hot distilled water, filtered, and washed. The filter paper and contents are ignited and weighed in a platinum crucible. The residue should be white or only faintly tinged with a trace of iron from the filter paper. It is treated with about 2 c.c. of pure hydrofluoric acid solution and a drop or two of sulphuric acid, evaporated to dryness, ignited, and the crucible again weighed, the loss representing silica.

To test the accuracy of the method, 50 g. of thorium nitrate free from silica was dissolved in distilled water, and to the solution was added 10 mg. of silica as a dilute solution of sodium silicate, so that no precipitation occurred. The whole was well stirred, evaporated to dryness on a water-bath, and when cool, the nitrate was dissolved and the silica determined by the foregoing method. The whole of it was recovered. The test was repeated, but with the difference that the nitrate was finally heated between 150° and 155° C. for 20 minutes. Again the whole of the silica was recovered.

In order to determine whether any silica was obtained from the oxalic acid or the vessels used, 30 g. of the acid was dissolved in distilled water, a few c.c. of pure nitric acid added, the whole evaporated to dryness, and the oxalic acid sublimed. The very slight residue left was then treated as above. This test was made several times, but the largest amount of silica obtained did not exceed 1 mg.

Vol. XLI., No. 16.] TRANSACTIONS [August 31, 1922.

Communications.

NITRIC ACID ABSORPTION TOWERS.

BY J. A. HALL, A. JAQUES, AND M. S. LESLIE.

The construction of towers for the absorption and conversion into nitric acid of useful concentration, of nitrous fumes from nitric acid stills, or from plant for the denitration of waste acids obtained n the manufacture of explosives, has been generally viewed in the past as primarily an engineering problem, and little regard has been paid to chemical factors such as the nature, concentration, and speed of the gases entering the towers. Although repeated trial may sometimes have produced designs highly efficient in the case of one particular set of conditions, these offered very little guide as to the changes to be introduced when the conditions differed to any considerable extent.

It was suggested by one of us that by a careful study of the rate of reaction of the gases in any given set of absorbing towers, and of the influence upon it of the velocity and composition of the gases and the rate of flow and concentration of the absorbing liquid, it might be possible to formulate a mathematical scheme by which the best conditions for the efficient treatment of any nitrous fumes whatsoever might be calculated. This was accomplished as the result of experimental work carried out in 1916 at H.M. Factory, Litherland, a formula being arrived at which reproduces the experimental results over a wide range of conditions. Certain assumptions were made in order to arrive at the formula, but it is not claimed that the experimental work proves the truth of these. The formula is merely put forward as an empirical guide for the sign of absorption towers.

Since the work was carried out a paper on the ubject by J. R. Partington and L. H. Parker (J., 919, 75 T) has appeared. These authors have alculated absorption coefficients for different conentrations of nitric acid in the absorbing liquid nd of nitrogen peroxide in the gas on the assumpion that, in general, sufficient empty spaces are rovided for oxidation. This treatment, whilst no oubt satisfactory for the average case of fumes rom a nitric acid plant, does not give any idea of he best distribution of packed and unpacked space nd of the optimum ratio between them—matters which become important in the case of very dilute cases or gases containing a low proportion of oxygen. As our work covers these points it was hought worth while to record it.

It was assumed that the whole reaction in the towers might be divided, for the purpose of the nvestigation, into two processes, one an absorption process the net result of which, whatever its mechanism, may be expressed by the equation

$$3NO_2+H_2O=2HNO_3+NO$$

(see Burdick and Freed, J. Amer. Chem. Soc., 1921, 43, 518), and the other an oxidation process whereby more nitrogen peroxide is produced ready for further absorption, namely,

$$2NO+O_2=2NO_2.$$

Absorption takes place in the towers themselves, in which is placed packing, such as pieces of quartz or pumice, earthenware rings, or anything else by which the water or nitric acid trickling over may be made to expose a large surface to the current of gas. Only oxidation can occur in the connecting pipes between the towers or in those parts of the towers left unpacked.

The plan followed was to establish an equation for each of the two processes in terms of quantities of reacting materials, velocity of gas, speed of flow of water, space traversed, and so on, and then from these two to develop a third which should express the relationship between the volumes of the absorption and oxidation spaces required for the most efficient absorption.

Absorption equation.—It is perhaps necessary to say something further in justification of the equation

$$3NO_2+H_2O=2HNO_3+NO.$$

It is probable that nitrous acid is one of the first products of the reaction

$$2NO_2+H_2O=HNO_3+HNO_2.$$

Some work carried out by Rây, Dey, and Ghosh (J. Chem. Soc., 1917, 111, 413, seems to indicate that the decomposition of nitrous acid according to the equation

$$3HNO_2=HNO_3+H_2O+2NO$$

is rather slow. On the other hand, Knox and Reid (J., 1919, 105 T) have shown that the rate of decomposition varies very greatly with conditions, and that agitation and exposure of a large surface of solution to air as in the case of absorbing towers, or even to an inert gas, greatly increases the rate of decomposition. The conclusion that the decomposition in the towers is very rapid is borne out by the fact that, under normal conditions, when the concentration of nitric acid issuing from the several towers may be anything up to 65%, the concentration of nitrous acid never exceeds 0·4—0·5%. The rate of absorption may therefore be measured by the rate of production of nitric acid.

It was assumed that, within the range of the experiments to be described, absorption depended on the partial pressure of the gas reckoned as NO_2 molecules. No account was taken of association to N_2O_4 molecules. This seemed to be justified both by later experimental results and also by the following consideration. Suppose that, instead of $2nNO_2$ we have nN_2O_4, then the rate at which molecules are absorbed by water in the first case will be twice the rate in the second, but in the second case each molecule contains twice as much nitrogen peroxide as in the first, so that the net result will be the same.

It was necessary to determine experimentally how the rate of reaction depended upon the flow of liquid. For this and later experiments a set of eight towers connected in series with the fume main from nitric acid stills was employed. Each tower consisted of four plain sections of earthenware pipe two feet six inches in diameter and about two feet six inches long, and sections at the top and bottom having junctions for the connecting pipes nine inches in diameter. A perforated tray was placed at the base of each section, and each plain section was packed two-thirds full of three-inch pumice. The gas was sucked from the nitric acid plant through a stoneware fan before being introduced into the towers, and a second fan was placed in series after the fourth tower, the towers being numbered from 1 to 8 in the direction of flow of the gas. Water was introduced at the top of number 8 tower, the absorption being carried out on the countercurrent principle, and the outflow from each tower was led into a movable tipping box with two outlets through which it could be delivered to either of two Pohle elevators. One of these raised the acid to the top of the same tower, and the other to the top of the following tower.

It may reasonably be supposed that the gases from nitric acid stills produced by the decomposition of sodium nitrate or of nitric acid consist almost entirely of nitrogen peroxide together with sufficient oxygen to reoxidise it to nitric acid. Air is drawn in through leakages in the pipework, and in our experiments the fumes formed 20—30% of the gases passing into the towers.

In the preliminary experiments to ascertain the effect of variation in the rate of flow of absorbing liquid no liquid was passed through towers 1—4, so that these acted as a condensing space for nitric acid vapour. Very little acid condensed in No. 1 tower, and none in the succeeding ones. A separate flow of water was arranged through each of the towers 5, 6, 7, and 8, and the gases were passed through these successively. A special constant-head apparatus was arranged so as to ensure a constant flow of water into each tower. The strength of the issuing acid was determined in each case by measuring its specific gravity.

From the speed of flow of water and the strength of the acid, the quantity of actual nitric acid formed per minute was calculated. This became successively smaller as the gas passed along the towers, the flow of water being approximately the same in all the four towers. The effect of altering the speed of flow was studied in succeeding experiments.

If a be the partial pressure of nitrogen peroxide in the gas, and f the average flow of water in litres per square foot of cross-section per minute, we assume that the speed of production of nitric acid per tower may be expressed by the equation—

$$-da/dt = k\,a^x f^y$$

The value of x was assumed to be 1. Integrating between 0 and t we have

$$\log_e a_0 - \log_e a_t = k f^y t$$

where a_0 and a_t are the partial pressures of nitrogen peroxide in the gases entering and leaving the towers respectively. For a constant rate of flow of gas t is constant. Thus the value of y can be calculated from two pairs of values of a_0, a_t, and f. The values of y were calculated for the first tower only, in order to eliminate the error due to neglect of the effect of oxidation of nitric oxide. It will be proved later that this is negligible under these conditions.

The nitric acid output for the remaining towers was determined in order to ascertain the total amount of gas absorbed, and also to afford a basis for the necessary extrapolation by means of which the value of z, the quantity of gas escaping, was estimated. This extrapolation was carried out by plotting strength of issuing acid against the number of the tower. The quantity z was added to the total quantity of gas absorbed in order to obtain a_0; a_0, a_t, and z were all expressed in kilograms of nitric acid formed per minute. The results are contained in Table I, and indicate that, within the limits of the experiments, the rate of absorption of nitrogen peroxide is very nearly proportional to the square root of the rate of inflow of water.

TABLE I.

Experiment.	Tower.	Flow of water in litres per sq. ft. per min.	HNO_3 formed in kg. per min.	a_t
1	5	0·437	0·64	
	6	0·555	0·40	
	7	0·581	0·24	
	8	0·581	0·12	
			Total .. 1·40	
			z = 0·17	
			1·57 = a_0	0·93
2	5	1·316	1·03	
	6	0·581	0·31	
	7	0·539	0·16	
	8	0·581	0·09	
			Total .. 1·59	
			z = 0·17	
			1·76 = a_0	0·73
3	5	0·306	0·71	
	6	1·454	0·76	
	7	0·539	0·27	
	8	0·437	0·14	
			Total .. 1·88	
			z = 0·26	
			2·14 = a_0	1·43

From 1 and 2, y=0·47.
From 2 and 3, y=0·54.
In subsequent calculations y was taken as 0·5.

The towers were next put into actual use, and for the purpose of the following experiments the liquid was caused to pass through each tower in succession, that is, from No. 8 to No. 1, without circulation. When the system had reached a steady state the strength of the acid issuing from each tower was determined by measuring its density. In most experiments the steady state was maintained for three hours. The quantity of nitrous acid in the liquid was very small when the sp. gr. was less than 1·4.

Considerable quantities of chlorine or nitrosyl chloride were evolved. The question of the distribution of chlorine in the towers will be discussed later. In the absorbing liquid it appeared to be present mainly as hydrochloric acid, in variable quantity. A typical example of its distribution is given in Table V. The chlorine was not all present as hydrochloric acid, and on account of this fact and the variability of the chlorine content during each experiment, it was considered that a certain error in the strengths of the acid issuing from the last three towers must be accepted. This affects the distribution of output from the towers, but not the total output. As an approximation, the sp. gr. of the liquid was corrected in each case by subtracting from it an amount equal to $d-1$, where d represents the sp. gr. of an average equivalent aqueous solution of hydrochloric acid. Control experiments showed that, so far as the hydrochloric acid content was concerned, this method of calculation is satisfactory, the following results being obtained:—

Percentage.		Sp. gr. of mixture.	Sp. gr. of hydrochloric acid of this concentration.	Calculated sp. gr. of nitric acid.	Calculated concentration of nitric acid.
HNO_3.	HCl.				
38·8	3·67	1·261	1·018	1·243	38·8
34·7	6·58	1·248	1·032	1·216	34·8
25·4	6·24	1·187	1·031	1·156	25·8
21·3	10·68	1·183	1·053	1·130	21·7
17·2	6·87	1·139	1·033	1·103	17·5

The velocity of the gas current was measured by means of Pitôt tubes.

The results of some of these experiments on the output of nitric acid are contained in Table II.

The rate of reaction of the nitrogen peroxide with the absorbing liquid is probably determined in practice by the rate at which the gas can reach the surface of the liquid, and may therefore be expected to depend simply upon the partial pressure of nitrogen peroxide in the gas. It may, therefore, be expressed provisionally by the equation

$$dy/dt = k_1\left(\frac{m}{v} - y\right)\sqrt{f}\cdot k_t \quad \ldots\ldots\ldots\ldots\ldots(1)$$

where m is the mass of nitrogen peroxide expressed in kg. of equivalent nitric acid contained in volume v cub. ft.; y is the diminution in concentration of nitrogen peroxide during time t minutes, k_1 is the speed constant for absorption for the particular absorbing material contained in the tower; f is the

TABLE II.

EXPERIMENT 1. t = 180 min.

Tower.	In-flow.				Out-flow.				HNO₃ formed.
	Kg.	Litres.	% HNO_3.	% N_2O_5.	Kg.	Litres.	% HNO_3.	% N_2O_5.	Kg.
1	418·0	302·2	62·0	53·1	454·7	323·8	66·4	56·9	42·9
2	369·2	274·6	54·7	46·9	418·0	302·2	62·0	53·1	57·2
3	311·6	245·0	43·3	37·1	369·2	274·6	54·7	46·9	67·0
4	284·5	232·0	36·2	31·1	311·6	245·0	43·3	37·1	31·9
5	252·0	217·7	25·9	22·2	284·5	232·0	36·2	31·1	37·7
6	231·5	209·5	17·9	15·3	252·0	217·7	25·9	22·2	23·8
7	218·5	204·6	12·0	10·3	231·5	209·5	17·9	15·3	15·2
8	196	196	0	0	218·5	204·6	12·0	10·3	26·2
									301·9
									z = 10·1
									312·0

EXPERIMENT 2. t = 180 min.

Tower.	In-flow.				Out-flow.				HNO₃ formed.
	Kg.	Litres.	% HNO_3.	% N_2O_5.	Kg.	Litres.	% HNO_3.	% N_2O_5.	Kg.
1	297·7	231·6	46·8	40·2	349·0	258·8	57·2	49·0	60·3
2	249·6	206·6	33·5	28·7	297·7	231·6	46·8	40·2	55·7
3	231·2	198·7	26·8	23·0	249·6	206·6	33·5	28·7	21·7
4	220·0	194·0	22·3	19·1	231·2	198·7	26·8	23·0	12·9
5	208·7	189·7	17·1	14·7	220·0	194·0	22·3	19·1	13·4
6	202·2	187·3	13·9	12·0	208·7	189·7	17·1	14·7	7·6
7	191·6	183·2	8·3	7·1	202·2	187·3	13·9	12·0	12·2
8	178	178	0	0	191·6	183·2	8·3	7·1	15·9
									199·7
									z = 5·3
									205·0

EXPERIMENT 3. t = 240 min.

Tower.	In-flow.				Out-flow.				HNO₃ formed.
	Kg.	Litres.	% HNO_3.	% N_2O_5.	Kg.	Litres.	% HNO_3.	% N_2O_5.	Kg.
1	473·5	343·4	63·3	54·3	535·6	380·5	69·6	59·6	73·2
2	427·7	314·3	57·7	49·4	473·5	343·4	63·3	54·3	53·0
3	360·1	278·3	46·5	39·9	427·7	314·3	57·7	49·4	79·4
4	317·8	258·4	37·2	31·9	360·1	278·3	46·5	39·9	49·2
5	269·1	236·8	22·9	19·6	317·8	258·4	37·2	31·9	56·6
6	249·6	228·8	15·7	13·3	269·1	236·8	22·9	19·6	22·4
7	236·8	224·0	10·1	8·6	249·6	228·8	15·7	13·3	15·3
8	216·4	216·4	0	0	236·8	224·0	10·1	8·6	23·9
									373·0
									z = 9·0
									382·0

EXPERIMENT 6. t = 180 min.

Tower.	In-flow.				Out-flow.				HNO₃ formed.
	Kg.	Litres.	% HNO_3.	% N_2O_5.	Kg.	Litres.	% HNO_3.	% N_2O_5.	Kg.
1	428·0	331·0	46·5	39·9	514·3	377·4	58·2	50·0	100·3
2	365·8	301·1	34·6	29·7	428·0	331·0	46·5	39·9	72·4
3	337·6	288·6	27·7	23·8	365·8	301·1	34·6	29·7	33·1
4	324·8	283·4	24·3	20·8	337·6	288·6	27·7	23·8	14·6
5	308·0	276·6	19·3	16·5	324·8	283·4	24·3	20·8	19·5
6	295·7	271·7	14·2	13·0	308·0	276·6	19·3	16·5	17·5
7	273·9	264·0	7·0	6·1	295·7	271·7	14·2	13·0	22·8
8	257·2	257·2	0	0	273·9	264·0	7·0	6·1	19·2
									299·4
									z = 10·6
									310·0

rate of flow of the liquid expressed in litres per square foot per minute; and k_f is a constant depending upon the units in which the flow is expressed.

By integrating equation (1) between 0 and t we get as the total change in concentration of nitrogen peroxide during a time t minutes—

$$y=\frac{m}{v}\left(1-e^{-k_1 t/f^{\frac{1}{2}} k_f}\right) \dots\dots\dots\dots (2)$$

Since the gas is flowing through the tower at a definite velocity of, say, V cub. ft. per minute, time may be expressed in terms of volume of absorbing space and velocity of gas through the towers. Let σ_y be the total packed space through which the reaction takes place, then the free space will be $k_c\,.\,\sigma_y$ where k_c is a constant depending upon the structure of the packing and $t=k_c\,\sigma_y/V$.

Thus equation (2) becomes

$$y=\frac{m}{v}\left(1-e^{-k_1 k_f/f^{\frac{1}{2}} k_c \sigma_y/V}\right) \dots\dots\dots\dots\dots (3)$$

The product $k_1\,k_f\,k_c=K_1$ which is the absorption coefficient for a liquid of definite concentration flowing at the rate of 1 litre per square foot per minute through a definite kind of packing.

Instead of expressing nitrogen peroxide in terms of concentration, we may consider the absolute quantities passing through the space σ_y in a definite time T, and put $Y=VTy$ and $P=VTm/v$. That is, P is the total amount of nitrogen peroxide entering a given space σ during time T minutes, and Y is the total amount of nitrogen peroxide reacting with the liquid in the space σ_y during the time T. Two-thirds of this is transformed into nitric acid and one-third into nitric oxide. In each case the quantity of gas is expressed in terms of equivalent kilograms of nitric acid. Equation (3) therefore becomes:—

$$Y=P\left(1-e^{-K_1\sigma_y/V.f^{\frac{1}{2}}}\right) \dots\dots\dots\dots\dots\dots (4)$$

The values of Y, P, σ_y, V, and f may be obtained from Tables I and II, and from these the values of the absorption coefficient K_1 determined for different concentrations of nitric acid and for water. The values of K_1 are derived from the amount of absorption taking place in the first tower only, and the oxidation in it is ignored. Table III shows the values of K_1 obtained in this way for acids of various concentrations.

TABLE III.

Average concentration % HNO_3 in absorption space	7	12·5	17	51·5	51·5	63·5	64·0	66·0
K_1	6·0	5·2	3·7	1·2	3·9	0·6	1·4	2·3
Temp. of outflowing liquid in ° C. ..	32·5	29·5	36	24·5	28·5	26·7	28·0	23·5
Table	I.	I.	I.	(II.)	II.	(II.)	II.	II.
Experiment ..	2	1	3	4*	2	5*	1	3

* Not shown in Table II.

There are considerable irregularities in the results, no doubt due to the impossibility of maintaining absolutely constant conditions, such as temperature, and due also, as will be shown later, to the presence of chlorine in the gases. With the help of these values, however, and the fact that, as Foerster and Koch (Z. angew. Chem., 1908, 21, 2161) have pointed out, the rate of absorption of nitrogen peroxide by nitric acid becomes very small when the concentration of the acid rises above 65%, and apparently ceases altogether at 69%, a curve showing the general order of magnitude of K_1 for any concentration of acid may be drawn (see Fig. 1).

Oxidation equation.—The equation $2NO+O_2=2NO_2$ represents a termolecular reaction. That the oxidation approximates very closely to such a reaction for concentrations of nitric oxide from 0 to 20% by volume has been shown by Lunge and Berl (Z. angew. Chem., 1906, 19, 807; 1907, 20, 2074). Their results were confirmed by Bodenstein (angew. Chem., 1909, 22, 1153). The rate of oxidation may therefore be expressed in the form

$$\frac{dx}{dt}=K_2\left(\frac{m}{v}-x\right)^2\left(\frac{m'}{v}-x\right) \dots\dots (5)$$

where K_2 is the oxidation constant; v the volum in cubic feet containing a mass m of nitric oxid

K_1 for flow of 1 litre per sq. ft. per min.

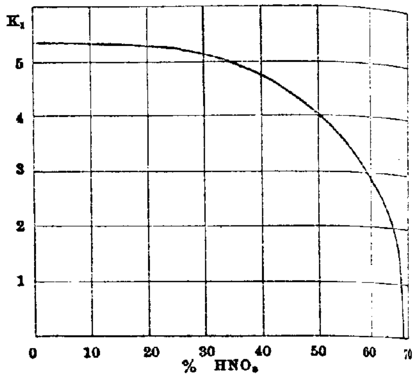


Fig. 1.

and a mass m' of oxygen *both expressed as kg.* *equivalent nitric acid*; and x the change in equivalent concentration of nitric oxide and of oxyge after time t.

Integrating between 0 and t we obtain

$$K_2=\frac{1}{t}\frac{1}{\left(\frac{m}{v}-\frac{m'}{v}\right)^2}\left\{\log_e\frac{\frac{m'}{v}\left(\frac{m}{v}-x\right)}{\frac{m}{v}\left(\frac{m'}{v}-x\right)}-\frac{\left(\frac{m}{v}-\frac{m'}{v}\right)}{\left(\frac{m}{v}-x\right)\frac{m}{v}}\right.$$

By converting Lunge and Berl's values in equivalent kg. of nitric acid the value of I in the required units was found. Their experimen were carried out at constant pressure, and th introduces complications in the change in co centration during the reaction, owing to shrinka of the system as the oxygen disappears. To obvia this difficulty the calculation was always ma between pairs of successive values, and the volu of the system in each case was taken as its volu at the beginning of the reaction interval. T values of K_2 calculated by this method from Lun and Berl's experimental results are shown Table IV.

TABLE IV

Reaction mixture: 125 c.c. NO, 500 c.c. air. Temp. 20° C.

Time in min.	Percentage of original NO.		K_2
	Converted.	Unconverted.	
0	0	100	128,000
$\frac{1·76}{60}$	52·49	47·51	114,150
$\frac{2·64}{60}$	61·33	38·67	
$\frac{3·96}{60}$	69·05	30·95	123,400
$\frac{7·92}{60}$	80·56	19·44	76,260
$\frac{13·78}{60}$	85·28	14·72	96,000
$\frac{29·92}{60}$	91·77	8·23	

The experimental data contained in this table ere also plotted, the values of dx/dt obtained raphically, and the value of K_3 calculated from his and the concentrations. In the case of the rst pair (t=0 to t=1·76÷60 minutes), the value ound was 112,700, agreeing substantially with the bove. The value of K_3 in round figures was taken s 100,000.

In many practical cases the concentration of the xygen is such that its changes are negligible comared with changes of nitric oxide concentration xtending through a considerable range, a fact hich admits of an important simplification in the quation, for, writing the differential equation

$$\frac{dx}{dt} = K_3\left(\frac{m}{v} - x\right)^2 [O_2] \;\ldots\ldots\ldots\ldots\ldots\ldots \quad (7)$$

here $[O_2]$ is the average oxygen concentration uring the time t, and integrating between 0 and t e obtain

$$\frac{x}{\frac{m}{v} - x} = \frac{m}{v} K_3 [O_2]\, t \;\ldots\ldots\ldots\ldots\ldots\ldots \quad (8)$$

f σ_x is the empty oxidation space and V the elocity of gas

$$t = \frac{\sigma_x}{V}$$

$$\therefore \frac{x}{\frac{m}{v} - x} = \frac{m}{v} K_3 [O_2] \; \frac{\sigma_x}{V} \ldots\ldots \quad (9)$$

Converting concentrations into absolute quantities, s in the absorption equation, we may put X= Tx and Q=VT$m/v$, where X is the total quantity xidised in the space σ_x and Q the total quantity ntering the space σ_x during the time T.

$$\therefore \frac{X/VT}{(Q-X)/VT} = \frac{Q}{VT} K_2[O_2] \; \frac{\sigma_x}{V}$$

Hence

$$\frac{X}{Q-X} = \frac{Q}{V^2T} K_2[O_2]\, \sigma_x$$

$$i.e., \qquad X = \frac{Q^2K_3\,[O_2]\,\sigma_x}{V^2T + QK_3[O_2]\sigma_x} \ldots\ldots \quad (10)$$

The product $K_3[O_2]$ may be regarded as a single onstant which will, of course, have a different alue for different average oxygen concentrations.

It has been found by several investigators that he velocity of oxidation of nitric oxide has a small egative temperature coefficient (Bodenstein, *loc. cit.*, also Z. Elektrochem., 1918, 24, 183, and Z. ngew Chem., 1918, 31, 145; Briner and Fridoeri, Helv. Chim. Acta, 1918, 1, 181; J. Chem. Soc., 918, 114, ii., 302; Wourtzel, Comptes rend., 920, 170, 229). Since, therefore, both the rate of xidation of nitric oxide and, probably, the rate of bsorption of nitrogen peroxide (Foerster and Koch, *loc. cit.*) are increased by lowering of temperature, it is evident that the gases should be cooled as much as possible before entering the towers. This is advisable also on another ground, namely, the liability to evaporation of the nitric acid solution by the passage of a strong current of air through it.

Relationship between oxidation space σ_x and bsorption space σ_y.—As the gas passes through a ertain portion of absorption space σ_y, it will become poorer in nitrogen peroxide and richer in nitric oxide, that is, at a certain point it will become more economical in space to stop absorption and allow oxidation alone to take place. To determine the exact ideal relationship between σ_x and σ_y would probably be rather difficult, but we cannot be far from the optimum condition if we regard xidation as equivalent in value to absorption and hoose such values as will make the ratio of oxidation and absorption with respect to space equal, that is,

$$\frac{dX}{d\sigma_x} = \frac{dY}{d\sigma_y}$$

It is evident that any considerable departure from this state of affairs would result in waste of space through devoting it to a slow process.

Differentiating equations (4) and (10) we get

$$\frac{dY}{d\sigma_y} = P\frac{K_1 ft}{V}\, e^{-K_1\sigma_y ft/V} \qquad \ldots\ldots(11)$$

$$\text{and} \quad \frac{dX}{d\sigma_x} = \frac{Q^2K_3\,[O_2]\,V^2T}{(V^2T+QK_3[O_2]\,\sigma_x)^2} \qquad \ldots\ldots\ldots(12)$$

$$i.e., \; \frac{PK_1 ft}{V} e^{-K_1\sigma_y ft/V} = \frac{Q^2K_3\,[O_2]\,V^2T}{(V^2T + QK_3[O_2]\sigma_x)^2} \quad (13)$$

From equation (13), for given values of P, f, V, T, and σ_y, we obtain two values for σ_x, one of which is always negative and has no meaning. The other may be either positive or negative. A negative value indicates that the absorption space is insufficient to enable the mixture to reach a point at which it is worth while to begin to oxidise. If the value is positive it gives the measure of the oxidation space to be added to the absorption space σ_y in order to produce the optimum condition. The value of σ_y is chosen arbitrarily and should not greatly exceed the value at which $\sigma_x = 0$. The smaller the total value of σ the more strictly does equation (13) represent the required condition and the smaller the total tower space necessary. Constructional requirements, however, may force the adoption of certain oxidation spaces, *e.g.*, the connecting pipes, but with the help of the above equation, knowing the nature and concentration of the gas under consideration, the plant can be adapted very closely to the form necessary for maximum efficiency.

Calculation showed that the towers employed in the above experiments would have been more efficient if all except the seventh had been packed full of pumice. The absorption space in tower 7 should be 40 cub. ft. instead of 49 cub. ft. In all other cases the pipes allow more oxidation space than is theoretically necessary. This would give an efficiency of 96% as against 92·5%.

Discussion of results in Table II.—The quantities of nitric acid produced in each tower in experiments 1—6 are shown graphically in Fig. 2. The ringed numbers on the curves indicate the corresponding experiments. The results are calculated to a time of three hours in each case.

In experiments 1, 2, and 3 the inflow of water was of the order of about 0·2 litre per sq. ft. per minute, and the velocity of the gas was 120 cub. ft. per minute. In experiment 4* the flow of water was somewhat greater, namely, about 0·3 litre per sq. ft. per minute, and the rate of flow of gas was made lower, resulting in an enormous absorption in tower 1. In experiment 5* the stream of gas was kept slow and the flow of liquid was also decreased to about 0·13 litre per sq. ft. per minute. In this case acid of sp. gr. approximately 1·44 containing nitrous acid issued from towers 1 and 2. The curve is drawn for towers 3—8 only. All the curves obtained up to this point show a distinct minimum at tower 4. It was thought that this might be caused through the output of tower 5 being raised in consequence of the large oxidation space occurring in the fan and connecting pipes at this point. In order to test this the fan was eliminated and towers 4 and 5 joined by a pipe of only slightly greater volume than those joining the other towers.

Experiments 6 and 7* were made under these circumstances, the velocity being about 90 cub. ft. per minute and the rate of inflow of water being somewhat greater than 0·2 litre per sq. ft. per minute. The acid running out of the first tower was a little weaker than formerly, namely, 58%, with the result that a very large absorption is obtained in the first two towers. The results of experiment 7 are very similar to those of experiment 6, and are therefore not plotted in the figure. In each case the results show a minimum in production at tower 4. The presence of the minimum is therefore not due to the fan space.

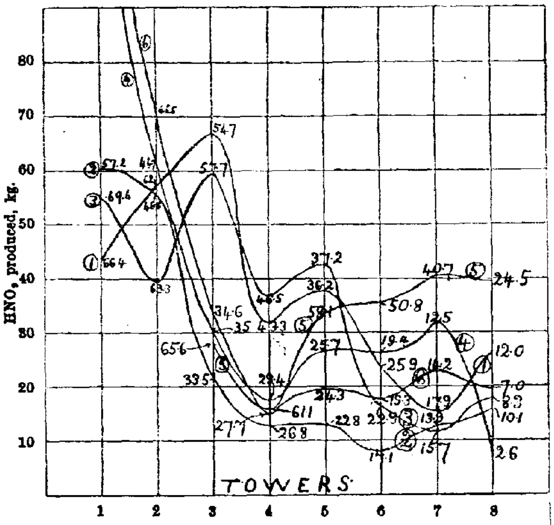


Fig. 2.

Production of nitric acid in each tower.
Time: 3 hours.
No. 5 not corrected for HCl.
The small figures refer to strength of issuing acid.

It is not improbable that small differences in the packing of the towers may affect the output considerably. For instance, if one of the trays in the sections were tilted slightly the stream of water, especially if small, would tend to run down one side of the tower and thus diminish the capacity for absorption. An experiment was made to test this. One section of a tower, filled with pumice, was arranged so that the water could be seen issuing from the bottom. It was found that on introducing even a considerable stream of water at one side the bulk of it flowed out at the bottom near that side and the stream did not spread beyond the middle of the section. This demonstrates also the necessity for efficient distribution of the liquid at the top of the tower over the whole cross-section.

The behaviour of the succeeding towers which show certain regularities in the recurrence of maximum and minimum outputs may possibly be similarly explained. Fluctuations will also be caused by variations in temperature in the towers, resulting in changes in speed of flow of gas and velocity of reaction, and by variation in the chlorine content of the gases.

It is evident that the speed of the inflowing gas causes important differences in the distribution of the output. In curves 4 and 6 in Fig. 2, in which the speed is very low, there is a very large initial output. It may therefore be concluded that a decrease in the velocity of the gas increases the efficiency of the towers, as is also shown by equation (4). The efficiency is, however, governed by other considerations than the velocity of the gas. For a given total quantity of nitrous gas, reduction in the speed of flow of gas involves a reduction in the concentration of the oxygen, so that although the absorption will be large at the beginning owing to large concentration of nitrogen peroxide, if the reduction in speed is carried too far the reaction will be difficult to complete because of the slowness of oxidation of the nitric oxide produced. In many cases, however, this velocity is determined by the source of the gas and cannot be diminished. For instance, a certain minimum velocity is necessary for the removal of fumes from nitric acid stills.

Fig. 3 gives an interesting comparison between the actual experimental efficiency of the towers and the theoretical efficiency, calculated for average conditions of concentration and velocity of gas and flow of liquid, from equations 4 and 10. Curves 1, 2, and 3 show the experimental rates of production reproduced from Fig. 2. Curve 4 represents the theoretical rate of production per tower. It will be seen that the calculated curve follows the same general course as the experimental one as closely as could be expected, although, as the conditions are supposedly ideal, the irregularities are smoothed out. Since the efficiency of the towers under the conditions of the experiments was over 90%, it follows that the formulæ arrived at represent the working of the process over a range of concentration of nitrous gases of approximately 10:1. Curve 5 shows the theoretical results to be obtained if the towers had been packed in the way indicated above as the best.

In obtaining the figures for curve 4 the amounts of oxidation taking place in the unpacked parts of the first tower were calculated. These were found to be negligibly small even near the end of the tower, thus justifying the neglect of oxidation in these spaces when determining the absorption coefficients and the influence of rate of flow of liquid.

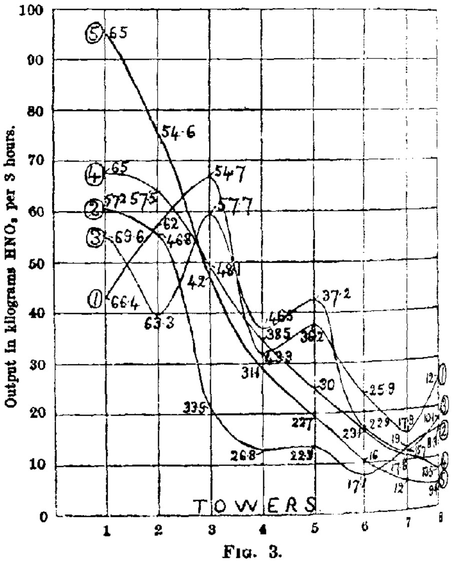


Fig. 3.

Procedure for the design of a set of towers for nitric acid stills.

As already stated, the velocity of flow of gas will probably be fixed within narrow limits by circumances. From this velocity, and the total equiva-nt nitric acid content of the gas, the value of P uring a certain time T may be calculated. The ow of liquid may be arbitrarily fixed, the strength f acid which it is desired to obtain determined pon, an approximate average strength of acid owing through the first absorption space thus ssigned, and the value of K_1 for that strength aken from the curve. A value of σ_y may then be hosen, the choice being guided by the fact that, if he gas is comparatively rich in nitrogen peroxide will probably require a fairly large absorption pace before it is worth while to begin to oxidise. rom equation 4 in which P, K_1, σ_y, V, and f have ow definite values, Y may be calculated. The mount of nitrogen peroxide will then have been iminished to $P-Y$, whereas the amount of nitric xide will have been increased by $Y/3$ to Q. In he case of the first tower for fumes from nitric cid stills $Y/3=Q$. $K_3[O_2]$ may be determined rom the known value of the oxygen concentration $K_3=100{,}000$ and $[O_2]$ must be calculated in kilo-rams of equivalent nitric acid per cub. ft. For 0% oxygen at about 20° C., $K_3[O_2]$ is practically 000). As indicated previously, equation (13) will hen give the value of σ_x which should follow y. If this should prove of suitable dimensions the alue of X may be calculated from equation (10) nd thus the composition of the gas at the end of he oxidation space determined. If σ_x should be egative or too large a new value for σ_y is chosen nd the calculation repeated. An approximate alue for the strength of the acid in the next bsorption space is now chosen and the process ontinued until the absorption has been carried to he desired limit. It will be seen from the fact hat the velocity of oxidation falls off as the square f the concentration of nitric oxide, and the velocity f absorption directly as the concentration of itrogen peroxide, that, other things being equal, he more dilute the gases the bigger the ratio of xidation space to absorption space required. The ollowing illustrates this. A set of towers was alculated for a case in which all the gas was riginally present as nitric oxide, and had a con-entration of 0·72 equivalent kg. of nitric acid per 100 cub. ft. The space required to absorb 82% was 795 cub. ft., divided into 410 of absorption space nd 385 of oxidation space. To absorb 91% an dditional 345 cub. ft. of absorption space and 406 f oxidation space were required.

---

*Not reproduced in Table II.

This example also demonstrates the greatly ncreased difficulty of absorption with dilution. It s practically impossible to reduce the concentration f the gases to much below 0·1 kg. of equivalent itric acid per 100 cub. ft. by water alone under rdinary atmospheric pressure. An alkali tower r increased pressure would be necessary for further absorption.

Equation (4) shows that increasing the flow of liquid increases the absorption. Increased flow without introduction of extra water may be obtained by more rapid circulation in each tower separately. There are obviously limits beyond which it would not be advisable to increase the flow, but the rate of absorption continues to increase with increase in the rate of flow up to at least 2·5 litres per sq. ft. per minute.

Absorption of nitrous fumes from other sources. Introduction of oxygen.

In the case of nitrous gases from denitration plants, the gases escaping from nitrating pots, or the oxides of nitrogen produced in the ammonia or nitrogen oxidation processes, the percentage of oxygen is often very low, the gases at the same time containing a large proportion of nitric oxide, resulting in slow oxidation and hence slow absorption. Absorption plants erected in some factories without due recognition of this fact proved deplorably inefficient. Indiscriminate addition of air, however, may prove equally fatal through too great a dilution of the gases.

Air must in any case decrease the rate of absorption because of increased dilution. If the initial concentration of oxygen is very low addition of air will speed up the oxidation at first in spite of dilution. As, however, the velocity varies as the square of the concentration of nitric oxide and only as the first power of the concentration of oxygen, a point will be reached at which the effect of dilution will overbalance the effect of increased concentration of oxygen, and the rate of oxidation also will be slowed down by further addition of air.

Equation (12) affords a guide as to the most favourable point for the introduction of air and as to the amount required to secure the best conditions. The average value of $dX/d\sigma_x$ through unit space at any point in the towers may be calculated from the equation (12) by putting $\sigma_x=1$. Then the changes in $K_3[O_2]$ and V due to a small addition of air may be determined and $dX/d\sigma_x$ calculated for the new conditions, and so on for increasing additions of air. If the values for $dX/d\sigma_x$ are then plotted on a curve against percentage additions of air it will be possible to see whether addition of air at that particular point causes increase or decrease of rate of oxidation, and if increase, at what percentage addition the maximum rate is reached. It is probably better to choose a value a little before the maximum, after the main bulk of the increase has taken place, because of the diminution in rate of absorption to which reference has already been made. Fig. 4 gives curves showing the variation of $dX/d\sigma_x$ with addition of air for different initial values of Q, V, and $K_3[O_2]$.

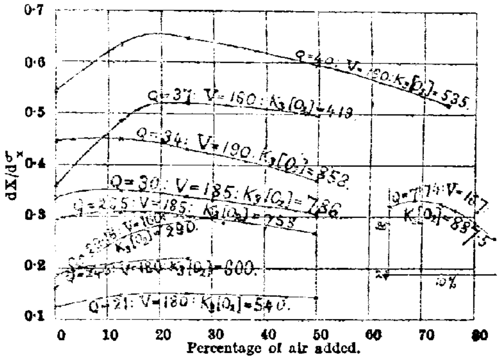


Fig. 4.

Effect of addition of air on rate of oxidation under different initial conditions.

For the absorption of very dilute fumes, such as those produced in the oxidation of nitrogen, it is conceivable that towers under pressure might be used. Suppose the pressure were increased to 10 atmospheres the amount of absorption space required would be of the order of 1/10th of that required under atmospheric pressure, and the oxidation space 1/100th.

In the nitration of phenol to picric acid by the old pot process about 22% of the nitric acid disappears entirely, even when efficient absorption plant for the escaping fumes is available. This points to the formation of unabsorbable nitrogen products, for example, nitrogen itself or nitrous oxide. These have been identified in large quantities in the fumes from the nitration by Dr. F. O. Rice. For the portion which is absorbable it is necessary to have large tower accommodation because of the variable rate of evolution. The latter applies to fumes evolved in all nitrating processes.

Further practical points in the construction and working of nitric acid absorption towers.

It has sometimes been found that the perforations of the plates supporting the packing have been few and small, causing great resistance to the flow of gas and thus necessitating greatly increased power for driving the suction apparatus. The total area of the perforations should at least be equal to the cross-section of the fume mains leading from the source of the gas and connecting the towers with one another, and these should be as large as convenient. For the same reason also, the towers should be wide, but only so wide as still to allow an even distribution of liquid over the whole cross-section.

Large towers may be built of acid-proof bricks and cement instead of earthenware pipes, but, in designing such towers, the number in series should never be less than four, and it is advisable to have six or more if the counter-current principle is to be worked successfully for any but weak acid. In order to obtain acid of the usual strength, that is, 55—60%, it is necessary to have acid of various strengths in the system simultaneously. The rate of circulation of liquid required to keep the packing effectively wet is much greater than the rate of forward travel corresponding to the maximum possible output of the system. This makes it impossible to provide, in one or two towers, the variations in strength necessary to produce the required degree of absorption. Several units, circulating independently acids of different concentrations, are necessary.

Packing should be of such a nature that it is not easily worn into channels which would direct the liquid by one or two streams only, and thus prevent the exposure of a large wet surface. It should give a large superficial area, and at the same time a large volume of free space, so as to offer as little resistance as possible to the passage of gas. Earthenware rings, hollow ball packing, and propellor packing may be recommended.

The concentration of the issuing acid should not be allowed to exceed 60%. Reference to Fig. 1 will show that above this concentration absorption will be too small to make it advisable to attempt it, and practice bears this out.

The percentage of nitrous acid in the issuing acid affords a rough test of the adequacy of the air supply. If it exceeds 0·3% more air should be introduced, either by increasing the suction of the plant or by blowing air into the fume main and carefully regulating until optimum recovery is obtained.

The efficiency of the towers may be judged by the absence of colour in the exit gases, unless the gas current is maintained by means of a steam jet at the end of the towers, when the oxidation of the brown fumes completes itself in the presence of the steam, giving a cloud of colourless nitric acid.

Effect of the presence of chlorine on the absorption of nitrous fumes.

With a view of studying the influence of the presence of chlorine on the production of nitric acid in the towers, investigations were carried out on the chlorine content of the gases entering and issuing from the towers, and of the nitric acid produced. Experiments were also made to determine the resulting products when air, both alone and charged with nitrous fumes, was passed through mixtures of nitric and hydrochloric acids of varying concentration. The results, and the general conclusions to be drawn from them, may be briefly indicated.

All the chlorine (free and combined) produced in the stills, from the chloride present as impurity in the nitrate, is carried to the absorption towers. Most of the chlorine appears to be evolved whilst the still is taking in acid, and probably also just after it has been lit up. Consequently, the gases passing into the absorption towers vary very much in chlorine content, and we may have the paradoxical result, at certain periods, that much more chlorine is present in the exit than in the entrance gases. It was found that for brief periods the chlorine content of the fumes might rise to 30—40% of the total gases capable of reacting with caustic soda, but for average conditions it was not more than about 5%, and might be less.

If the gases leaving the towers are left in contact with water until all the nitrogen compounds have been absorbed, a trace of free chlorine almost always remains, but its amount is usually very small compared with the amount of hydrochloric acid in the resulting liquid.

The acids from all the towers contained a certain amount of chlorine in some form, but it was only in nitric acid of concentration less than about 42% that appreciable quantities were found. Above that concentration not more than about 0·5%, reckoned as hydrochloric acid, was in general present. A typical example of the distribution of chlorine and nitrous acid through the towers is given in Table V.

TABLE V.

Tower No.	% HNO_3.	% HNO_2.	% HCl.
1	68·7	0·31	0·05
2	60·5	0·22	0·08
3	52·5	0·36	0·25
4	42·3	0·45	0·47
5	37·4	0·31	1·75
6	25·5	0·20	6·0
7	16·2	0·15	8·7
8	9·6	0·33	6·6

If chlorine is mixed with the brown fumes produced by the decomposition of a nitrite by an acid the brown colour persists even if the gases are damp, provided that no liquid water is present. On the addition of the latter, however, the brown colour disappears and the oxidation of the oxides of nitrogen to nitric acid appears to take place through the agency of the chlorine rather than of the oxygen of the air, even when the concentration of the latter exceeds that of the former by as much as five times. This conclusion agrees with that reached by Webb (J., 1921, 162 T).

If a small percentage of pure hydrochloric acid is added to pure nitric acid of a concentration even as low as 30%, a yellow colour is produced, presumably owing to the formation of nitrosyl chloride. If air is passed through such a mixture both chlorine and nitrogen compounds are found in the resulting gases, and on treating these with water some free chlorine is left. This was the case even with a mixture of 29·85% nitric acid and 6·8% hydrochloric acid. The total given off is in much greater equivalent quantity than the nitric acid. If air charged with nitrous fumes is now passed through the liquid, much more chlorine is carried over, but none of it is in the free state, and it is usually in much smaller equivalent quantity than the nitric acid.

These results suggest the following conclusions as to the behaviour of chlorine compounds in the towers.

In the still hydrochloric and nitric acids react practically completely to produce nitrosyl chloride and chlorine, so that the gases reaching the towers consist of a mixture of nitrosyl chloride, chlorine, nd nitrogen peroxide. The two latter do not re-ct in the gaseous state, but as soon as absorption egins and nitric oxide is produced the chlorine robably combines with it, producing more nitrosyl hloride instead of nitrogen peroxide (Boubnoff nd Guye, J. Chim. Phys., 1911, **9**, 290). The effect f this in the presence of the stronger acid will be o reduce the effective concentration of nitrogen eroxide and so diminish to some extent the amount f absorption. This will result in a greater fall in he production of nitric acid than theory indicates, nnoticeable in the first tower, but more marked s the concentration of nitric oxide increases. The ffect, of course, will be limited by the proportion f free chlorine in the fumes, and as we have seen hat this is very variable, the production of nitric cid will also vary with it.

When the gases reach the acid containing a con-iderable quantity of hydrochloric acid and still airly rich in nitric acid, say about 40%, a further actor in the diminution of production of nitric acid vill appear. As the acid becomes richer in nitric cid it will tend to decompose the hydrochloric acid, iving nitrosyl chloride and chlorine, which will ass on with the nitrous fumes. The fresh chlorine hus produced will react with more nitric oxide, eaving the gas still poorer in nitrogen peroxide. Soon after this point, however, at 35—30% itric acid, the nitrosyl chloride, if of sufficient apour pressure, will begin to react with water to orm nitrous and hydrochloric acids, the former eing rapidly transformed into nitric acid and itric oxide. If, therefore, the concentration of ydrochloric acid is not already very high, and if he original gases were rich in chlorine, absorption nay now become greater than theoretical, hence the endency to a minimum in the middle of the towers.

On the other hand, if the entering gases contain ittle chlorine, and the weaker absorbing liquids re becoming fairly rich in nitric and hydrochloric cids, more decomposition of hydrochloric acid, and ence of nitric acid, may take place than absorp-ion of nitrosyl chloride, so that more chlorine will scape than enter. It is probably under these cir-umstances that the largest amount of free hlorine will escape from the towers.

It is evident from the whole of the foregoing that he chlorine present is certainly responsible in part or the irregularities in the absorption coefficients. At the same time, owing to the very large varia-ion in the chlorine content of the gases, and the probability that it may both help and hinder the bsorption under different conditions, it seems nlikely that the curve in Fig. 1 gives values very ar from the true ones. This conclusion is sup-ported by the fact that comparison of theoretical with practical efficiency of towers absorbing fumes rom a denitrating plant, containing no chlorine, how the two to be in very satisfactory agreement, oth for low and high efficiencies.

Summary.

Assuming that the production of nitric acid from he fumes escaping from nitric acid stills consists ssentially of two processes—one, absorption of itrogen peroxide by water or weak acid, to form itric acid and nitric oxide, and the other, the xidation of nitric oxide to nitrogen peroxide—the xperimental data derived from an actual set of bsorption towers, together with the oxidation onstant determined by other investigators, have been utilised for the development of mathematical xpressions for the amounts of absorption and oxida-tion taking place under given conditions of velocity and concentration of gas, and of flow and con-centration of absorbing liquid.

From these expressions a third has been obtained by means of which the optimum ratio between bsorption and oxidation spaces might be fixed.

These mathematical expressions are intended as empirical rules, which are borne out by practical results, but are not put forward as evidence for the truth of the hypotheses as to the mechanism of the reactions used in developing them.

The method of employing these expressions for the design of absorption towers for nitrous gases from different sources has been indicated.

The effect upon absorption of the presence of chlorine in the gases from nitric acid stills has also been discussed.

In conclusion the authors wish to thank Mr. A. Moore and other members of the staff at H.M. Factory, Litherland, for their assistance in carrying out the experimental work.

THE VAPOUR PRESSURE OF ACETALDEHYDE.

BY ROBERT GILMOUR, B.SC., PH.D.

The following measurements of the vapour pressure of acetaldehyde at various temperatures were carried out some years ago, in connexion with other experimental work, and as there appears to be no mention of similar measurements in the literature, they are perhaps worth recording.

The acetaldehyde used was a synthetic product from acetylene and was available in quantity. The sample used for the measurements was the mid-fraction obtained from about a litre of acetaldehyde which was already of high purity. This fraction, amounting to about 70% of the whole, distilled within 0·03° C., and practically the whole of it came over at the constant temperature of 20·55° C. at a barometric pressure of 771 mm.

The distillation was carried out with a column about 1 in. diameter and 18 in. high, filled with glass beads and water-jacketed. This enabled the upper part of the column to be kept about 5° C. below the boiling point of the acetaldehyde. The outlet from the column was connected through a condenser cooled by ice water, with a receiver packed in ice, and the thermometer stem over the range used was entirely immersed in the vapour. The thermometer used was a "Jena Normal" which had been compared with a calibrated thermometer. For maintaining a steady pressure the excellent apparatus described by Wade and Merriman (Chem. Soc. Trans., 1911, **99**, 984) was used. The vapour pressure measurements were carried out with the apparatus described above, over the temperature range of 27° C. to 12° C.

Experimental readings. 1st Series.

Pressure in mm. .. 770, 731·1, 721·2, 709·1, 693·7, 672·4, 652·4, 628·8, 607·7, 581·0, 555·4.
Boiling point, °C. .. 20·43, 19·07, 18·70, 18·27, 17·70, 16·91, 16·14, 15·20, 14·32, 13·20, 12·08.

The pressure was then raised to atmospheric (770 mm.) and the boiling point again read. It was found to be the same as at the commencement, viz.:—20·43° C.

Experimental readings. 2nd Series.

Pressure in mm. .. 772, 794·8, 826·0, 858·8, 891·9, 922·2, 961·9, 1011·1.
Boiling point, °C. .. 20·51, 21·27, 22·30, 23·38, 24·40, 25·33, 26·51, 27·89.

For the temperatures below 12° C., Wade and Merriman's apparatus was used (Chem. Soc. Trans., 1912, **101**, 2438). This consists of a round-bottomed flask surrounded with cotton-wool, and provided with a very fine capillary, a connexion to vacuum, and a thermometer with the bulb immersed in the liquid.

Experimental readings. 3rd Series.

Pressure in mm. .. 557·8, 517·3, 504·9, 467·5, 425·2, 381·8, 336·8, 306·5, 275·5, 256·2, 227·7, 187·5, 156·8, 127·7, 100·0.

Boiling point, °C. .. 12·80, 10·60, 9·60, 8·40, 6·20, 3·67, 0·90, −1·23, −3·60, −5·50, −8·40, −12·15, −15·95, −19·65, −24·15.

The experimental values were plotted and the curve smoothed. From the smoothed curve the following values for pressure and boiling point were read, and from these figures dt/dp calculated.

Pressure in mm.	Boiling point, °C.	dt/dp	dp/dt		Pressure in mm.	Boiling point, °C.	dt/dp	dp/dt
1000	27·55	0·0278	35·9	..	550	11·71	0·0445	22·5
950	26·15	0·0290	34·5	..	500	9·41	0·0475	21·0
900	24·67	0·0307	32·6	..	450	6·94	0·0515	19·4
850	23·10	0·0321	31·1	..	400	4·23	0·0571	17·5
800	21·45	0·0339	29·5	..	350	1·10	0·0646	15·5
760	20·10	0·0355	28·2	..	300	− 2·50	0·0743	13·4
750	19·70	0·0357	28·0	..	250	− 6·40	0·0867	11·5
700	17·86	0·0377	26·5	..	200	−11·20	0·1027	9·7
650	15·92	0·0398	25·1	..	150	−17·00	0·1225	8·2
600	13·87	0·0420	23·8	..	100	−24·30	0·1670	6·0

The pressure-dt/dp curve was plotted and from it and the pressure-b.p. curve the following values were read and dp/dt calculated.

Vapour pressures of acetaldehyde.

Temp. °	Pressure in mm.	dt/dp.	dp/dt.		Temp. °	Pressure in mm.	dt/dp.	dp/dt.
27	981	0·0284	35·2	..	1	346	0·0652	15·3
25	911	0·0304	32·9	..	0	331	0·0680	14·7
23	846	0·0324	30·8	..	− 1	317	0·0708	14·1
21	786	0·0345	29·0	..	− 3	290	0·0763	13·1
20	757	0·0355	28·2	..	− 5	264	0·0830	12·0
19	729	0·0365	27·4	..	− 7	241	0·0891	11·2
17	676	0·0387	25·8	..	− 9	219	0·0955	10·5
15	627	0·0407	24·6	..	−11	200	0·1027	9·7
13	580	0·0428	23·4	..	−13	181	0·1110	9·0
11	534	0·0453	22·1	..	−15	163	0·1200	8·3
9	490	0·0475	21·0	..	−17	147	0·1290	7·7
7	451	0·0514	19·5	..	−19	132	0·1400	7·1
5	414	0·0552	18·1	..	−21	119	0·1500	6·6
3	378	0·0598	16·7	..	−23	106	0·1610	6·2

Boiling points recorded at atmospheric pressure.

1. 20·55° at 771 mm. = 20·16° at 760 mm.
2. 20·43° at 770 mm. = 20·08° at 760 mm.
3. 20·51° at 772 mm. = 20·08° at 760 mm.
4. 20·20° at 762 mm. = 20·13° at 760 mm.

Mean value of b.p. = 20·11° at 760 mm.

Note.—The temperatures recorded are corrected for error of thermometer down to −5° C., but not reduced to hydrogen scale. Temperatures below −5° C. may be somewhat erroneous, due to superheating or error of thermometer, since no elaborate precautions were taken. The pressures are as read, at a temperature of 16° C. throughout.

Density of acetaldehyde.

The densities were taken in a carefully calibrated U-shaped pyknometer of capacity about 36 c.c. with capillary bore tubes surmounted by reservoirs which were closed by rubber stoppers instead of ground-in glass stoppers. As a confirmatory test, a determination was made in a pyknometer with calibrated capillary tube, with a small bulb at the top which was sealed before removing from the ice bath; the true volume of the acetaldehyde being read off on the scale.

The usual corrections for buoyancy were made when calculating the results. Densities at 0°/0° C. (1) 0·8056, (2) 0·8060, (3) 0·8058 (sealed pyknometer); mean value at 0°/0° C.=0·8058. The density was also taken at 16° C.

D at 16°/4° C.=0·7839; at 16°/16° C.=0·7847. On account of the extreme volatility of acetaldehyde great difficulty was experienced in obtaining concordant results for the densities. In addition the ease with which the substance oxidises makes it difficult to be sure of the purity.

Latent heat of vaporisation of acetaldehyde.

The latent heat of vaporisation was calculated according to the method of Lewis and Weber (J. Ind. Eng. Chem., 1922, 14, 486), using the curve obtained by plotting boiling points of aldehyde against the temperatures at which water has the same vapour pressure. This curve was practically a straight line over the range +27° to −24° C.

The value obtained was:—L=132 calories per gram at 20° C., from which Trouton's constant ML/T=19·8.

Robinson in "The Elements of Fractional Distillation," gives L=134·6 calories per gram at the boiling point, which agrees fairly well with the calculated value L=132.

In conclusion, I desire to express my thanks to Messrs. W. Dunville and Co., Ltd., in whose laboratory the work was carried out, for permission to publish these figures.

Annual Meeting.

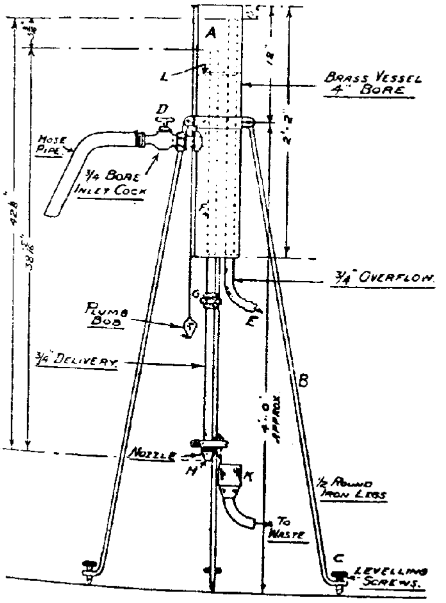
RAPID AND ACCURATE METHOD FOR THE CALIBRATION OF STORAGE TANKS.

BY J. W. M'DAVID, D.SC., F.I.C.

(Abridged.)

The volumes of storage vessels are usually deter-iined either by measuring the vessel and calcu-iting its volume mathematically, or by filling the essel with water and weighing the water as it is un out of the tank. The first method is accurate nly for rectangular tanks or cylindrical tanks tanding on end, while the second method, though ccurate, is somewhat laborious. Another method hich has been employed consists in filling a tank ith water, adding a known weight of a soluble alt, and then analysing a sample of the solution. his is an ingenious method for determining the otal volume of a vessel, provided there is adequate ieans of stirring the solution, but it becomes iborious if the volume per inch of depth is equired.

A fourth method which can be employed for the etermination of the volumes of tanks depends on he principle that water, flowing through a tube or rifice under a constant head, gives a constant rate f flow. This method, however, does not seem to ave been much used in practice, probably owing to he fact that the degree of accuracy of such a iethod was not known, and also, possibly, because he amount of time taken to fit up the apparatus equired, and to determine the rate of flow under given head, makes the method as laborious as the hers. It was thought, however, that it should be ossible to design, on this principle, a conveniently ortable and accurate apparatus which, after being librated once and for all, would be available for e rapid calibration of storage tanks of all shapes d sizes.



Such an apparatus was accordingly constructed, d, after a few minor alterations, was calibrated. A description of the instrument, and an account of the experiments carried out in order to determine the rate of flow of the water, are given below.

The apparatus, which was designed by Messrs. J. M. Weir, N. Taylor, and the author, is shown in the accompanying figure. A is a brass cylindrical vessel 4 inches in diameter, and about 2 ft. 1½ in. in length. The vessel is open at the top, and is held in a vertical position by means of three legs, B, each of which carries a levelling screw, C. A plumb-line is provided to ensure that the apparatus is set vertically. Water is supplied to the apparatus through the ¾-in. inlet cock, D, to which a hose-pipe can be attached. E is a brass overflow pipe ¾ in. in diameter, while F, a pipe of similar size, delivers water to the tank to be calibrated. In the first instrument this pipe was, for convenience, made in two parts connected together by means of a screw coupling, G, but in later instruments this coupling was omitted. The bottom of the delivery pipe is fitted with a screw thread, so as to take a nozzle, H. Five nozzles of diameters ¼, ⅜, ½, ⅝, and ¾ in. respectively were provided, so that the quantity of water delivered to the tank could be varied.

The funnel, K, works on a swivel, so that it can be placed underneath the nozzle in an instant, and so divert the water from the tank which is being calibrated. L is a plate perforated with holes ⅛ in. in diameter, and serves the double purpose of forming a support for the pipes, E and F, and at the same time reducing turbulence at the surface of the water. The complete apparatus only weighs 26 lb., and can therefore be easily carried about from place to place by one person.

The method of using the apparatus is as follows:—The instrument is set up in a vertical position over any convenient inlet hole in the cover of the vessel to be calibrated. The funnel, K, is placed under the nozzle, and sufficient water led into the apparatus through the cock, D, until there is just a slight trickle of water escaping through the overflow pipe, E. In the experiments carried out to calibrate the apparatus the quantity of water escaping through the overflow pipe was determined, and averaged 0·7 lb. to 1·5 lb. per minute. As soon as water is leaving the overflow pipe at the rate mentioned above, the head of water in the apparatus has reached a constant figure, and, so long as this level is maintained, the quantity of water delivered through the nozzle will be constant. When this condition has been obtained the funnel, K, is smartly drawn from below the nozzle, and the water is allowed to flow into the tank. At the same time a reliable stop-watch is started. If it is required to find merely the total volume of the tank, the time taken to fill it with water is noted, but if it is required to determine the volume per inch of depth, then the funnel, K, is placed beneath the nozzle after a definite interval of time, and the depth of water in the tank measured. By choosing suitable intervals of time the volume per inch of depth can be calculated.

The calibration of the instrument fitted with each of the five nozzles in turn was carried out in the following manner:—A large rectangular box was placed on a platform weighing machine and tared. The calibrator was set up so as to deliver water into the box while a short length of hose pipe was fitted to the overflow pipe, E, to carry the water passing from the overflow into a tared bucket. As soon as the box on the weighing machine had been tared, the funnel, K, was fixed beneath the nozzle in such a way that it prevented water from entering the box. The water was then turned on and regulated until the quantity passing out of the overflow was about 1 lb. per minute. The funnel was then drawn smartly away, the time being taken by means of a stop-watch, while at the same time the water running from the overflow was led into the bucket mentioned above. At the end of a definite time the funnel was replaced in position, and the bucket drawn from underneath the overflow pipe. The water both in the box and in the bucket was then separately weighed. The reason for weighing the latter was to ensure that a constant rate of overflow had been maintained. During the course of each test the temperature of the water was noted; in the case of cold water this did not vary by more than 0·2° C. in any one test, while in the case of the warmer water the maximum variation was not more than 1° C. The stop-watch employed was found to agree with several other watches to within 1 in 4000. The weighing machine was overhauled and tested before being used, and was found to be sensitive to the degree of 0·5 lb. in 700 lb. At least three tests were carried out at each temperature, and with each nozzle.

The results of the calibration experiments showed that the apparatus is capable of giving very accurate results. With the exception of those obtained with the ¼-in. nozzle, all the results in any one series agreed to within 0·3%. In the case of the ¼-in. nozzle the difference between the highest and lowest result in any one series was about 0·5%, and even this is satisfactory, since the measurement of the contents of a tank by dipping is not usually correct to ¼ in. in 50 ins. As the temperature of the water affects the quantity delivered, it is more convenient for purposes of calculation, in using the apparatus with water at any temperature between 5° and 20° C., to determine the quantity delivered in cubic feet instead of in lb. This has therefore been done, and the results are given in the subjoined table:—

Temperature of water, °C.	Volume of water delivered in cubic feet per minute.				
	¼" nozzle.	⅜" nozzle.	½" nozzle.	⅝" nozzle.	¾" nozzle.
4	.. 0·2720	.. 0·674	1·012	1·404	1·642
8	.. 0·2725	.. 0·675	1·015	1·412	1·651
12	.. 0·2731	.. 0·677	1·018	1·421	1·660
16	.. 0·2736	.. 0·678	1·021	1·430	1·668
20	.. 0·2743	.. 0·679	1·024	1·439	1·678

Stress has already been laid on the fact that, in order to obtain the best results, it is necessary that water should escape through the overflow pipe, E, at approximately constant rate, which during the calibration of the instrument was 0·7 to 1·5 lb. per minute. Any increase in the rate of overflow is accompanied by a slight increase of head; for example, when the overflow is 1 lb. per minute, the head is 3·19 ins. above the top of the delivery pipe, while when the overflow is 4 lb. per minute the head is 3·32 ins. above the same level. Thus, by increasing the overflow from 1 lb. to 4 lb. per minute the head is increased by ⅛ in. A few tests carried out showed that an increase of head of 0·1 in. increased the outflow by about 0·1%, so that the error caused by increasing the overflow from 1 to 4 lb. per minute is not very great. It is preferable to eliminate the source of error altogether.

When the rate of flow had been determined for each of the nozzles, the apparatus was used for the calibration of several tanks, in order to see whether concordant results could be obtained.

In the first test a plant-measuring vessel, designed to deliver a definite volume of acid to a cylindrical tank, was calibrated by running water into it from the calibrator until water just appeared in the sight-glass of the overflow pipe. In two consecutive tests, using the ¼-in. nozzle, the times taken to fill the measuring vessel were 50 min. 47·5 secs. and 50 min. 49 secs.—a difference of 0·05%.

The second test consisted in the calibration by two independent observers of a stoneware tank of about 200 gallons capacity, using the ⅜-inch nozzle. The difference between the two determinations for the same volume was 0·1 in 39 ins., or about 0·25%.

The third test carried out was the calibration of an egg-ended boiler, which had previously been twice calibrated by filling it with water and weighing the water which it delivered for each inch of depth. The water from the calibrator was delivered to the boiler during definite intervals of time. At the end of each interval the depth of water in the boiler was determined by means of the same measuring rod that had been used in calibrating the tank previously. In order to obtain the volume per inch, the volumes of water run during the various intervals of time were plotted graphically, on a very large scale, against the depths of water registered in the boiler. On connecting these points to furnish a smooth curve, it was found that whereas a few points lay outside the graph, out of these none was further from it than a distance representing 0·1 in. in the dip, whilst the very great majority were within half this distance. The volume per inch was then read off the graph, and these results compared with the figures obtained by actually weighing the water delivered from the boiler.

There was a considerable difference in the volumes of the boiler up to a depth of 10 ins. as found by direct weighing of the water and by the calibrator, probably due to the fact that an error of 0·1 in. in measuring the depth makes, during this part of the calibration, a considerable percentage error in the volume. At any rate, it does not appear to be due to errors either in the weighing of the water or in the calibrator, since at greater depths when an error of 0·1 in. in the depth has a comparatively small effect the agreement between the two sets of results is highly satisfactory.

The results showed that the apparatus is capable of giving results quite as accurate as, if not more accurate than, those that can be obtained by the direct weighing method.

From the results of the three tests described above, the calibrator appears to be capable of giving results correct to within 0·2%, provided that the depth measurements are read to that degree of accuracy. By using the largest nozzle a boiler of 600 cub. ft. capacity can be calibrated in a little over six hours, while the apparatus is also suitable for the accurate calibration of small vessels such as guncotton nitrating pans, one of which, by using the ½-in. nozzle, can be calibrated in less than ten minutes. Several of these instruments have been in use more or less continuously for the last two years, and have proved thoroughly satisfactory.

The author wishes to express his thanks to the management of Messrs. Nobel Industries, Limited, Ardeer Factory, Stevenston, Ayrshire, for granting permission to publish the information contained in this paper.

TAR DISTILLING.

BY W. A. WALMSLEY.

(Abridged.)

Up to about ten years ago town's gas was made almost exclusively in horizontal retorts at high temperature, and the resulting tar was thick and heavy. Horizontal-retort tar has been fairly thoroughly investigated by a number of workers, and its constituents proved to be of an aromatic character. On distillation, it yields approximately 60—70% of pitch of good merchantable quality, and 30—40% of oils containing aromatic hydrocarbons of the benzene, naphthalene, and anthracene series, phenols and phenol homologues, pyridines, etc.

With the introduction of the vertical retort, a radical change occurred in the tar. The specific gravity was lower, and the tar of a more oily nature. Glasgow vertical tar yields on distillation 40—44% of pitch and 56—60% of oils.

The tar vapours in horizontal retorts have to pass through the hot outer crust of the charge, and also to some extent along the hot walls of the etort. Breakdown occurs, and the resulting tar s benzenoid in character. In vertical retorts the earlier portions of tar vapours are provided with a cool means of escape from the retort through zones at a lower temperature than that at which they are formed. It is even possible that they have some solvent action on the coal in these lower temperature zones, and pick up, in passing, some of the primary constituents of the coal stuff itself. The tar resulting from such conditions is paraffinoid n nature, and is known as low-temperature tar. The later portions of tar vapours, however, are subjected to some extent to the conditions that appertain in horizontal retorts and give benzenoid tar.

Vertical-retort tar may therefore be looked upon as a mixture of high- and low-temperature tars. No thorough investigation has been made of vertical-retort tar. It contains less benzol than horizontal tar, practically no naphthalene, a large percentage of compounds extractable with caustic soda, containing very little real phenol. These compounds would appear to approximate to the phenolic substances extractable from wood tar creosote, which contains guaiacol and coerulignol.

Some recent experiments carried out by us appear to indicate the presence of even trihydric phenols in the higher boiling portions. They show great affinity for oxygen, absorbing it very readily in the same way as pyrogallol.

The following figures serve to show the difference in distillation range between the tar acids obtained from vertical and horizontal retort tars. The whole of the oils up to pitch were extracted with caustic soda, and the resulting tar acids dried and then distilled.

Horizontal-retort tar.

The crude dry tar acids obtained were equivalent to 9% by weight of crude tar, and had the following distillation range, using a Wurtz flask :—

Drop	186° C.
45·2% at	200° C.
69% ,,	210° C.
72·5% ,,	220° C.
81% ,,	230° C.
84·5% ,,	240° C.
88% ,,	250° C.

Vertical-retort tar.

The crude dry tar acids obtained were equivalent to 13·2% by weight of crude tar, and had the following distillation range, using a Wurtz flask :—

Drop	185° C
10% at	200° C
28% ,,	210° C
45% ,,	220° C
56% ,,	230° C
63% ,,	240° C
78% ,,	280° C
84% ,,	300° C
92% ,,	310° C.

Distilled above 260° C. ruby red in colour. Gave highly viscous fluid when cooled.

It was thought that tar acids obtained from vertical-retort tar might approximate to some considerable extent to the high-coefficient acids obtainable from blast-furnace creosote, and the comparison between the distillation ranges and physical properties was made, with the results given at the foot of this page.

The following, taken from monthly distillation and yield statements from two separate works, one distilling horizontal-retort tar, and the other distilling vertical-retort tar, illustrates the difference in specific gravity, percentage of volatile products, and percentage of pitch obtained during the primary or crude distillation of the tar.

	Vertical tar. Sp. gr. 1·091.		Horizontal tar. Sp. gr. 1·175.	
	Sp. gr.	% Yield.	Sp. gr.	% Yield.
Ammonia water	1·025	4·0	1·003	3·0
Crude naphtha	0·946	2·59	0·925	1·34
Light oil	—	—	1·007	6·02
Middle oil	0·996	30·91	1·025	6·18
Creosote	1·053	20·09	1·045	16·32
Pitch	—	41·47	—	66·56
	Total	99·06	Total	99·42

	Vertical tar.	Horizontal tar.
Viscosity (Redwood) at 100° F.	345 secs.	610 secs.
Free carbon	1·19%	11·5%
Calorific value	16,120 B.Th.U.	16,150 B.Th.U.
Pitch volatile matter	69·9%	53%
Fixed carbon	30%	47%
Free carbon	5%	25%
Ash	0·1%	0·1%

All crude tar contains a certain percentage of entangled ammonia water. The removal of this ammonia water, which comes over along with the crude naphtha fraction, is the most troublesome part of the distillation. The still must be fired very cautiously, until all ammonia water has been driven off, otherwise frothing takes place, and a considerable quantity of tar passes over to the condensers and receivers.

In a typical distillation carried out at the Provan works the total time of distillation was 28 hours, and the total distillate approximately 36—40%. The distillation of the crude naphtha and water, amounting to only 3%, took 22 hours, the remaining 33—37% coming over in 6 hours.

Even at 300° C. the distillate still contained 9% of oils boiling at 210° C.—probably the result of breakdown of more complex organic compounds, which occurs in all distillations.

Fuel used per ton of tar distilled at two of our works, using this type of still:—

Works 1.	For distillation only.	For steam throughout works and in steaming of tar stills.
	1·75 cwt.	1·18 cwt.
Fuel used	Dross and coke breeze.	Coke breeze.
Works 2.	1·625 cwt.	0·57 cwt.
Fuel used	Coke.	Coke breeze.

An experiment on the continuous distillation of vertical-retort tar was carried out in two Wilton dehydration coils, with a final steaming still. The tar in the first coil was maintained at 170° C. and at a pressure of about 30 lb. per sq. in. On releasing to atmospheric pressure, naphtha and water passed off as vapours to the condenser, and the residual tar was then pumped through the second

Distillation test of tar acids.

Fraction.	Dalmarnock crude naphtha. % between these temperatures.	Sp. gr. 15·5° C.	Refractive index. Mean D line 25° C.	Dalmarnock middle oil. %	Sp. gr.	Refractive index.	Blast-furnace tar acids. %	Sp. gr.	Refractive index.
-190°	24·6	1·055L	1·5435	—	—	—	—	—	—
190°–205°	34·8	1·036L	1·5385	47	1·038L	1·5362	21·4	1·031L	1·5385
205°–210°	7	1·022L	1·5375	9·7	1·020L	1·5370	11	1·021L	1·5330
210°–216°	5·7	1·020L	1·5370	—	—	—	—	—	—
210°–230°	—	—	—	17	1·013L	1·5350	30·7	1·011L	1·5325
230°–252°	—	—	—	4·5	1·047N	1·5050	—	—	—
230°–270°	—	—	—	—	—	—	19·4	1·038N	1·5530
270°–295°	—	—	—	—	—	—	7·3	1·066N	1·5730

Note.—L after the specific gravity indicates that the fraction gives Liebermann reaction for phenols. N indicates that it does not.

coil, where the temperature and pressure were maintained at 360° C. and 24 lb. per sq. in., respectively. On reducing to atmospheric pressure, mixed carbolic and heavy oils passed away as vapours to the condenser, and the residual tar was steamed with superheated steam in the final superheating still. The experiments showed that tar could be distilled continuously with production of a good medium soft pitch of 120° F. twist-point, even without the final steaming-still.

In the ordinary method of distillation, the tar yielded approximately 57% of oils and 43% of pitch. Under the conditions of the experiment, the yields were 73% of oils and 27% of pitch.

Since the experiment, the top portion of the second coil has been dismantled, and six laps show a deposit of carbon. The first lap shows from ⅜ in. to ½ in. deposit. The next three show a ¼-in. deposit, and the next two ⅛ in. deposit of carbon.

The oil produced from the second coil during the experiment has been examined, and a comparison is given below between this oil and the oil obtained by distillation in the pot still.

	Oil obtained during experiment.	Mixed carbolic and heavy creosote oils obtained during ordinary distillation in pot stills.
Sp. gr. 15·5° C. ..	1·03	1·014
Fraction to 300° C. ..	0·991	0·987
Fraction to 300° C. washed free from tar acids and pyridine..	0·9568	0·9547
Paraffins (fraction to 300° C.)	15%	12%
Loss on washing with sulphuric acid (fraction to 300° C. washed free from tar acids and pyridine)	16%	12%
Tar acids	34%	34%
Sp. gr. crude dry tar acids	1·087	1·083
Character of tar acids	Apparently identical.	
Calorific value ..	17,100 B.Th.U.	17,400 B.Th.U.
Residue at 300° C. ..	Stiff, sticky, homogeneous mass. No evidence of low-boiling substances.	Mobile, oily mass containing crystals.

From these figures it would appear that there is very little difference between the fraction of either oil boiling up to 300° C.

On carrying the distillation of both oils to 360° C., the oil obtained in the experiment leaves a residue of soft pitch amounting to 24%, against 9% from the ordinary oil. Examined microscopically, the pitch produced during the experiment appeared to contain no more free carbon than that produced in the ordinary method of distillation by the pot still.

(NOTE: The full paper, which will appear in the Proceedings of the Chemical Engineering Group, also contains an illustrated account of the tar distilling and auxiliary plant at the Provan Chemical Works.)

Canadian Sections.

Meeting held at Ottawa on May 15, 1922.

MR. F. J. HAMBLY IN THE CHAIR.

THE OPERATION OF KOPPERS BY-PRODUCT COKE OVEN PLANT.

BY C. E. WALLIN.

In this paper the author will give a short description of the Koppers coke plant of the Dominion Iron and Steel Co., Ltd, at Sydney, Nova Scotia, and also touch briefly on some points in connexion with the by-product operation and give a comparison between results obtained from this plant and from the old oven plant of another design which was in operation from 1902 to 1921.

The importance and necessity at the present time of taking advantage of every possible mechanical improvement in quenching and handling coke, combined with short coking time and maximum recovery of by-products, led to the decision to modernise the coke plant; a contract for two batteries of 60 ovens each was placed early in 1917 and the whole plant was in operation in March, 1919, despite difficulties in the way of getting prompt delivery of material. A further battery of the triangular flue type has been constructed but is not yet in operation.

The coal carbonised is entirely from the Dominion Coal Co.'s mines at Glace Bay; the following is an average analysis:—Volatile matter, 33·50; fixed carbon, 57·50; ash, 9·00; sulphur, 2·50%. In order to eliminate a portion of the ash and sulphur the coal is crushed to ¾" and then washed in a British Baum Washer of 150 gross tons per hour capacity, the coal being delivered to the oven bin by a 36" belt conveyor without any further drainage than is obtained in the regular operation of the washer. In this condition the average moisture content is 11% and the average analysis calculated to a dry basis:—Volatile matter, 35·00; fixed carbon, 60·50; ash, 4·50; sulphur, 1·75%.

The ovens are of the standard Koppers regenerative type and of the following dimensions:—Length, 37′ 6″; width, pusher side, 15¾″; width, coke side, 18¼″; height from floor tile to top of coal, 8′ 7″. They have a capacity of approximately 11·3 net tons of dry coal; this capacity will vary somewhat with the percentage of moisture in the coal and also with the degree of fineness to which the coal is crushed.

Each oven has its own independent regenerator and is a separate unit. The gas for heating is supplied by means of a hollow gun brick running the entire length of the flues, and fitted with graduated clay nozzle bricks, each nozzle brick supplying gas to individual vertical flues, of which there are 16 on the pusher side and 14 on the coke side of the division wall. The nozzle bricks of the largest area are placed on the two outside flues to compensate for the heat lost through radiation at the doors and outside walls; the nozzle next to these is the smallest, and then the size increases again towards the centre of the oven to allow for loss in gas pressure and also loss in B.Th.U. per cub. ft. of gas burned owing to the increase in temperature of the gas.

The necessary air for combustion is drawn through the regenerators by stack draught, and is heated to about 1800° F., and from the regenerators passes into the vertical flues alongside the gas nozzles. The air supply to each regenerator is regulated by dampers, the damper for the oven farthest away from the stack having the widest opening, thus equalising draught conditions on each oven. Further adjustment for each vertical flue can be made by altering the size of the opening where the vertical flue joins the horizontal flue, by means of a sliding brick. The individual flues can be inspected by removal of a cast iron cap, and in this way it is possible to examine the state of the gas nozzles, change them if necessary, and generally keep a close check on the conditions under which combustion is taking place. This careful attention to the methods for regulating gas and air results in the even heating of the oven walls with the minimum amount of fuel gas.

The gas burns on individual sides of the division wall for periods of half an hour at a time, and the reversal of gas cocks and air and stack dampers is effected by a master control operated by a self-winding clock. This control sets in operation the lectric motors which close the gas cocks, reverse tack, and air dampers and open the gas cocks on he opposite side of the ovens.

The coal is charged into the ovens from a larry quipped with four hoppers, the coal from the oven in being weighed into each hopper, so as to obtain is even a charge as possible in the oven, and evelled by means of a levelling bar. The charging overs are then placed in position, luted on, and he ascension pipe connected to the collecting main y opening a butterfly valve.

A charge of 11·3 tons of coal can be carbonised n 18 hours with a flue temperature of 2500° F. The ovens are designed for a coking period of 16 hours, but with coal containing 11% of moisture t is not deemed advisable to raise the flue emperature sufficiently to accomplish this.

At the end of the coking period the oven is disconnected from the main, the doors removed, and he coke pushed out into a car of steel and cast iron onstruction, which is then taken by an electric ocomotive to the quenching station, where it is prayed with water for 30 to 35 seconds, and the oke, after draining for 5 minutes, is discharged n the coke wharf. From the wharf the coke is fed n to a belt conveyor, which delivers it on to a -inch grizzly screen, the furnace coke and breeze eing delivered direct into cars.

The gas generated during the coking period is arried by means of ascension pipes to the collecting main and thence by cross-over and suction mains o the header outside the primary coolers. The ross-over mains are fitted with a gas-governing levice, the function of which is to maintain a constant pressure on the ovens. It is operated by a loat which is controlled by the pressure in the ollecting main; this float actuates a lever making lectrical contact in the power circuit of a reversing notor, and this in turn opens or closes a butterfly valve on the main until the lever returns to a neutral position and cuts out the motor.

In order to keep all mains clear of pitch a flush of hot tar and gas liquor is circulated by a centrifugal pump and the solid matter filtered off by suitable screens and removed.

The gas passes through the primary tubular coolers in counter current to the cooling water, the exit temperature of the gas being determined by a Tagliabue temperature control operating a motor valve on the water inlet line. Here the greater part of the tar and ammonia liquor is condensed and flows to the hot drain tank to be used as a flush n the manner mentioned above.

The gas is drawn from the ovens by means of xhausters having a capacity of 700,000 cub. ft. per hour and driven by a steam engine fitted with piston valves. The cut-off of these valves is regulated by a Root's gas governor which maintains a onstant vacuum on the suction main and eliminates irregularities due to varying quantities of gas generated and also, to a less extent, to variation in team pressure. After leaving the coolers, the gas s led through a tar extractor which removes the ast traces of tar and then into a reheater, where ts temperature is raised to 60° C. by means of xhaust steam from the engines. The heated gas is hen passed into the saturator, which is a cylindrical cast-iron vessel lined with lead. Its passage is lown a vertical lead pipe inside the saturator, into horizontal cracker pipe also of lead. This cracker pipe is of inverted U-section, and is slotted with elliptical holes through which the gas bubbles into saturated solution of ammonium sulphate containing 7% of free sulphuric acid. The deposited ammonium sulphate is continually ejected by an air iphon on to the drain table, the mother liquor lowing back into the saturator. The addition of acid is controlled by the operator, who tests the acid content of the bath at intervals of half an hour.

The sulphate from the drain table is flushed into a centrifugal dryer, where it is washed with hot water and whizzed for 15 minutes and then discharged. It contains on an average 2% of moisture and 0·25% of free acid.

Dealing with the type of coal used on this plant, about 50% of the ammonia is separated as gas liquor at the primary coolers. The gas liquor, after separation from the tar, is fed into a 6-ft. still having free and fixed ammonia stills on separate foundations, the lime necessary to decompose the fixed ammonium salts being introduced into the bottom section of the free ammonia still; the steam for operation is obtained from the exhaust steam from the engines at 15 lb. pressure. The liquor feed is measured by a Venturi meter, and these stills have successfully treated 3000 gallons per hour with a loss of 0·02 g. per litre in the waste liquor. The ammonia liberated by the combined action of steam and lime is conducted by a covered pipe to the main gas line between the reheater and saturator. The saturator is at times liable to blockage from formation of "rock salt," but by increasing the acid content of the bath and raising the top temperature of the still to 103° C., that is to say, introducing an excess of steam, at the end of each shift, this difficulty is entirely overcome. The gas liquor contains 8·2 g. of total ammonia per litre, of which 65% is fixed, and of this nearly all is present as chloride. Although the coal used is obtained largely from submarine areas, it contains very little sodium chloride, leading to the assumption that the chlorine which is present as ammonium chloride in the liquor is organically combined in the coal.

After leaving the saturator the gas passes through an acid separator to remove traces of acid mother liquor and thence to the final cooler, a steel tower 60 feet high and 12 feet in diameter, containing wooden grids. The gas is here in direct contact with a descending spray of water, the consequent cooling being accompanied by partial deposition of naphthalene. No difficulty is experienced in cooling the gas if necessary to within 3° of the water temperature. After being cooled the gas passes through two towers 100 feet high and 15 feet in diameter, arranged in series, and is here washed with a petroleum oil of high boiling point which absorbs the benzol vapours from the gas. Under suitable conditions of gas and oil temperatures and oil flow, at least 92% of the total benzol is absorbed.

After leaving the benzol scrubbers the gas is passed into the holder, from which is supplied all the gas necessary for the coking operation, while the surplus is raised to a suitable pressure and used under boilers or in reheating furnaces. Of the total gas generated during carbonisation approximately 40% is used for heating the ovens, while 60% or about 6300 cub. ft. per ton of coal carbonised is available for other purposes.

This plant has had an experience which is probably unique, at any rate on this continent. It is constructed of silica brick, and although it has operated for three years and a half with coal containing 11% moisture, a factor which but a short time ago would have dismayed even the most courageous operator, as far as can be judged it has suffered no undue deterioration. In addition it has made coke in periods ranging from 17½ to 48 hours, with frequent changes in schedule owing to the changing business conditions in the past two years.

When washed coal is coked in silica ovens no undue harm appears to be done to the brickwork if the coal is in a sufficiently fine state to prevent the drainage of the water; this state of division will depend on the nature of the coal and the percentage of water present.

Changes in schedule, especially if frequent, are more difficult to combat, as alterations in flue temperatures will cause more or less serious leaks in a brick structure, and it is only by the closest co-operation between the battery and heater foremen and the oven patcher that these can be kept under control.

For successful operation of a coke plant both from the point of view of coke and by-product production it is necessary to keep a continual check on every part of the operation, and in order to accomplish this the plant is fitted with recording instruments giving a 24-hour record of all necessary particulars, such as pressure on ovens, gas temperatures at various parts of the plant, amount of gas consumed on ovens, and amount of surplus gas made. In addition daily analyses of coal and coke, gas, ammonia liquor, and loss of ammonia at stills and saturators are made by the laboratory department, and the coke is tested at the ovens daily by the shatter and hardness tests. It is only in this way that the operation can be maintained regular and errors in operation can be detected and rectified.

It is important that the oven should be filled to the proper level and that it should be as tight as possible, and in addition that the gas pressure in the oven should be kept as little above atmospheric pressure as is practicable. No ovens can be absolutely tight, and it can easily be understood that excessive pressure will cause loss of gas and other by-products into the flues, and thence into the atmosphere, or a suction will draw in waste products of combustion containing excess oxygen and burn up part of the gas in the oven. A pressure of 2½ mm. of water carried on the collecting main is usually sufficient to ensure correct conditions in the oven.

The most important factor in the nature of the coke and the yield of by-products is the temperature of carbonisation; this is determined by the speed of carbonisation and also the temperature carried at the top of the oven. This latter factor determines the yield and nature of the by-products, as if the temperature at the oven tops is excessive, the gas in contact with the coke and hot brickwork undergoes complicated chemical changes.

Generally speaking, with increase of temperature the coke is smaller and harder, more gas is generated per ton of coal, and more benzol and naphthalene are produced, while the tar and ammonia yields drop. The light oil made at high temperatures contains a smaller percentage of saturated and unsaturated paraffin hydrocarbons, the reason being that these are decomposed into benzene and its homologues, and this is evident in an increased yield of benzene and freedom from admixture of paraffins.

The yields of benzol and ammonium sulphate vary in opposite directions, higher temperatures being favourable to the former and reducing the latter.

A comparison of the ovens working with coking periods of 18 and 24—26 hours respectively, and also of the yields from the original ovens and the Koppers ovens will illustrate this:—

	Coking period 18 hours.	24-26 hours.
Flue temperature ..	2500° F.	2200° F.
Coke—		
Shatter test	52%	58%
Hardness test ..	83%	81%
Ammonium sulphate ..	28·3	30·3 lb. per ton of coal.
Tar	10·5	12·0 galls. per ton of coal.
Total gas	11,200	10,300 cub. ft. per ton of coal.
Benzol (pure)	1·8	1·6 galls. per ton of coal.

The presence of paraffin compounds in the benzol, although not detectable by a distillation test, is revealed by the difference in specific gravity. No figures for benzol, toluol, or solvent naphtha can be given, as these are recovered and purified together for use as motor fuel. But whereas a motor fuel made with a high oven temperature will have a specific gravity of 0·870, a product showing a similar distillation test, but the result of lower temperature carbonisation, will show a gravity of only 0·860, an unmistakable evidence of the presence of paraffin hydrocarbons.

A further interesting point may be noted in the quality of the tar produced. With a coking time of 19 hours the specific gravity is 1·158 and a plain distillation test gives:—3% at 190° C., 5% at 200° C., 22% at 250° C., and 35% at 300° C., while corresponding figures for tar made with a 25-hour coking period are:—Sp. gr. 1·132, 4% at 190° C., 8% at 200° C., 28% at 250° C., 42% at 300° C.

Comparison between the by-product yields from the operation of the old plant and the Koppers plant brings still further into prominence the differences due to temperature control and gas regulation.

In the case of the original plant the temperature control was of very indifferent nature, judged by modern standards. The fuel gas was introduced through one straight pipe at the side of the combustion flue and burnt as best it could, the result being that the charge was unevenly coked and the top of the oven generally as hot as the walls. There was no automatic control of gas pressure, and it was no uncommon occurrence to have excessive suction or pressure on the ovens. The yield of by-products was very much less than with the Koppers plant. The surplus gas would only average approximately 3000 cub. ft. per ton of coal against 6300 cub. ft. with the Koppers plant, and was of a very inferior quality, containing 25—30% of nitrogen. The tar yield was 7 gallons and the yield of ammonium sulphate 20 lb. per ton of coal as against an average of 11 gallons and, say 28·5 lb. respectively with the Koppers plant.

Again, the influence of indifferent gas pressure control and high heats at the top of the ovens show its effect in the widely different nature of the tar as the following table shows:—

	Original oven plant.	Koppers oven plant.
Sp. gr.	1·17	1·15
Naphthalene	80	20·7 lb. per ton of tar.
Pitch	13·2	13·2 cwt. per ton of tar.
containing	26%	18% of free carbon.
Creosote oil	14%	30%
containing	18%	29% of tar acids.
60's carbolic acid	2	1 gall. per ton of tar.

Montreal Section.

Meeting held on March 17, 1922.

A STUDY OF CONDITIONS CAUSING DISINTEGRATION OF CEMENT UNDER THE "ACCELERATED" TEST.

BY A. G. FLEMING.

(*Abstract.*)

The "boil" or "accelerated" steam test for cement, in use for many years, was first introduced by Michaelis in 1870. As first used, small balls of neat cement, of about 5 cm. diameter, were kept in moist air for 24 hours and then placed in cold water which was boiled for 6 hours. Despite various modifications, the essential details of the process have not greatly altered, as a study of the present-day American and Canadian specification shows. According to this specification the test should be carried out as follows:—

"A steam apparatus which can be maintained at a temperature between 98° and 100° C. is recommended. A pat from cement paste of normal consistency, about 3" diameter, ½" thick at the centre and tapering to a thin edge, shall be made on a clean glass plate about 4 inches square, and stored in moist air for 24 hours. In moulding the pat, the cement paste shall first be flattened on the glass and the pat made by drawing the trowel from the outer edge towards the centre. The pat shall then be placed in an atmosphere of steam at a temperature between 98° and 100° C., upon a suitable support, 1 inch above the boiling water, for 5 hours. Should the pat leave the plate, distortion may be best detected with a straight edge applied to the surface which was in contact with the plate."

The American specification further advises that: "In the present state of our knowledge it cannot be said that a cement which fails to pass the accelerated test will prove defective in the work: nor can a cement be considered entirely safe simply because it has passed these tests."

Despite various attempts to displace the "boil" test by others, it still finds much favour among American cement manufacturers as being a fair indication of weak points which need attention and a useful gauge of the essential qualities of a cement, although it is sometimes unnecessarily severe.

As alternative methods to the "boil" test the following are sometimes used:—

(1) *Autoclave test.*—Neat briquettes are made up in the usual way, and after 24 hours in a moist chamber are placed in an autoclave and covered with water. Steam is passed in until, in 45 minutes, a pressure of about 20 atmospheres is obtained. This pressure is maintained for 1¼ hours, after which the briquettes are cooled and broken in a standard testing machine. After a great deal of controversy in the United States and Canada, and considerable investigation, it was considered that this test was misleading and did not warrant the greater expense entailed, in comparison with the more rough-and-ready low-pressure "boil" test, which was held to be quite severe enough and fully as accurate in determining constancy of volume.

(2) *The Le Chatelier test*—as carried out in Great Britain.

(3) *The cold water test.*—Pats are stored in cold water for 28 days. This test loses much of its utility from the fact that many unsound cements improve under water. Usually, too, a much more rapid test is required.

(4) *Microscopical test.*—The determine free lime in cement a microscopical test is sometimes used. But since the microscope does not differentiate between the free lime (considered by some authorities as the cause of unsoundness) and the calcium hydroxide developed in the cement on storage and seasoning, it is not of much value.

A number of comparative tests were made in the author's laboratory with the primary object of noting the relative effect of the ordinary "boil" test on test pats stored under three different conditions, viz., in dry air, in moist air, and in water at 70° F. These tests were made on seven different cements (A, B, C, D, E, F, and G), obtained from three different mills, the chemical analyses of these cements being as follows:—

	Mill No. 1.		Mill. No. 2.			Mill No. 3.	
	Sample A.	Sample B.	Sample C.	Sample D.	Sample E.	Sample F.	Sample G.
	%	%	%	%	%	%	%
Silica ..	19·72	20·72	21·66	21·64	21·20	22·56	22·70
Alumina	5·90	5·98	7·05	7·25	7·18	5·90	5·66
Ferric oxide ..	2·86	2·62	3·05	3·25	3·22	2·00	2·12
Lime ..	65·05	63·74	61·67	61·59	61·53	63·05	63·13
Magnesia	3·28	3·14	2·14	2·16	2·10	2·75	2·78
Sulphur trioxide	1·69	1·72	1·90	1·86	2·08	1·72	1·51
Loss on ignition	1·06	1·10	1·80	1·48	1·88	1·04	1·09
Total ..	99·56	90·12	99·27	99·25	99·29	99·02	98·99
CaO ÷ (SiO_2+ Al_2O_3)	3·0	2·82	2·56	2·54	2·60	2·60	2·60

Mill 1. Cements A and B.—Neat pats of cement A completely disintegrated under the specification "boil" test, as also did neat pats stored under the three different conditions aforementioned when subjected to the accelerated test after various intervals up to 62 days. Mortar pats, made in the proportion of 1 cement:2 sand and 1 cement:3 sand, disintegrated up to the age of 1 month, after which there was a gradual improvement. After 2 months the 1:3 pats were sound, while the 1:2 pats, though greatly improved, still showed signs of checking and cracking when subjected to the test.

Test pieces made from cement B passed the test perfectly, at all ages and under every variation of storage. [N.B. Cement A was over-limed and contained at least 1½% excess of free lime—a probable cause of failure.]

Mill 2. Cements C, D, E.—Though these cements were practically identical in composition, C failed to pass the specification "boil" test, D was unsound at first but seasoned in storage and finally passed, while E was sound both at first and throughout all the tests. "Boil" tests were made on neat pats of these cements after storage in dry air, for periods ranging from 16 hours to 2 months. Cement C was unsound at every period; D, when tested after storing for 16 and 24 hours, showed some cracking and deformation, but was satisfactory after storing for 48 hours; E was sound at every period tested.

After storage in water, neat C cement failed at ages 1, 2, and 3 days. After a week pats were less unsound, but curled and cracked under the test. After three weeks, distortion was very slight; after four weeks pats were quite sound. The 1:2 mortar was sound after two weeks; the 1:3 mortar curled and cracked in the test after 48 hours, but was sound after 72 hours.

Neat pats from D (after seasoning), and E, as well as pats from 1:2 and 1:3 mortars, successfully passed the "boil" test after storage for 24 hours in moist air followed by storage in water.

Mill 3. Cements F, G.—Cement F passed the usual specification test, but the neat pats checked and warped in the test after being stored in moist or dry air. The effect of dry air was not so marked as that of moist air, as pats stored in dry air were sound after 4 days. Pats stored in water were sound at all periods tested. The mortar pats were sound at every period and under all conditions.

Cement G completely failed the normal specification test, as did neat pats stored under varying conditions up to 1 month. The mortar pats behaved better, and showed varying degrees of improvement until, after 2 weeks, they were sound under the test.

Conclusions reached from these experiments are:—

(1) The chemical composition of an average Portland cement gives little guidance as to its probable behaviour under the accelerated test. (*Cf.* cements F and G, which are almost identical in composition.)

(2) Unsound cement stored under water shows a marked improvement compared with that stored in air, either dry or moist—the natural storage for cement, at any rate during hardening, is under water.

(3) Mortars poor in unsound cement improve more rapidly than mortars rich in unsound cement. There is thus little danger of disintegration of a water-stored concrete made from poor cement such as C.

(4) Mortars in practice do not exhibit the weakness of their neat cement.

(5) Mortars and concretes are improved by water-storage; concrete should be kept moist, at any rate until completely set.

Unsoundness of cement.—According to Erdahl, unsoundness in the accelerated tests is due to the slower hydration of dicalcium silicate as compared with that of tricalcium silicate and calcium aluminates.

Klein and Phillips, on the other hand, maintain that it is due to hydration of free lime, which, unless very fine, may hydrate in a crystalline condition and exert disruptive forces by the growth of the crystals, thus causing disintegration in the test. Some cements, however, will pass the " boil " test, but not the autoclave test; others will pass both tests, but only after seasoning. In the first case, according to Klein, the free lime may be so coarse or so highly-burned as not to hydrate in the " boil " test, but only under the higher pressure and temperature of the autoclave. In the second, aeration with insufficient water to allow of solution and crystallisation may cause the free lime to hydrate in the amorphous condition. In the light of this, it would be natural to expect that the addition of free caustic lime to a cement previous to mixing with water would cause the cement to fail under the test. In the author's experiments, however, on the products of a number of cement mills, additions of up to 6% of quicklime—in some cases even as much as 10%—had no effect on the soundness under the 5 hours' " boil " test. The probable explanation of this is that lime added in this way is immediately exposed to the hydrating action of the mixing water, and slakes before the setting of the cement begins. The disruptive force of hydration of free lime is thus expended before the test-piece becomes hard and inelastic. The danger from free lime comes when this lime is locked up in small nodules of clinker, and hydration is delayed until the steam can penetrate the nodules, by which time the cement is of course set and disruption occurs. This was borne out by tests made on the fine flour (passing 200-mesh) of an unsound cement. Test-pieces made from the finely-ground product successfully passed the accelerated test.

Experiments with calcium chloride showed that additions of from 1 to 2% of this substance to the mixing water would correct unsoundness in the " boil " test when the cement pats had been stored in air before testing. When, however, the pats of unsound cement, with the calcium chloride already added, were stored under water after they had set, in most cases they failed to pass the test. The application of some theory of chemical action or physical cause other than the hydration of uncombined lime appears necessary in explanation of this.

The addition of alkali carbonates quickened the set, and in some experiments as little as ½% caused serious deterioration of the cement in the accelerated test.

These various experiments seem to point to the fact that the unsoundness of cement under accelerated tests is not entirely due to free lime. The combination of the alkali bases (from the silicates of the raw clay) with carbon dioxide from the air and sulphur from the sulphides of the clinker, and the subsequent oxidation to hydrated carbonates and sulphates may, in some cases, be responsible for the disruption of the test-pieces. The salutary effect of the addition of less than 2% of calcium chloride may thus be due to the prevention of the formation crystals of alkali carbonates and sulphates, which, by their quickening action on the set of the cement, would prevent complete hydration of free lime in the early plastic condition of the test-piece.

Prevention of unsoundness.—As the combination of lime with the silica and alumina of the clay takes place at a temperature below fusion point, there is relatively little movement possible between the particles of clinker during burning. Hence the finer the raw materials are ground before entering the kiln the less chance there is of excess of either constituent remaining uncombined. The ability of cement clinker to pass the accelerated tests thus depends greatly on the fineness of the mixture entering the kilns, and great improvements have been made, both in quality and economy, by better pulverising machinery. Thus, where formerly in the " dry " process the mixed clay and limestone were ground to such a fineness that 90% passed the 100-mesh sieve, most plants now reduce their raw mixtures to a minimum fineness of 95—96% through the 100-mesh sieve and 80—90% through the 200-mesh sieve.

When natural cement rock is used, it is not necessary to grind so finely, as the combination of lime and clay is already an intimate one. (In this connexion it may be of interest to note that the Montreal Island deposit approximates so closely to the perfect Portland cement proportions that the average stone on a 20-foot face seldom requires the addition of either clay or stone of higher lime content.)

In the " wet " process, using marl and clay, there is not much difficulty in obtaining finely-ground materials, but in the " dry " process the necessary intimate mixing can only be obtained by heating the raw materials. It has been demonstrated that, for most materials, if the mixture from the dryers has a temperature of 150° C., this is sufficient to ensure a fine enough grinding to give sound clinker. If only one of the raw materials is heated, or if only the surface moisture be removed from both, the resulting clinker will probably be unsound. If both materials are heated to 150° C., this will ensure the removal of all surface moisture and a sufficient portion of the chemically combined water of the clay to give a sound clinker, provided that the proportioning and the burning conditions are correct. There is nearly always enough clay in the limestone to make the drying of it as important as that of the clay itself.

In the author's opinion very few cases of unsound clinker are caused by a high lime content of the mixture in the kilns. This is based on the daily records of a number of plants over some years; a comparison of the analyses showed a greater proportion of sound cements among the products of higher lime content.

Communications.

THE THERMAL DECOMPOSITION OF PETROLEUM RESIDUES AT REDUCED PRESSURES.

BY J. REILLY, M.A., D.SC., AND E. W. BLAIR, D.I.C., B.SC.

(Preliminary note.)

The dry distillation, at various pressures, of petroleum residues of high boiling point and viscous crude petroleum oils has been extensively carried out owing to the commercial importance of the fuel oils and other products produced by cracking. Refined petroleum residues have also been investigated from a more general aspect by many workers during the past fifty years. There is still, however, doubt as to the constitution of these complex petroleum products and as to the nature and extent of the chemical change or decomposition which occurs when they are distilled, especially under mild conditions in which secondary reactions are reduced as much as possible. In view of the remarkable results recently obtained by A. Pictet in the rapid dry distillation under reduced pressure of certain natural products it seemed to be of interest to subject various petroleum residues to similar treatment, and to separate, and if possible, identify, the different fractions of the distillate.

The first material which the authors had occasion to investigate is that known as "mineral jelly" or "petrolatum"—a viscous, highly fluorescent residue obtained from crude American petroleum by distillation at low pressure with superheated steam. The "mineral jelly" used in the following experiments contained approximately 87% of carbon and 13% of hydrogen, and had sp. gr. 0·883 at 38°/38° C. and flash point (close test) 238° C. The dropping point was 47° C. and the time of flow of 50 c.c. (at 60° C.) from a Redwood standard viscometer was 330 secs. The unsaturation value was equivalent to 85 mg. of bromine per gram of petroleum product.

A large number of rapid distillations of this material have been carried out in both glass and copper vessels at pressures ranging from atmospheric to 1 mm. of mercury. Experiments of this type are still in progress as well as others on the influence of time of distillation and on the effects of the introduction of a current of steam or inert gas during the heating. The initial experiments were carried out on 250 g. of material in glass retorts and the later distillations on 500—1000 g. in copper retorts. The properties of the various fractions obtained show that more than simple distillation has occurred even at the lowest pressures. The purified fractions are being investigated as to their ultimate composition and chemical nature, molecular weight, specific gravity, viscosity, refractive index, coefficient of expansion and calorific value. The oils separated from the various fractions by distillation in a current of steam, as well as the gases produced in the original distillation, are also under examination.

To illustrate the pronounced effect of the pressure and temperature (which latter depends to some extent on the rate of distillation) on the character of the distillate, the following typical examples of a series of distillations are recorded (see Table I):—

TABLE I.

Expt. No.	Pressures (mm.).		Temp. in the vapour, approx. ° C.	Dis-tillate yield %	Bromine (mg.) absorbed per gram of distillate (approx.).	Oil (in c.c.) volatile in steam per 100 g. of distillate.
1	762	Copper retort.	285—385	93·0	275	37
2	510		280—365	95·0	280	33
3	200		275—320	96·0	255	21
4	68	Glass retort.	260—310	96·5	235	9
5	45			97·0	185	4
6	16		260—300	97·5	170	2·5
7	14			97·5	140	1
8	1		255—300	98·0	130	Nil.

There is a decrease in the "volatile oil content" and in the degree of unsaturation of the distillate taken as a whole, as the distillation pressure is reduced. These two properties of the distillate, however, do not vary in direct proportion with the change in pressure. Moreover, the distillate collected at any one pressure is not of constant composition during the whole of the distillation, since the separate fractions show a measurable difference in the degree of unsaturation. Table II. records this effect at three pressures.

TABLE II.

Distillation pressure, mm.	Fraction.	Percentage distilled.	Bromine (mg.) absorbed per gram of distillate (approx.).
758	1	40·0	290
	2	21·5	270
	3	32·0	230
23	1	43·0	125
	2	32·0	230
	3	22·0	220
1	1	41·5	75
	2	24·0	135
	3	33·0	145

Part of the unsaturation of the first fraction, especially in the distillation at atmospheric pressure, is probably caused by condensation of the vapours at the commencement of the distillation. This refluxing effect would tend to increase cracking effects.

At low pressures the first fraction sets to an almost white and non-fluorescent crystalline wax. As the distillation proceeds the colour of the semi-solid distillate changes through yellow and orange to greenish-brown. The last drops of the distillate in vacuum distillation experiments show an intense green-red fluorescence. The fractions from the distillation at atmospheric pressure, while still liquid, are all less fluorescent than the original mineral jelly. On setting they acquire a characteristic brownish-red colour markedly different from the colours of the fractions obtained at low pressure.

The unsaturated and saturated portions of the fractions can be partially separated by steam distillation or by rapid distillation at very low pressure under certain conditions. These portions are being further purified and differentiated by their varying solubilities in organic and inorganic solvents and by other means.

It is hoped to publish a detailed account of this work at a later date.

This note is published by permission of the Director of Armament Supply, to whom our thanks are due.

Main Laboratory,
R.N. Cordite Factory,
Holton Heath, Dorset.

THE OXIDATION OF HYDROCARBONS, WITH SPECIAL REFERENCE TO THE PRODUCTION OF FORMALDEHYDE.

BY E. W. BLAIR, D.I.C., B.SC. (LOND.), A.I.C., AND T. SHERLOCK WHEELER, B.SC. (LOND.), A.R.C.SC.I., A.I.C.

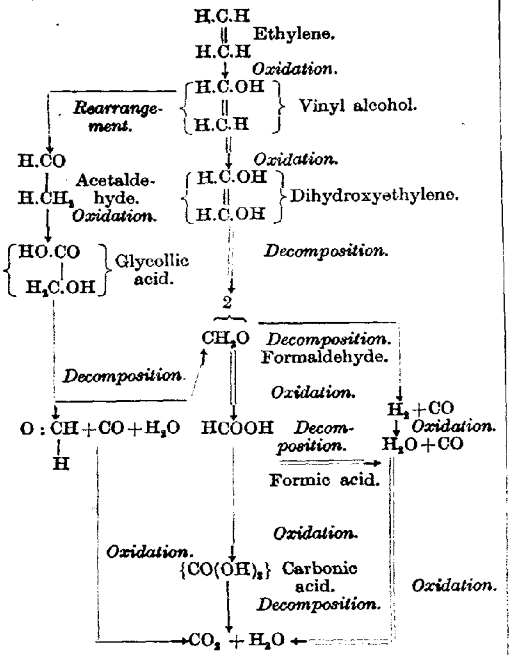
Part I. The Action of Oxygen on Ethylene.

At present formaldehyde is made from methyl alcohol by direct oxidation. This process has always had the disadvantage of being costly and even before the war many seemingly cheaper methods had been brought forward to replace it, but without success. With the object of investigating possible methods of manufacture, the authors have been engaged for some time past on a study of the oxidation of certain hydrocarbons. The following is an account of the first portion of the work, in which ethylene was the hydrocarbon employed. It was selected as the most suitable hydrocarbon with which to commence, after a study of the results obtained by Willstätter and Bommer (Annalen, 422, 36), and by Bone and his co-workers in their researches on the oxidation of hydrocarbons (Trans. Chem. Soc., 1902, 555; 1903, 1074; 1904, 693, 1637; Proc. Chem. Soc., 1905, 220).

According to the latter the interaction of ethylene and oxygen between 350° and 500° C. in contact with a surface occurs in the stages shown on p. 304 T (Trans. Chem. Soc., 1904, 1637).

From this and earlier work it seemed that only at temperatures above 500° C. does the action of oxygen on ethylene proceed with any great rapidity. Vinyl alcohol, considered to be the first oxidation product, is too unstable to be isolated, but the isomeric acetaldehyde has been obtained by Bone and Wheeler, who regard it as an intermediate only in very slow oxidations of ethylene.

Formaldehyde is the most prominent intermediate product because, comparatively speaking, it is the most stable. But although the general details of the course of the slow oxidation of ethylene had been worked out, precise information was, for the most part, lacking as to the effects of temperature, catalysts, etc. A quantitative investigation of the conditions of formation of formaldehyde from ethylene had been undertaken by Willstätter and Bommer (*loc. cit.*), who passed mixtures of ethylene, oxygen, and nitrogen through a tube at various temperatures and estimated the formaldehyde formed. They were led to the following conclusions:—



(Compounds that have not been isolated are enclosed in brackets. Double lines show the most usual course of the oxidation in their experiments.)

(1) That since ethylene, unless it be dilute, is unstable at temperatures above 350° C. it must not amount to more than 30% of the gas mixture, and the period of heating must be very short, *e.g.*, a second.

(2) That since formaldehyde, unless it be dilute, is unstable at temperatures above 310° C., it must not be formed in quantities greater than 2% by volume of the gas mixture, and, once formed, must be cooled as quickly as possible.

(3) All catalysts tried accelerated the oxidation of ethylene; but formaldehyde was never detected when they were used.

The present work amplifies these conclusions and in some respects modifies them; in principle the results are in complete agreement with the hydroxylation theory of hydrocarbon combustion first put forward by Bone and his co-workers. Evidence has been obtained that, even under very different external conditions, the stages by which the combustion of ethylene proceeds do not change; the formation of formaldehyde in contact with catalysts and in oxidations in which inflammation took place, has been proved (*cf.* Bone and Drugman, Trans. Chem. Soc., 1906, 660). Also acetaldehyde has been detected in oxidations under varying conditions, so it would appear that in our experiments the main course of the interaction of ethylene and oxygen is represented by the scheme on p. 310 T, which differs only in detail from that of Bone and Wheeler. The evidence for these views is set out below, together with some other deductions from our results; a full discussion is given at the end of the paper.

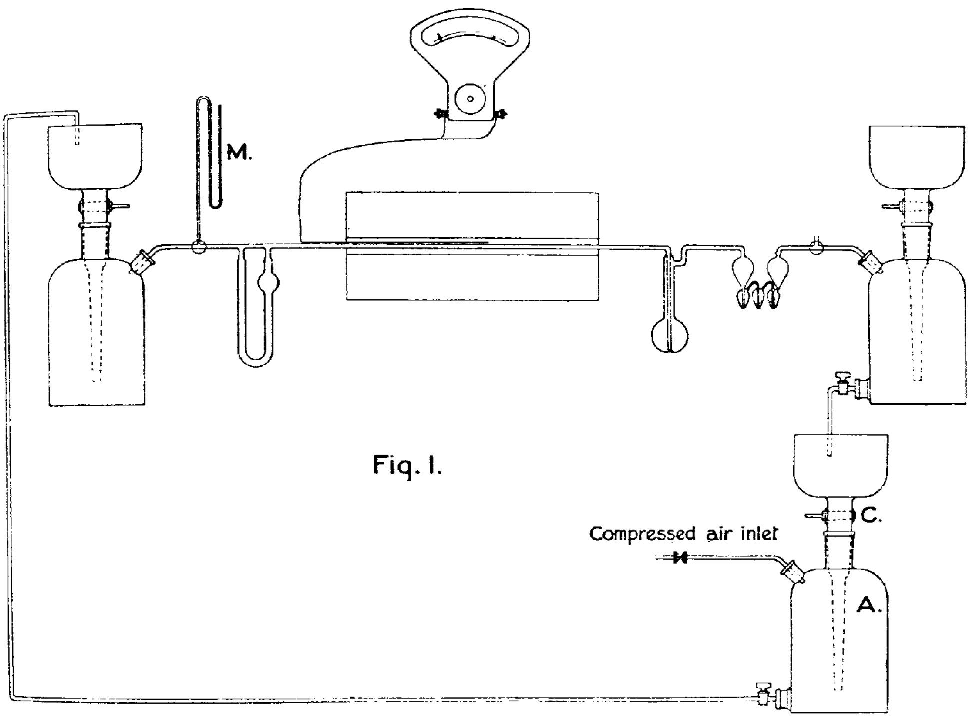
Preparation of gaseous mixtures.

The ethylene used was prepared by Newth's method (Trans. Chem. Soc., 1898, 915) and was well washed with caustic soda and with distilled water. We also made the gas by the action of zinc-copper couple on the dibromide in alcoholic solution and by the action of alcohol on sulphuric acid at 170° C., followed by a thorough purification, but found Newth's method the most satisfactory for the quantities we required. The gas was tested by explosion analysis and rejected unless the ratio contraction/absorption was between 0·99 and 1·01. Oxygen and nitrogen were obtained from cylinders and were washed with caustic soda and with water. The gaseous mixtures were stored over boiled-out 50% aqueous glycerin in which they were found to be insoluble; they were always rendered thoroughly homogeneous either by shaking or by allowing to stand overnight.

Apparatus for direct experiments.

Our first experiments (see Fig. 1) were carried out on the same lines as Willstätter's. The gas was passed from a graduated gasholder through a differential pressure gauge, in which the fall in presure of the gas in passing through a capillary tube was measured. By previous calibration this gave the rate of flow. The gas then entered a 3 or 4 mm. hard glass tube some 50 cm. long. This tube was heated at first in a gas furnace packed with asbestos, but in later experiments in an electric tube furnace, 40 cm. long, both ends of which were plugged with asbestos. The temperature was measured by means of a standardised indicator and thermo-couple; the junction of the latter was fastened to the centre of the hard glass tube. The gas, on leaving the tube, bubbled through a wash-bottle and a set of Liebig bulbs, both containing distilled water, and, freed from formaldehyde (this was proved experimentally), was collected in a graduated gas-holder fitted with a three-way tap.

An experiment was commenced by passing in the initial gas mixture to test for leaks. Three or four litres of gas was then passed through the apparatus and away by the three-way tap before the final receiver. Experiments showed that this was sufficient to remove all air. The furnace was brought to the requisite temperature, and the pressure, temperature, and volume of the initial gas mixture noted, allowance being made for the head of aqueous glycerin in the gas-holder. The pressure in the apparatus, as registered by the manometer, M, was also observed. The gas was then passed at a rate of the order of 1 litre in 10 minutes, and was thus heated for less than 2 seconds in its passage through the furnace. The rate was adjusted by controlling the flow of aqueous glycerin from the final gas-holder, which was used as an aspirator; the head of liquid in the initial holder was maintained by returning the liquid from A by closing tap C, and turning on compressed air. The pressure in the apparatus was kept as near to that of the atmosphere as possible during the experiment; at the end the manometer, M, was brought back to its initial reading before stopping the gas current. This ensured the same amount of gas being in the apparatus before and after an experiment. The pressure, temperature, and volume of the final gas were measured, and both gases were analysed in a Bone and Wheeler apparatus (Trans. Chem. Soc., 1904, 1640). All absorptions were repeated until no further contraction occurred. The residual gas, or an aliquot portion, was then mixed with a suitable quantity of pure oxygen, and electrolytic gas added before exploding to determine the ratio of contraction on explosion to absorption by potash and baryta water after explosion. This enabled the hydrogen and a figure for the thermal decomposition of the ethylene to saturated hydrocarbons to be obtained; these latter always had the approximate composition of methane. We never detected more than traces of acetylene in the products.



Fiq. I.

The volumes of the initial and final gases were reduced to N.T.P. and compared as a check, but these volumes could not be measured accurately enough to use both to deduce the quantities of ethylene etc. consumed in the experiment. This was done by using the initial volume only and calculating the final volume by comparing the analyses of the gases, and making use of the fact that the quantity of nitrogen did not change during the experiment. The absorbing water was made up to 250 c.c. and the formaldehyde estimated in an aliquot part, usually iodometrically (Z. anal. Chem., 36, 19), but when the presence of acetaldehyde was shown by a precipitate of iodoform, Ripper's bisulphite method (Monatsh., 21, 1079) and the potassium cyanide method were combined, the formaldehyde being estimated with potassium cyanide and the two aldehydes together with bisulphite; the amount of acetaldehyde could then be calculated. The iodometric method, though found best for dilute formaldehyde solutions, was not satisfactory when acetaldehyde was present; the bisulphite method was found to give more consistent results. All these methods were tested, with synthetic solutions of the strengths usually obtained. Also several experiments were made to prove that the amount of ethylene dissolving in the wash-waters was not sufficient to interfere with the iodometric estimation of formaldehyde.

After estimating the aldehydes and formic acid present, all other probable intermediate products —ethyl alcohol, glycol, glyoxal, ethylene oxide, and acetic acid—were tested for qualitatively in much the same manner as described by Bone and Stockings (Trans. Chem. Soc., 1904, 710), but all such tests gave negative results.

Experiments on catalysts.

Our first series of experiments was an extension of Willstätter's examination of the effect of catalysts on the reaction. Using a catalyst, the temperature was gradually reduced and the time of contact and the dilution of the gas increased until a barely perceptible reaction was obtained. If then formaldehyde is being formed and not being immediately decomposed some traces of it at least should be obtained. Formaldehyde was detected but even with a scarcely perceptible reaction hydrogen and carbon monoxide were the main products. Once the temperature is raised to any extent the catalyst causes the oxidation of carbon monoxide to carbon dioxide, and even more so of hydrogen to steam. The following examples taken from our experiments will make clear the type of action that occurs.

Experiment 9. *Catalyst: Platinum gauze. Temperature* 540° *C.*—Rate of gas-passage—I litre in 5 minutes. The gas was passed through a 4 mm. tube in the furnace described, a roll of platinum gauze 3 cm. long being placed in the tube 10 cm. from the exit of the furnace. The time of contact of gas with gauze was about 0·1 sec. No formaldehyde was obtained.

	Initial gas.	Final gas.
	%	%
CO_2	nil	8·3
O_2	17·6	0·6
C_2H_4	13·1	6·0
CO	nil	4·3
H_2	nil	3·0
Absorption	nil	0·5

No inflammation took place in this experiment, but the platinum was somewhat blackened and white fumes were formed. The gas mixture used suffered a contraction in volume of some 10% during the oxidation. The wash-water was faintly acid. The high CO_2 content is probably due to the oxidation of the CO first formed.

No formaldehyde was isolated by leading the gases in a capillary tube away from the gauze, so after a number of experiments a single thickness of gauze and a capillary tube were used.

Experiments 13, 14, 15. *Catalyst: Pt gauze.*—Rate of gas passage 1 litre in 5 minutes. 3 mm. tube. Gauze sealed across it 8 cm. from exit end of furnace. Capillary tube thence to exit. Time of contact less than 10^{-4} secs.

Experiment 13. 325° No action detected.
„ 14. 385° „ „

Experiment 15. 405°.

	Initial gas.	Final gas.
	%	%
CO_2	nil	nil
O_2	7·0	6·2
C_2H_4	25·5	24·7
CO	nil	1·3
H_2	nil	1·0
Absorption	nil	0·2

2 mmg. of formaldehyde was obtained per litre of gas. This result is of theoretical importance, as it shows that even with a catalyst formaldehyde is formed; it readily decomposes into hydrogen and carbon monoxide. Many experiments were made with varying mixtures of gases, but a satisfactory quantity of formaldehyde was never obtained using platinum gauze. It is probable, however, that with very high rates of gas passage and at a temperature of about 450° formaldehyde could be obtained in quantity with a catalyst, especially if a stabiliser were used (see later). Such experiments were not carried out, however, as we had not facilities for dealing with the high gas-speeds necessary. Among other catalysts platinised asbestos and ferric oxide were investigated. The action of the former is very vigorous. With these and with all catalysts tried, as the temperature rises, thermal decomposition of the ethylene can be observed; but this is not accelerated to such an extent as the oxidation. To sum up, the effect of a catalyst is to lower the temperature at which the various oxidation reactions take place and to bunch them together—so to speak—making them follow one another at very short intervals.

Extensions of Willstätter's experiments.

The next point that arose was whether in experiments without catalysts, as carried out by Willstätter, it might not be better to heat for a shorter time at a higher temperature. This was investigated in the same apparatus, using furnaces from 10 cm. to 35 cm. in length, and tubes of diameters from 1 to 5 mm. As the time of heating diminished at any given temperature the ratio of acetaldehyde to formaldehyde increased, but the total conversion was of course reduced; the percentage yield of aldehyde on ethylene improved, and if the time of heating at 540° was short enough, say, 1·5 secs., no carbon monoxide was formed, the only loss being due to thermal decomposition. With the same time of heating it is better to pass the gas through a narrow tube than through a wide one. This is probably due to turbulence giving more even heating with the former or perhaps to an increased surface effect.

Willstätter did not work with less than 20% of ethylene; on continuing his investigations in this direction by decreasing the ethylene and increasing the oxygen content, it was found that the percentage of formaldehyde on the ethylene converted rose. This also occurred as the temperature was reduced. Thus at 540°, using a mixture containing 17% of ethylene and 13% of oxygen, 4 mmg. of formaldehyde per litre in 70% yield, and a little acetaldehyde were obtained; no carbon monoxide was detected.

Experiment 45.—Four litres of gas was passed through a 3 mm. tube in the same apparatus in 60 minutes. Time of heating of gas, about 1 sec.

	Initial gas.	Final gas.
	%	%
CO_2	nil	nil
O_2	13·3	13·1
C_2H_4	17·7	17·5
CO	nil	nil
H_2	nil	nil

There is so little change in the volume in the gas before and after the experiment that the percentage of ethylene in the final mixture can be subtracted directly from the percentage in the initial mixture to obtain the quantity consumed.

Apparatus for circulation.

As the small quantities mentioned could not be determined very accurately, it was decided to circulate the gas mixture; in this way the course of the oxidation could be followed even when interaction was occurring slowly. Our experiments up to this point had convinced us that to make formaldehyde directly from ethylene in yields approaching the theoretical the gas mixtures must be circulated without a catalyst. For a successful circulation it is necessary that the conversion should be to formaldehyde, and very little else, even though the amount of formaldehyde is very small in consequence.

The circulation apparatus (Fig. 2) was as follows:—From the automatic Sprengel pump, A (*cf.* Bone and Wheeler, Trans. Chem. Soc., 1903, 1076), the gases passed to a bulb, B, of about 350 c.c. capacity. Fresh gas was admitted through the tube, *p*, and three-way tap, t^1, by means of a mercury valve, K, arranged to admit gas automatically as soon as the pressure fell below a predetermined amount. The gas then passed the three-way tap, t^2, whence samples could be withdrawn into the bulb, C, and thence delivered by three-way tap, t^3, and tube, *b*, into holders for analysis. The bulb, D, prevented any sudden sucking back of the water in the various wash-bottles during this operation. By means of the three-way taps, t^4 and t^5, the gas could be passed through either, or both, of two furnace tubes, and their corresponding sets of worms, *l*,*l*,*m*,*m*. E^1, E^2 were rate gauges, F^1, F^2 wash-bottles containing distilled water put in to act as flash-traps in the event of inflammation in the tubes. The second tube was used only when it was desired to compare the effect of tubes of different materials, construction, etc. *n* was a final worm common to both tubes. All the worms contained distilled water. The arrangement of tubes and thermo-couple in the electric furnace was as before. L, M, N, P, were four gas holders. L contained pure ethylene, M pure oxygen, N pure nitrogen, and P an almost equimolecular mixture of the first two, made up so that by adding it to the circulation gas, the latter remained nearly constant in composition. An experiment was started by exhausting the apparatus first with a water pump through t^6, and then with the Sprengel pump, using the three-way tap, *t*. When the apparatus was exhausted, as shown by the manometer and by the mercury clicking in the fall tube, exhaustion was stopped and the whole allowed to stand overnight to test for leaks. These being absent, nitrogen, ethylene, and oxygen were admitted in the requisite amounts, the quantities being controlled by means of the manometer, T. K and *p* were always swept out to the air with the gas to be treated, by means of three-way tap, t^7. The actual quantities of gases admitted were read from the graduated holders, and reduced to N.T.P. The gases were circulated for 6 hours thoroughly to mix them, saturate them with water vapour and enable all adjustments to be made before a sample was drawn off for analysis. The furnace was then heated to the required temperature, and the mercury in K adjusted so that gas was on the point of being admitted, by adding or withdrawing mercury by the bulb R. The gases were at times circulated for days, being analysed three times in 24 hours. The rate was kept constant by controlling the air-lift on the automatic pump as described by Bone and Wheeler (Trans. Chem. Soc., 1903, 1079). At Z was fitted a small glass reaching half-way across the top of the fall-tube. It was found that it broke even rapid streams of mercury, thus enabling high rates of gas circulation to be maintained.

By adjusting the taps connecting L, M, N, P with the tube, X, it was possible to admit gas from one of the holders continuously. Usually it was P that was connected. If the mixture in P was not keeping the composition constant its constitution was altered, by adding more ethylene or oxygen from L or M, or through Y, an open tube dipping under mercury, whence also samples of the gases in the holders could be taken. If the constitution of the circulating gas required altering some of it could be pumped off through *t* and fresh gas added, T being used to check quantities.

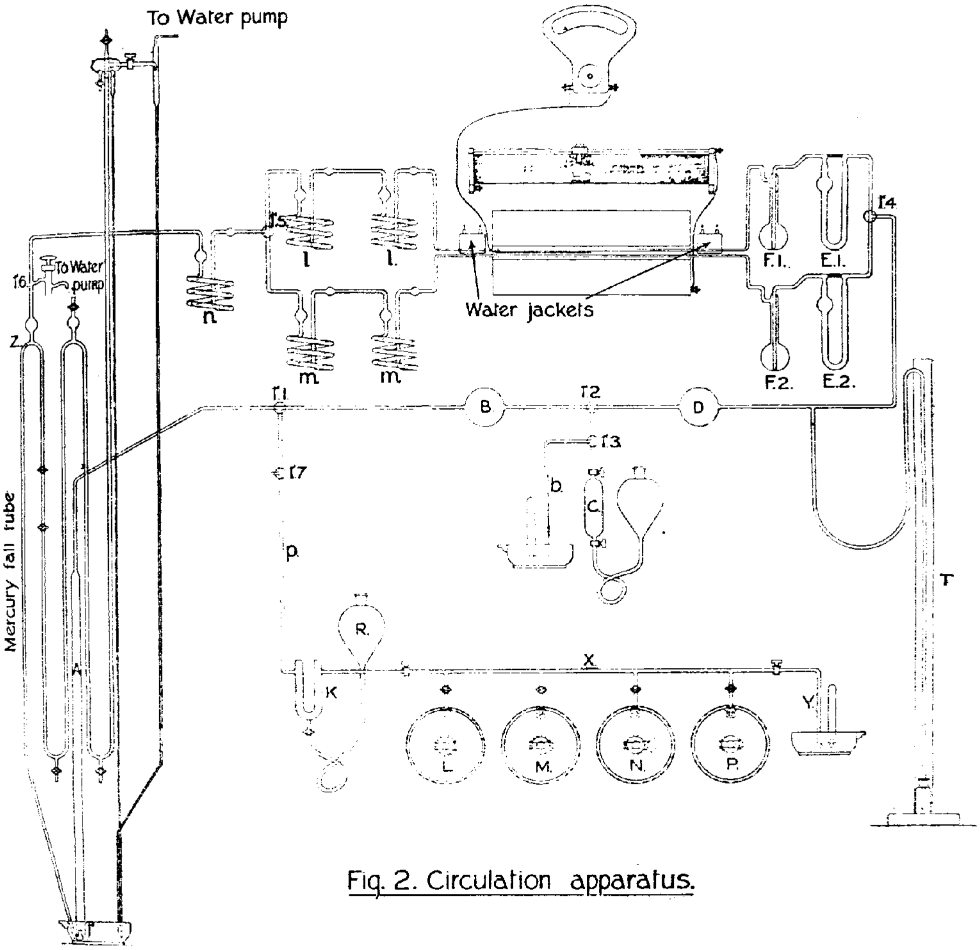


Fig. 2. Circulation apparatus.

Results of circulation experiments.

In our first experiments the circulation period was only 12 hours and no additional gas was admitted. Pressure readings were taken at intervals to control the experiments just as described by Bone and Wheeler (*loc. cit.*); the pressure curves obtained were of the type described by them. Dilute gases at temperatures of about 560° were used, as our previous experiments had convinced us that this was the optimum temperature. The following is a typical experiment.

Experiment 67. 0·720 litre of gas at N.T.P. was circulated at 560° for 12 hours at an initial corrected pressure of 748 mm. The corrected pressure fell 76 mm. during the experiment. The rate of circulation was approximately 1 litre in 30 mins.

A 4 mm. tube in a 30 cm. furnace was used, so the time of contact was about 4 secs.

	Initial gas. %	Final gas. %
CO_2	nil	0·3
O_2	9·6	3·5
C_2H_4	15·1	10·8
CO	nil	2·6
N_2 (saturated hydrocarbons included)	75·3	82·8

The yield of formaldehyde was 75 mmg. per litre (50%) and the amount of ethylene consumed 53 c.c. per litre.

Comparing the volumes of the gases before and after the experiment it can be calculated that 63 c.c. of oxygen and 53 c.c. of ethylene were consumed. There were obtained in the products per litre of gas:—

3 c.c. CO_2 = 2 c.c. C_2H_4 and 5 c.c. O_2 (allowing for
26 c.c. CO = 13 c.c. „ „ 26 c.c. O_2 „ H_2O)
75 mmg. CH_2O = 28 c.c. „ „ 28 c.c. O_2 „

43 c.c. of C_2H_4 and 59 c.c. of O_2 are thus directly accounted for. The remainder of the oxygen was consumed in the formation of intermediate products etc. The ethylene is not all accounted for, the difference in this case being due to thermal decomposition. Thus, for 100 c.c. of C_2H_4 used, 4 c.c. oxidised to CO_2, 25 c.c. oxidised to CO, 53 c.c. oxidised to CH_2O, and 18 c.c was thermally decomposed.

This is a good conversion, for as the oxygen-content decreased there was a greater possibility of thermal decomposition of the ethylene than if the oxygen-content was being maintained. The slow rate of circulation also helped this decomposition and also the oxidation of formaldehyde to formic acid and the further decomposition of the latter to steam and carbon monoxide. As no hydrogen was obtained, direct decomposition to hydrogen and carbon monoxide does not seem to occur to any extent under the conditions of the experiment.

Several circulation experiments of the above type were carried out. The automatic valve to admit fresh gas was then used, and experiments were performed with its aid, and many of the statements made in the earlier part of this paper as to the influence of surface, time of heating, dilution, etc. were confirmed. Also by circulating a mixture and raising the temperature a few degrees at intervals of 3 hours it was possible, by observations of the fall in pressure, to confirm our results as to the temperature at which an appreciable reaction occurs in a heating period of about a second. Of special interest is an experiment in which, using a short time of heating (0·6 sec.), in addition to 100 mm. of formaldehyde, 5 mmg. of formic acid was obtained per litre per day. With such a time of heating the gas does not reach the temperature of the couple, for even with a mixture within the explosive limits, inflammation does not occur below 610°. In all experiments in which much formic acid was isolated the percentage of oxygen was high (20%), C_2H_4 being usually about 13%. On the other hand, by decreasing the oxygen-content to about 10%, C_2H_4 remaining at 13%, at 540° as much as 5 mmg. of acetaldehyde per litre of circulating gas was obtained in a day. Bone and Wheeler, and Willstätter also detected these compounds.

Investigations were then carried out with this apparatus to determine whether it might not be better to use explosive mixtures at temperatures below the ignition temperature, 546° C. It has been shown that the greater the dilution of the ethylene the better the conversion, but mixtures containing less than 14% ethylene are inflammable, so it remained to see if such dilute mixtures could be used below 546°. The action, however, was too slow and the percentage of acetaldehyde in the formaldehyde produced was high, viz., up to 10%.

It is noteworthy that a large excess of oxygen inhibits the oxidation, much more than a large excess of ethylene (see also Trans. Chem. Soc., 1904, 703, 1643). Thus, starting with a gas containing 10% of oxygen and 20% of ethylene, and gradually increasing the oxygen content, keeping nitrogen at 70%, the rate of reaction increases until the mixture contains equal volumes of the gases but falls off rapidly when the oxygen is further increased.

By the aid of the second tube shown in the diagram the effects of tubes of steel etc. were compared by passing one half of the gas through the metallic tube and the other half through the glass tube. Slight oxidation of the metallic tubes occurs; the metal, and also the oxides formed, act as catalysts and cause the decomposition of the formaldehyde (see Expts. IV. and V., Table I.). Only 15 mmg. of formaldehyde per litre of ethylene was obtained in 48 hours at 600° with the steel tube, but the formation of even this small quantity confirms our results with platinum gauze. The yield was 1·5% on the ethylene consumed. Both CO and CO_2 were formed. Under similar conditions with a glass tube (O_2, 16%; C_2H_4, 19%) formaldehyde was obtained at 8 mmg. per litre per hour in 70% yield. There was only a small quantity of acetaldehyde in the product.

Experiment 69. (See Experiment III. Table I.). 0·625 litre (N.T.P.) of a mixture of ethylene, oxygen, and nitrogen was circulated at 575° for 39 hours. The rate of circulation was about 1 litre in 15 mins., the time of heating in the tube being about 1 sec. Fresh gas (C_2H_4 48·3%; O_2 51·3%) was admitted automatically and a 25 c.c. sample was taken after 15 hours, the pressure being kept constant throughout.

	Initial gas.	Sample.	Final gas.
CO_2 ..	Nil	Nil	0·2%
O_2 ..	15·8% = 99 c.c.	15·4% = 4 c.c.	14·2% = 89 c.c.
C_2H_4 ..	19·4% = 121 c.c.	19·1% = 5 c.c.	17·0% = 106 c.c.
CO ..	Nil	1·1%	3·5% = 22 c.c.
N_2 ..	64·8% = 405 c.c.	64·4% = 16 c.c.	65·1% = 404 c.c.

192 mmg. of formaldehyde and some acetaldehyde were obtained. 0·163 litre of gas containing 77 c.c. C_2H_4, 82 c.c. O_2, 1 c.c. N_2 was fed in during the experiment. Allowing for the quantities in the sample, there disappeared during the reaction 87 c.c. of C_2H_4 and 88 c.c. O_2, and there was found 17 c.c. of residual gas. The contraction due to reaction = 160 c.c. Making use of the following equations

$$C_2H_4 + O_2 = 2CH_2O$$

$$C_2H_4 + 2O_2 = 2H_2O + 2CO,$$ we have

192 mmg. CH_2O = 70 c.c. C_2H_4, 70 c.c. O_2, 140 c.c. contraction.
22 c.c. CO = 11 c.c. C_2H_4, 22 c.c. O_2, 11 c.c. contraction.

Total appearing in products =
81 c.c. C_2H_4, 92 c.c. O_2, 151 c.c. contraction.
Total consumed =
87 c.c. C_2H_4, 88 c.c. O_2, 165 c.c. contraction.

The oxygen is in fair agreement; the other differences are due to thermal decomposition which cannot well be allowed for, and to the difficulty of measuring accurately the volumes of the gases used. The experiment may be summarised as follows:—

Expt.	Temp.	C_2H_4.	O_2.	mmg. CH_2O formed per litre.	c.c. C_2H_4 consumed per litre.	% C_2H_4 → CH_2O
69	575°	19·4%	15·8%	300	160	70

The composition of the gas must be carefully controlled so that the ethylene does not fall below 14%. If a mixture of 50% C_2H_4 and 50% O_2 be added through the automatic valve the composition of the reacting gases will alter only slowly as the oxygen is usually consumed a little faster than the ethylene. The method of calculating the results of these experiments will be clear from what has been given above, so it is unnecessary to give further details of gas analysis etc.

The following is a summary of some of our circulation experiments:—

TABLE I.

Temp. of expt.	Diam. of tube.	% of ethylene in mixture before and after experiment.	% of oygxen in mixture before and after experiment.	Total time of experiment in mins.	Rate of passage of gas in c.c. per min.	Time of heating of gas in each passage through tube in secs.	No. of mmg. of formaldehyde produced in passage of 1 litre through tube.	% of C_2H_4 consumed, converted to formaldehyde.
°C.	mm.							
I. 560°	4	15·1% → 10·8%	9·6% → 3·5%	720	30	4	3	50%
II. 575°	3	13·4% → 10·5%	14·9% → 13·0%	840	50	2·4	2·3	70%
III. 575°	2	19·4% → 17·0%	15·8% → 14·2%	2340	67	1·0	2	75%
*IV. 600°	3	14·9% → 17·5%	11·6% → 0·0%	1080	31	2	0·3	1·5%
*V. 550°	4	12·8% → 9·8%	17·9% → 3·9%	2970	31	4	0·7	25%

* These experiments were made with a steel tube; the remainder with glass tubes.

Formaldehyde stabilisers.

(*a*) *Steam.*—The use of steam as a formaldehyde stabiliser was investigated; it was hoped by means of some such stabiliser to be able to isolate a quantity of formaldehyde from an oxidation giving little in the ordinary way. This would confirm the view that under all conditions formaldehyde is formed though only momentarily. In several experiments steam was added to the gases up to 50% of the total volume, by passing the ethylene-oxygen-nitrogen mixtures through water at the temperature (83°) at which its vapour pressure is slightly more than half an atmosphere. The steam in these experiments was condensed and the formaldehyde absorbed by passing the gases through two water-worms. The steam did stabilise the formaldehyde to some extent. From an explosive mixture ($O_2=50\%$; $C_2H_4=25\%$), using a 40 cm. furnace, 15 mmg. of CH_2O was obtained at 600° in 55% yield. No inflammation took place, but in another experiment at 610° inflammation took place and the yield was materially reduced (14 mmg. in 8% yield). The steam had also a protective action on the formic acid. Our experiments showed that, although no formaldehyde may be obtained, yet it is undoubtedly formed even under conditions which lead to inflammation of the gas mixture. It may be added that steam does not stabilise formaldehyde in the presence of catalysts; hydrolysis then seems to occur. $CH_2O+H_2O=CO_2+2H_2$. (See J. Amer. Chem. Soc., 1921, 1670.)

(*b*) *Ammonia.*—The use of ammonia to stabilise formaldehyde as hexamethylenetetramine was then tried (E.P. 156,136). It was introduced into the gases either directly or by bubbling through 0·880 ammonia solution (Trans. Chem. Soc., 1903, 1169), the hexamethylenetetramine being distilled with dilute sulphuric acid to recover formaldehyde. The following typical experiment may be quoted.

Experiment 74.—A mixture containing 42·1% ethylene and 43·2% oxygen was passed through a bulb of about 500 c.c. capacity, and ammonia was led into the bulb at the same rate. The mixed gases were then passed through a 4 mm. tube in the usual furnace, through three washers to remove ammonia and hexamethylenetetramine, and into a gas holder.

Rate of passage of the ethylene-oxygen-nitrogen mixture=1 litre in 20 minutes.

1·33 litres (at N.T.P.) of the mixture was passed through the tube in 15 minutes. The time of heating was 3 secs.

Expt.	Temp.	C_2H_4.	O_2.	c.c. C_2H_4 consumed per litre.	Yield CH_2O per litre.
74	590°	42·1%	43·2%	49 c.c.	60 mg., 50%

The stabilising effect of the ammonia is here clearly seen. A 50% yield at such a temperature and with such a mixture is interesting considering that almost 50 c.c. of ethylene had entered into the reaction. Also, with the aid of ammonia, we isolated some formaldehyde in contact with catalysts, but much thermal decomposition occurred. At lower temperatures better results were obtained, due to less decomposition of both the ethylene and hexamethylenetetramine. The latter decomposes if heated much above 100°; in a vacuum it is stable and also at high temperatures when formed in a gas current as above and swept out of the hot tube immediately. Since the best results were obtained at lower temperatures it would seem best to use ammonia in conjunction with a catalyst which would lower the oxidation temperature but would not thermally decompose ethylene. No such catalyst was found, but the subject was not pursued for the presence of formaldehyde had been proved, and on economic grounds the ammonia method seemed to offer no advantage over the direct oxidation process, more especially as a portion of gas is oxidised to nitrogen. It may be noted that excess of ammonia increases the stabilising action, but even when using only a little it still exerts to some extent its stabilising effect. It also hinders the decomposition of formic acid, which was always detected, sometimes in quantity, in the distillate in most of the experiments in which ammonia was used.

It was not impossible that in the presence of ammonia, hydrogen and carbon monoxide might yield formaldehyde owing to the latter being removed by the ammonia as fast as formed. To test this a mixture of 3 vols. of hydrogen, 3 vols. of carbon monoxide, and 6 vols. of ammonia was circulated for 5 days beginning at 500° and gradually rising in 2 days to 700°. Up to 640° no reaction was noted; at this temperature crystals appeared on the exit end of the furnace tube and a fall in pressure took place. The matter was not further investigated as the temperature at which this reaction took place was too high to affect our ethylene experiments. The crystals looked not unlike urea.

Discussion of results.

(*a*) *Course of the oxidation.*—Our experiments with ammonia and steam indicate that formaldehyde is always formed in inflammations and even in contact with catalysts. It then breaks down if the temperature is high, say above 600°, or if its concentration rises above 2% of the mixture. Otherwise the formaldehyde is oxidised, if enough oxygen is present and the time of heating is sufficient, to formic acid, which decomposes very readily into carbon monoxide and steam; the carbon monoxide then oxidises much more slowly to carbon dioxide. With dilute ethylene the action is slow and from such mixtures, with a short time of heating, the formation of appreciable quantities of acetaldehyde or of formic acid according to the proportion of oxygen present has been proved. A short period of heating is necessary for the detection of acetaldehyde because it is an early intermediate product and for that of formic acid because of its instability. A slight excess of oxygen helps the formation of the latter, a deficit or a large excess assists that of the former. The inhibitory action of an excess of oxygen has been noted. (*Cf.* Bone and Andrew, Trans. Chem. Soc., 1906, 1232.)

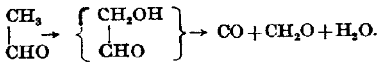
The effect of catalysts, concentrated gases, high temperatures or increased period of heating is to make the reactions follow one another very rapidly and to proceed further to completion. It is interesting to observe how with catalysts, as the temperature increases, the percentage of carbon dioxide, even with little oxygen, approaches that of carbon monoxide, owing mostly to an increase in the rate of oxidation of the intermediate products. One point may here be emphasised. Bone and Wheeler (Trans. Chem. Soc., 1902, 537) proved that under the conditions of their bulb experiments the following reactions do not take place:—

$$\begin{aligned}&1.\quad CO + H_2O = CO_2 + H_2\\&2.\quad 2CO + O_2 = 2CO_2\\&3.\quad 2H_2 + O_2 = 2H_2O\end{aligned}$$

so that in their experiments carbon dioxide and water were only formed as a result of nascent action and through direct decomposition of the hydrocarbon oxidation products. But in our experiments, though 1. and 2. were comparatively slow except with catalysts, yet 3. was not; so that a small direct decomposition of formaldehyde is not easy to distinguish from decomposition *via* formation of formic acid. The quantities of formaldehyde persisting make the latter more probable.

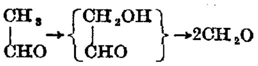
Acetaldehyde was obtained so frequently that we believe that under the conditions of our experiments acetaldehyde rather than dihydroxyethylene was the intermedeiate product of oxidation. It would seem that in oxidations where the gases are interacting slowly there is time for most of the vinyl alcohol first formed to isomerise to acetaldehyde before further oxidation occurs. In inflammations, however, and in oxidations accelerated by surfaces or by catalysts, the main course of the oxidation may be *via* dihydroxyethylene as indicated by Bone and Wheeler (Trans. Chem. Soc., 1904, 1637).

With regard to the oxidation of the acetaldehyde formed in our experiments, Bone and Stockings (*loc. cit.*) found that under the conditions of their experiments acetaldehyde was oxidised thus:—



$$\begin{matrix}CH_3\\|\\CHO\end{matrix} \rightarrow \left\{\begin{matrix}CH_2OH\\|\\CHO\end{matrix}\right\} \rightarrow CO + CH_2O + H_2O.$$

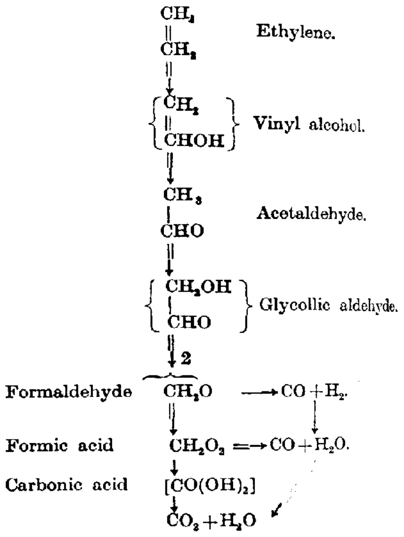
At first sight it would appear from this that it was impossible that acetaldehyde could be in the main course of the oxidation of ethylene where yields of over 50% of formaldehyde are obtained. But the scheme



$$\begin{matrix}CH_3\\|\\CHO\end{matrix} \rightarrow \left\{\begin{matrix}CH_2OH\\|\\CHO\end{matrix}\right\} \rightarrow 2CH_2O$$

is quite possible on the hydroxylation theory, and it is probable that under the conditions of our experiments acetaldehyde did oxidise in this way. This follows from the consideration that as the temperature of oxidation fell the ratio of acetaldehyde to formaldehyde increased, and yet the carbon monoxide formed decreased until at 550° none was to be detected, although acetaldehyde was present, and some must have oxidised (*cf.* Willstätter and Bommer, Annalen, **422**, 45; also our experiment 45, p. 306 T).

The following scheme represents then the main course of the interaction of ethylene and oxygen under the conditions of our experiments:—



(Double lines show the most usual course of the oxidation in our experiments).

We have to thank Professors W. A. Bone, F.R.S., and R. V. Wheeler for their kindly criticism of our work. Both agree with the above scheme for the preponderating course of oxidation of ethylene under the conditions of our experiments.

This work was carried out for the Chemistry Research Board of the Department of Scientific and Industrial Research, to whom we are indebted for permission to publish these results.

Main Laboratory,
R.N. Cordite Factory,
Holton Heath, Dorset.

Canadian Sections.

Meeting held at Ottawa on May 15, 1922.

MR. F. J. HAMBLY IN THE CHAIR.

THE CORROSION OF CAST IRON AND LEAD PIPES IN ALKALINE SOILS.

BY J. W. SHIPLEY.

Part I.

The Corrosion of Iron by Soil.

The corrosive destruction of underground metal structures in western Canada has become a matter of real concern to the public as well as to the engineering profession. The disintegration of concrete foundations, aqueducts, and sewers, when exposed to the alkaline salts found in the soils of the western prairies, has led to an investigation conducted jointly by the Engineering Institute of Canada and the Industrial Research Council assisted financially by several western cities, the Canada Cement Company, and the Governments of Saskatchewan and Alberta.

The corrosive destruction of steel and iron structures when buried in these soils led to an investigation of the problem, primarily, in the interests of the Winnipeg Electric Street Railway, in order to determine whether such destruction took place in the absence of stray electric current. Field observations indicated severe corrosion remote from railway tracks or in localities where current would be flowing into the metal structures, and not out of them. Such was the case at the Mental Hospital at Selkirk, Manitoba, where the flanges on the bells of the cast-iron water main could be whittled off with a jack knife to a depth of a quarter of an inch or more. Soft areas on the pipe were marked by patches of rust, on removing which the iron could be dug into with a knife blade. At one spot where a limestone pebble was in contact with the pipe the deepest pitting was observed, the pipe having softened to a depth of about a quarter of an inch. This pipe line had been in the ground for eight years, and was located 1¼ miles beyond the northern extremity of the trolley line that runs to Winnipeg, the nearest sub-station being over five miles further south. The hospital water-pipe system had no connexion with the town water pipes, and the observed corrosion was on that part of the system farthest removed from the electric railway. A delicate galvanometer failed to show any trace of stray current.

Other instances of this graphitic softening of cast iron were found in the C.P.R. yard at North Transcona, almost three miles from the nearest electric railway track, and in St. Boniface at the stock yards, half a mile outside the area of electric railway operations.

Before the construction of the concrete aqueduct from Indian Bay water from artesian wells to the north-west of the city was conducted into Winnipeg. Steel water pipes, first laid, were so badly damaged by external soil corrosion after three years that they were replaced by cast-iron pipes, well covered with a coat of tar. About half a mile of these pipes was dug up in the autumn of 1921, and examination indicated that they were remarkably well preserved. Corrosion was only apparent where the protective coating had been abraded, *e.g.*, beneath the sling with which the pipes had been lowered into the trench. The pipes had been in the ground for eight years.

Breaks in the cast-iron water main system within the city of Winnipeg are frequently occurring, and a number of these show the characteristic graphitic softening clear through the pipe. Laboratory experiments showed that this softening is produced alike by soil salt solutions acting on the iron, or by an electric current leaving the pipe. Consequently, it is impossible to determine what damage should be attributed to stray current electrolysis and what to soil action. The problem is further complicated by the fact that the very conditions most conducive to soil corrosion are also most conducive to stray current electrolysis. A concentration of salts in the ground water makes a path of low resistance for the electric current.

The soils of the Winnipeg district.

The soils of the Winnipeg district consist of layers of lacustrine and alluvial silts and clays overlying glacial till. The first three to four feet below the surface loam is quite porous and rich in finely-divided limestone. The next layer is a dense, colloidal, chocolate-coloured clay containing a considerable percentage of limestone, but quite impervious to the flow of water. Beneath this lies a narrow, dark yellow layer of limy silt, frequently filled with crystals of selenite. This narrow layer rests upon the so-called blue clay or "gumbo." This last is very similar in composition and texture to the 5—6 feet of chocolate-coloured clay overlying the 18 inches of silt impregnated with selenite. The water pipes lie in the first or second clay layers, while the back fill is composed of a mixture of all layers. Crystal aggregations of salts occur in the three lower layers. These are disseminated along the bedding planes, in the vertical cleavages and particularly along roots and rootlets, where the spaces are frequently completely filled with crystals. These consist largely of calcium sulphate containing a little magnesium sulphate.

The water-soluble salt content of the soil is frequently more than 1% of the total weight of soil, while, in some instances, it is as high as 10%. The ground waters contain the sulphates, chlorides, and carbonates of calcium and magnesium, and are saturated in respect to calcium sulphate and carbonate.

Through the clay layers there is practically no lateral movement of the ground waters, and the use of the term "water table" has no significance. A difference of 4—6 feet in the ground water level has been observed over a horizontal distance of 30 feet, and this difference persisted through several months. The moisture content of the soils varies between 20% and 30%. The average electrical resistance of eighteen samples was 570 ohms per c.c., the lowest being 206 ohms, the highest 1085. A gravel back fill saturated with water gave an electrical resistance of 12,750 ohms per c.c. Below is given an analysis of three of the soil layers described above. The samples were dried at 105° C. and treated with hydrochloric acid.

	SiO_2 insol. in HCl	Fe_2O_3	Al_2O_3	P_2O_5	CaO	MgO	Na_2O	CO_2	SO_3	Cl	H_2O and organic
	%	%	%	%	%	%	%	%	%	%	%
Yellow limy silt	43·0	1·9	5·6	0·15	17·0	7·8	0·41	23·8	0·4	0·07	0·2
First clay layer	59·2	6·3	11·1	0·30	5·7	3·3	0·95	5·5	3·6	0·05	3·8
Second clay layer or "gumbo" ..	59·4	5·0	10·2	0·26	7·6	3·3	0·26	5·2	4·7	0·04	4·4

The clay layers in the above table contain a higher sulphate content than the average of these layers, but represent what is frequently encountered.

Composition of corroded material.

The graphitic softening of cast iron differs entirely from the destruction of steel and wrought iron. The two latter are pitted, and the material of the pipe is completely carried away, but cast iron corrodes without affecting the form of the pipes. No pitting appears on the surface, and a casual inspection indicates an undamaged condition. Much of the iron passes out into the surrounding soil, leaving a soft, spongy mass of residual graphite, silica, and iron, and frequently, secondary deposits of sulphide, carbonate, and phosphate appear in the corroded mass. This softening may extend entirely through the pipe without affecting its functioning as a conduit.

Table I.

Composition of matter in soft areas on cast iron pipe.

Location of pipe	Metallic iron. %	Ferrous iron. %	Ferric iron. %	Silicious-graphitic residue. %	Remarks.
Portage and Hargrave	26·2	23·0	2·2	30·4	Pitting 3/8″ deep.
Edmonton and Qu'Appelle	35·2	16·6	10·4	25·6	Pitting 3/8″ deep.
Stock Yards, St. Boniface	52·0	17·4	8·9	13·2	Pitting 1/8″ deep.
Stock Yards, St. Boniface	41·4	·24·6	4·2	18·4	More than 1/8″ deep, and sulphur 1·1%
Selkirk Mental Hospital	49·2	18·4	9·1	17·8	Pitting 1/4″.

The proportion of residual metallic iron decreases as the corrosion progresses, while that of the silicious-graphitic residue increases. The proportion of the components in the graphitic mass bears little relation to the original ingredients of the cast iron and the state of oxidation varies within wide limits. Sometimes the corroded material lifts completely out of the pipe. An analysis of one of these "fillings" gave metallic iron 2%, ferrous phosphate (vivianite) 18%, and carbon and silica 42%. The specific gravity of the mass is often reduced to one-third of that of the original cast iron.

Besides this graphitic corrosion, scale sometimes appears on the pipe. A full analysis of this material was not attempted, since it was more or less incorporated with the soil in contact with the pipe. The large proportion of iron in the ferrous condition was the most remarkable feature in the composition of this scale.

Table II.

Nature of iron in pipe scale.

Location of pipe.	Metallic iron. %	Ferrous iron. %	Ferric iron. %	Remarks.
Ellice and Donald ..	1·4	30·0	7·4	Slightly magnetic.
Manitoba Gypsum Works	4·2	9·7	13·0	Slightly magnetic.
Bannatyne and Princess	0·4	12·5	0·2	Non-magnetic.
Stock Yards, St. Boniface	1·1	23·1	12·5	Slightly magnetic.

The field observations covered practically the entire city of Winnipeg, together with adjacent municipalities, and included the examination of half a mile of water mains along River Avenue, Fort Rough, and half a mile of pipe from the old water district, north of the city.

Laboratory investigation.

The laboratory investigation was carried out with the object of determining (1) what salts were most active in promoting the corrosion of cast iron, and (2) what was the probable cause of the corrosion. Pieces of cast iron immersed in salt solutions, dilute and concentrated, to which distilled water was added as evaporation proceeded, were kept under observation for a period of 40 days.* During the day some of these were heated to 80° C. or higher. Graphitic softening was produced in more than half the samples, the sulphates and chlorides of calcium and magnesium attacking the iron most actively. Calcium carbonate saturated with carbon dioxide also proved to be corrosive, but the salts of magnesium were the worst. In general those salts which formed acid products of hydrolysis were most corrosive, while those giving basic products were least.

Heating did not appear to hasten the corrosion. This would indicate that the corrosive action is electro-chemical rather than chemical in nature, and the usual doubling of the chemical action for a 10° C. rise in temperature does not follow. That is, we are dealing with the chemical action produced by a difference in E.M.F., and consequently the temperature coefficient for voltage, which is relatively small, is alone concerned.

A set of experiments in which samples of soil were used instead of salt solutions was made simultaneously with those just described. Corrosion of the cast iron was of the same nature as that observed from the salt solutions, but the softening was not so clearly defined. The most marked local softening was observed in a sample of soil taken from the thin, yellow layer known to contain much calcium sulphate in the form of selenite.

Concentration cells.

Several concentration cells were set up on freshly polished pieces of cast iron. These were made by "diking" off portions of the surface of a cast iron pipe with paraffin. Then adjacent sections were filled with dilute and concentrated salt solutions, and liquid electrical connexion made by an inverted glass U-tube containing a wick saturated with the dilute solution. Rusting was observed to take place on the surface containing the dilute solution. Here the iron was going into solution under the influence of the galvanic action of the concentration cell. The iron ions soon became hydrated and rust appeared.

A striking manifestation of the flow of current and of the migration of iron was afforded by the passage of colloidal ferric iron up the wick of the U-tube. After a few hours the reddish-coloured colloid passed completely through the glass tube and was being deposited on the iron in the other division of the cell. This phenomenon complicated the interpretation of the observed results and limited the time during which an experiment could run.

Three experiments were carried out in cells similar to those just described with solutions of unlike salts.

Table III.

Galvanic electrolytic cells in diverse concentration on cast iron.

1. NaCl dilute to NaCl conc.	Rusting on dilute only
2. $MgSO_4$ dilute to $MgSO_4$ conc.	Rusting on dilute only
3. $MgCl_2$ dilute to $MgCl_2$ conc.	Rusting on dilute only
4. Na_2SO_4 dilute to Na_2SO_4 conc.	Rusting on dilute only
5. $CaSO_4$ dilute to $CaSO_4$ sat.	Rusting on dilute only
6. Na_2SO_4 solut'n to $CaSO_4$ solut'n ..	$CaSO_4$ rusted.
7. Na_2SO_4 solut'n to $MgSO_4$ solut'n. ..	Na_2SO_4 rusted.
8. $MgCl_2$ solut'n to $CaSO_4$ solut'n	$CaSO_4$ rusted.

A second kind of concentration cell was constructed by tightly stoppering the lower end of a glass tube and suspending in it a cast-iron bar. The tube was half-filled with a concentrated salt lution, and then the upper half filled with a arm dilute salt solution, care being taken not to ix the two. The difference in density kept the lutions from mixing for a considerable period. ight such cells were constructed and allowed to and for 9 months. Table IV. contains the results this series of experiments.

---

* Smith and Shipley, Report, Engineering Institute of Canada, Saskatoon, Sask., Aug. 10, 1921. Eng. Inst. of Canada, Oct. 1921.

Table IV.

Corrosion of cast iron gravity cells for nine months.

Salt solution.	Area of exposed iron.	Weight of iron removed by corrosion.	Nature of surface corroded.
	sq. cm.	g.	
NaCl above .. $MgCl_2$ below ..	84	2·0	Some soft areas.
$MgSO_4$ above .. NaCl below ..	98	1·8	Soft areas above surface. Pits could be excavated ¼ in. deep. Cone and crater effect.
Same as 2, but mixed	132	1·9	Graphitic areas above.
Na_2SO_4 above .. $MgSO_4$ below ..	90	0·7	Graphitic areas over surface.
$MgSO_4$ above .. Na_2SO_4 below ..	112	3·2	Graphitic areas with a few deep pits.
Na_2SO_4 above .. $MgCl_2$ below ..	132	2·4	Softening quite general in patches.
$MgSO_4$ dilute ..	112	0·6	Uniform corrosion with little localisation.
$MgSO_4$ above .. NaCl below ..	112	1·2	Corrosion fairly well distributed.

Corrosion was most marked on the upper half of he cast iron bars. Reddish oxides of iron formed n the upper part of the solution, but on sinking to he bottom these became reduced to bluish-green ompounds. Graphitic softening occurred and some uite deep pits could be dug out with a knife blade. xperiment 7 was carried out with the iron immersed in a dilute magnesium sulphate solution nly. The loss in weight was less than in any of he other cells.*

The results of these experiments showed conclusively that concentration cell effects will bring about raphitic corrosion of cast iron. Such concentraion cells would be formed by the salt-impregnated oils in contact with the cast iron water pipes buried rom 6 to 10 feet beneath the surface. The impervious nature of the soil prevents the ground ater having a uniform concentration, and this ifference in concentration over short lengths f pipes must give a concentration cell effect. Vherever crystals of gypsum are in contact with he pipe, there the solution must be saturated. At hort distances removed from this point of contact, he soil solution will be less concentrated. Consequently, iron may pass out from the pipe into the ilute solution, and, as it is almost immediately emoved as insoluble hydrate, polarisation does not ccur. The reduction of the ferric iron to ferrous ron was observed in the cells constructed as above, hen the ferric oxide entered the cathode areas. This reduction would depolarise the cathode. If we ombine with this the migration of the colloidal erric hydroxide from anode to cathode, it is readily een how the whole process might continue indeinitely. Granted a concentration cell, the continuance of the reaction is dependent only upon a supply f oxygen, and this supply is provided by the oxygen eld in solution in ground waters.

Electric battery effect of a cell consisting of two cast iron electrodes in contact with two different soils.

Two cells were so constructed as to provide two ieces of cast iron not in contact with each other, ut both in contact with moist soils, the anode being in contact with limy silt and the cathode in contact with a clay soil, both soils being kept moist. One of these cells had an initial E.M.F. of 2·1 millivolts and the other 9·2 millivolts, which latter became 7·6 millivolts when filled with distilled water. Within the first three hours No. 1 rose 10 millivolts, and No. 2 rose 40 millivolts. In about three days No. 1 had reached 14 millivolts and No. 2 63 millivolts, which were reduced respectively to 12 and 48 millivolts after adding more water. The voltages varied for two months, alternately rising and falling. At the end of about two months, the cells having stood on open circuit, and without any addition of water, the polarity showed a reversal in both cells. Upon adding water once more, No. 1 recovered its original polarity and voltage, but No. 2 increased its negative polarity to 64 millivolts negative, while No. 1 rose to 66 millivolts positive.

These results show that soils of Winnipeg and vicinity, when in contact with iron, can of themselves set up an appreciable E.M.F. like that of a primary battery amply sufficient to decompose the iron.

The effect of gypsum.

Medinger (J. Gasbeleucht., 1918, **61**, 73, 89) noted the autocorrosion of cast iron pipes buried in a soil heavily charged with calcium sulphate during the occupation of Esch in the Grand Duchy of Luxembourg in 1916. The condition of the pipes and the nature of the corrosion products were almost identical with those found in Winnipeg. Direct action of stray currents or of free acids was known to be absent in this Luxembourg case. Apparently, the presence of calcium sulphate had something to do with the corrosion of the iron pipes.

The usual explanation for the autocorrosion of cast iron lies in the galvanic action set up by differences in composition of the metallic structure. The electric potential between graphite and iron is relatively high, and so, if in contact with an electrolyte, the E.M.F. of this cell would tend to drive the iron into solution. This tendency would be much enhanced should hydrogen ions be present. The clay soils of the Winnipeg district possess a high content of limestone, and since calcium carbonate gives basic products of hydrolysis, the ground waters would tend to be alkaline. But such waters in clay soils are impregnated with carbon dioxide, and this is sufficient to overcome the basic hydrolysis of calcium carbonate, so that a slightly acidic condition results. If now, gypsum be present, it will drive the equilibrium still further into the acidic region. Although calcium sulphate is a neutral salt, the effect of the added calcium ions is to cause an increase in the concentration of the hydrogen ions. The ionic products concerned are the following:—(i.) $(\mathrm{Ca})(\mathrm{CO_3})=\mathrm{K}$, (ii.) $(\mathrm{H})(\mathrm{CO_3})=\mathrm{K}$, (iii.) $(\mathrm{Ca})(\mathrm{SO_4})=\mathrm{K}$. When calcium sulphate is added, the (Ca) content in solution is increased and $(\mathrm{CO_3})$ must diminish proportionately. This affects the equilibrium in equation (ii.), for in order to satisfy the ionic product K when $(\mathrm{CO_3})$ diminishes, (H) must increase a corresponding amount. Consequently, gypsum causes an increased acidity in ground waters containing free carbon dioxide in contact with calcium carbonate.

This, probably, is the explanation of the fact that the ground waters of the Winnipeg district are slightly acid to phenolphthalein. Moreover, the presence of calcium sulphate would keep the ground waters continuously acid, and thus the corrosion of the cast iron due to the graphite-iron couple would proceed apace.

Summary.

(1) The corrosion of cast iron by soil salts is of the graphitic softening type.

---

* A ninth experiment in which a copper strip replaced the iron n a sodium chloride cell, gave a bluish insoluble precipitate of a copper alt and in time beautifully formed crystals of metallic copper ppeared on the lower end of the copper plate immersed in the oncentrated sodium chloride solution.

(2) Magnesium salts are the most corrosive of the soil salts, and magnesium sulphate is the most effective of the salts experimented with.

(3) Local action induced by naturally occurring concentration cells may easily be a factor in the soil corrosion of cast-iron pipes.

(4) The presence of calcium sulphate in a limy silt soil gives a slight acidity to the ground waters.

(5) Autocorrosion of the cast iron is promoted by this acidity of the ground waters due to the stimulation provided to the graphite-iron galvanic couple by the presence of the hydrogen ion. Iron more readily displaces hydrogen when the latter is present in the ionic condition.

The soil corrosion of iron structures is thus seen to be an electro-chemical process, complicated by its dependence upon several variables, of which the composition of the metal in the structure, the nature of the soil in contact with the metal, and the movements of the ground waters are the most important.

Part II.

The Soil Corrosion of Lead.

During the field investigation concerned with the damage of cast iron water-mains, it was observed that the lead service pipes showed evidence of corrosion. This disintegration usually took the form of pock-marked cavities incrusted with carbonate and sulphate of lead, but sometimes black, wart-like protuberances appeared on the lead pipe. Where the lead pipes were bent or in the neighbourhood of joints, criss-cross fissures occurred on the surface, together with the characteristic pock-marked cavities. Yellow and red oxides of lead appeared on the surface of the pipe, the transformation varying in depth but usually being about as deep as the fissures. There did not appear to be any special relation between the corrosion on the cast iron mains and the service pipes, as sometimes the lead was found deeply pitted and no corrosion on the iron pipe to which it was connected. The damage was frequently found in electrically negative and neutral areas and was quite marked on the lead pipe connected to the Mental Hospital water works system at Selkirk, Manitoba.

Laboratory investigation.

A series of experiments with lead plates immersed in salt solutions and in soils was carried out, extending over a period of fourteen months. Sodium carbonate was found to be the most corrosive salt, with magnesium sulphate and calcium carbonate next. Calcium carbonate saturated with carbon dioxide was the least corrosive. The soils also attacked the lead, one in particular, a sample of limy silt from Glasgow Street, standing next to the sodium carbonate as a corrosive agent. Several instances of corrosion in which the lead pipe was completely perforated had been reported from this neighbourhood. An analysis of the ground water and of the soil itself did not give any clue as to the cause of the virulence of this particular soil.

Lead plates exposing 37·5 sq. cm. surface immersed in salt solutions and water-saturated soils for 14 months:—

Solution.	Loss of weight in grams.
$CaCO_3$	0·32
$Ca(HCO_3)_2$	0·21
Na_2CO_3	0·82
$MgSO_4$	0·34
Soil—Man.-Gypsum	0·24
„ Glasgow Street	0·60
„ Stock Yards, St. Boniface	0·25

Corrosion of lead anodes and cathodes.

Three experiments were carried out in which lead anodes and cathodes were immersed in saturated soils contained in beakers. A current of ten milliamps. was passed continuously for three days, after which the series was discontinued, owing to the disintegration of the anodes. The loss at the anode was 150%, 210%, and 350% respectively, of that required by Faraday's law. This extra loss wa due to mechanical disintegration of the anode accompanying the formation of the oxides of lead. Such extensive losses indicate how futile it is t apply "corrosive coefficients" to the electrochemical decomposition of metals, whether it be b stray current, salt solutions, or soils.

The cathodes did not appear to be attacked at all in fact they showed a slight gain in weight. I order to find out whether cathodic corrosion woul occur at all, nine experiments were allowed to ru continuously for 60 days. The cathodes were plate of lead exposing 37·5 sq. cm. of surface, and th anodes, carbon brushes. These electrodes wer immersed in salt solutions of the carbonates, chlorides, and sulphates of calcium, magnesium, an sodium, and were set up in series and a current o from 4 to 10 milliamps. passed continuously for 6 days. The lead cathodes showed no evidence o corrosion, but the carbon anodes were badly decomposed.

Salt solution corrosion in the presence of nitrate.

Lead corrosion is frequently attributed to the presence of nitrates. Five experiments with lead immersed in salt solutions containing nitrate were carried out, the lead being immersed i 400 c.c. of the solutions for eight months. Saturated solutions of calcium sulphate and calcium carbonate, saturated with carbon dioxide, together with $N/10$ solutions of magnesium chloride, magnesium sulphate, and calcium chlorid constituted the series. To each was added one gra of ammonium nitrate. In every case the surface o the lead became immediately covered with a coating of black oxide of varying thickness. This coat wa very heavy in the case of the lead immersed in th magnesium sulphate solution, and quite thin in th calcium sulphate solution. Spots of lead carbonat with pits beneath were very marked on the plat immersed in the calcium carbonate saturated wit carbon dioxide. A few little nodules of lea sulphate formed here and there, over the surfa of the lead, in the calcium sulphate solution, whi quite deep pits were found beneath mixed deposi of lead carbonate and chloride in the chloride sol tions. These incrustations had formed at the poi of contact of the lead with the glass.

The attack on both lead and cast iron was fr quently observed to be more pronounced where t metal was in contact with a foreign substance, su as a pebble or the glass of the containing vessel, above.

The total loss of lead in the above experime was of the same order as that found in solutions the same salts, without the addition of the nitra Possibly the formation of the black oxide protect the lead from further corrosion, but whatever t cause, the nitrate did not markedly accelerate t corrosion under the conditions of the experiment.

Corrosion of lead plates and lead foil in soils.

Three lead plates and four wax-supported str of lead foil were buried in moist soil and left t disturbed for several months. The plates a strips were about six inches long and two inc wide, placed vertically in large glass tubes with soil packed closely around them. Each tube c tained two samples of soil, the upper half of lead strip being in one kind of soil and the lo half in another. The tubes were corked in order prevent evaporation. The lead strips remained the soils for almost eight months.

Examination at the end of this period disclo extensive corrosion. The following observati were made at the end of eight months:—

No. 1. Lead foil badly attacked at the upper d, completely perforated. Lower end of foil also rroded and blackened.

No. 2. All foil beyond end of wax completely stroyed. Lower end of foil also corroded and ickened.

No. 3. Corrosion completely through at upper d and lead disappeared. Lower end also per-ated. White lead salt formed.

No. 4. Both protruding ends of foil completely stroyed. Elsewhere perforations especially when soil found its way between the wax and the foil.

No. 5. Lead plate deeply pitted in portion buried surface soil. Pits $\frac{1}{32}$″ deep or more. Lead phate incrusted over pits.

No. 6. Slightly incrusted but not badly attacked.

No. 7. Badly corroded and incrusted. White rustant of lead carbonate $\frac{1}{32}$″ thick on both sides the upper end of the lead strip. Lower end not dly attacked. No sulphate.

The results of this series of experiments were cidedly illuminating. They established without ubt the autocorrosion of lead by the action of the l alone. The nature of this corrosion was quite nilar to that observed on the lead service pipes eady described, the same crater-like cavities rusted with lead carbonate and sulphate being med.

Cause and course of the corrosion.

The amphoteric character of lead as regards its emical reactions and the varied nature of the ssible products of corrosion, even under one set conditions, prevents the adoption of any one eory, to the exclusion of all others, as to the use and course of the corrosion. The lack of finite basic or acidic properties makes this metal ool of its environment. The end products of the rosion are determined by the relative solubility the compounds possible under the particular nditions under which the corrosion proceeds. ese possibilities are also conditioned by the idising or reducing nature of the environment. One of the first products found in the corrosion lead is the oxide, PbO. A coating of this oxide adily forms upon the surface of metallic lead, d is commonly believed to protect it from rrosion. This coating, however, is actually uble in water, the more so if the water is quite re, or if it carries much oxygen in solution. e sulphate of lead is slightly soluble in water, and e carbonate much less soluble, so that in the esence of the acid radicle of sulphuric or rbonic acid the lead hydroxide is easily transmed into carbonate or sulphate, and the sulphate y be transformed into the more insoluble rbonate.

According to several authorities lead has a culiar physical property of occurring in more an one physical modification, even in the same ece of metal, and these allotropic modifications y occur quite near together in the same metal. ese variations of the physical structure of the d possess different physical and electrical prorties, and these differing properties may persist a long time. Consequently adjacent portions lead in the same piece of metal may set up a lvanic couple when in contact with an electrolyte, d provide all the conditions required for eleclytic self-corrosion. This property of lead has en investigated by Lambert and Cullis (J. Chem. c., 1915, 107, 210), who have observed as follows:

" The electrolytic theory of corrosion is applicable lead. The passing of the metal into solution ich precedes corrosion is due to electrolytic tion between the electrically different parts of e mass of lead. In the case of chemically pure d the physical heterogeneity due to the presence different allotropic modifications of lead in the mass of the metal causes some parts of the mass to be electrically different from other parts, and these electrical differences persist for a long time after the preparation of the metal."

The practical effect of this allotropic property of lead is met with in practice by users of lead pipe. This property was observed, for instance, by the engineer of the Mental Hospital at Selkirk, who exhibited a piece of lead pipe taken out of the earth, where it had been buried for some years, which he said had " lost its life." That is to say, it was very brittle, had a different appearance from ordinary lead, and was no longer suitable for being worked.

Lambert and Cullis found that the purest lead that it was possible to produce by distillation in a vacuum was immediately corroded when immersed in water containing oxygen. The first product of corrosion under such circumstances is evidently lead hydroxide which, when there are no salts present, will appear as a precipitate.

It has also been ascertained by a number of observers that when lead, water, and oxygen are brought together hydrogen peroxide is formed. This is a strong oxidising agent, and accordingly might well account for the presence of the higher oxides of lead which are sometimes found amongst the corrosion products of lead pipe. We have observed several such transformations of lead. A lead union from a service pipe in Moose-Jaw, Saskatchewan, sent in for examination, was found to be almost wholly transformed into a red oxide of lead. A similar case was shown us by Mr. A. Blackie, City Chemist of Winnipeg, in which a considerable portion of a piece of lead pipe consisted of a red oxide of lead. Black oxide of lead was also observed on service pipes from River and Glasgow Avenues in Winnipeg. The corroded lead pipe taken from Selkirk had an insoluble lead compound adhering to the matrix of clay that surrounded the pipe, which was probably lead peroxide. There was not enough of it to make an analysis.

L. A. Stenger (Chem. and Met. Eng., 1920, 22, 965) attributes the soil corrosion of lead pipes as observed by him to two probable sources:—(1) The action of a concentration cell produced by differences of concentration of a salt in the soil in contact with the pipe, and (2) the presence in the soil of a substance subject to a change in valence, the bi-electrolyte causing corrosion in the cathode areas.

The first of the two causes above méntioned is similar to that described by the author in that section of this paper dealing with the self-corrosion of cast iron.

The effect on lead pipe would be similar to that observed on iron pipe, that is, the lead would pass into solution where the metal was in contact with the more dilute electrolyte. Both of these causes of corrosion, as outlined by Stenger, are external to the pipe, and not in any way dependent upon the lack of homogeneity in the lead.

In a recent article in " Metall und Erz," on the destructive action of mortar on zinc and lead, it is stated that lead is attacked by the limestone alone, and by mixtures of limestone and gypsum. This is substantiated by the work of R. H. Gaines, mentioned above, as well as by the case of corrosion noted at Charlottenburg, Germany.

H. S. Rawdon (U.S. Bureau of Standards, Bulletin No. 377, April, 1920) describes the results of a series of experiments on lead corrosion which show that the so-called allotropic modifications of lead are produced by corrosion in an electrolyte by the solvent action of the salt solution removing the foreign metals lying between the crystals of metallic lead in the mass of the lead. Even the purest commercial lead is subject to this attack, and since the metallic impurities removed lie above lead in the electrochemical series, this form of corrosion is quite parallel with the galvanic action brought about between graphite and iron in cast iron, when iron goes into solution and graphite remains in the pipe. In the case of lead pipe, the impurities are removed and the lead in unsupported crystals remains, imparting to the pipe that characteristic crystalline structure and brittleness which eventually destroys its usefulness.

These observations of Rawdon, supplemented by a later investigation* in which he used lead of 99·99% purity, subjected under tensile stress to the corrosion of salt solutions, clearly demonstrate the possibility of electrochemical destruction due to the presence of almost infinitesimal amounts of an impurity in the metal structure, when such a structure is in contact with water containing salts in solution. Rawdon also observed that the corrosion of lead was more rapid in an acid solution. Recent investigations in the laboratory of the University of Manitoba (not yet published) indicate that the soil waters of Winnipeg in the presence of calcium sulphate and carbonate are slightly acid, especially when they contain free carbon dioxide. Moreover, the function that mechanical stress plays in promoting the corrosion of lead would lead to widely diverging observations on the extent of the corrosion at different places on the same lead pipe, buried in the same soil. Whenever the pipe is bent, there the pipe may be considered to be under stress, and there intergranular cracks, as described by Rawdon, will first appear, the rapidity of the disintegration depending on the amount of the stress and the character of the soil solution.

We thus see how complicated is the whole matter of the corrosion of lead. Not only does the peculiar amphoteric character of lead enter into it, but also the physical character of the crystalline metal structure, the infinitesimal amounts of intergranular impurities present, and the stress to which the structure is subjected. These factors, combined with the complexities of the salt content of ground waters, make the whole question of the soil corrosion of lead a matter for most intensive study.

Summary.

(1) Salt solutions attack lead, a carbonate of lead being the final product when exposed to the air.

(2) Sodium carbonate was the most corrosive of the salts experimented with.

(3) Lead cathodes are not attacked by currents of from 4 to 10 milliamps.

(4) "Coefficients of corrosion" are not applicable to electrochemical decomposition.

(5) The presence of ammonium nitrate appears to inhibit corrosion by the formation of a protective coating of lead oxide over the surface. Such a protective coating may only be temporary.

(6) The soils of the Winnipeg district have a decidedly corrosive action on lead, the nature of the corrosion being usually that of a crater-like pitting of the surface, with or without an adhering deposit of lead sulphate or carbonate.

(7) Contact with a foreign substance localises the corrosion.

(8) The cause of the corrosion may be attributed to local galvanic action due to differences in the physical structure of the lead, to the presence of impurities lodged between the crystals of the lead, or to concentration cell effects.

Chemistry Department,
University of Manitoba.

---

* Rawdon, Krynitsky, and Berliner, "Brittleness produced in pure lead by stress and corrosion," Chem. and Met. Eng., 1922, 26, 109.

London Section.

Meeting held at Burlington House on March 6, 1922.

MR. E. V. EVANS IN THE CHAIR.

GOLD METALLURGY OF THE WITWATERSRAND (TRANSVAAL).

BY W. CULLEN.

Although there have been frequent references to the metallurgy of gold on the so-called Rand (short for Witwatersrand), the only comprehensive paper in the Journal is that of H. de Mosenthal (J., 1894, 326). It was thought that possibly the best method of recording the changes or advances made since that date would be to describe a modern plant—one acknowledged to be almost the last word in gold metallurgy. But even since this paper was started revolutionary proposals have been made and have already been put into practice. The outstanding difference between 1894 and to-day is this, that whereas in the former year the value of the Transvaal gold output was £7,500,000, to-day it is almost five times as great, and in 1916 it amounted to £39,500,000. It may be mentioned that the Transvaal output of to-day is just 50% of the world's production.

"Banket," or the ore in which the gold occurs, is principally composed of silica. It is in the main a mass of silicious pebbles imbedded in a silicious matrix. The following is a typical analysis of deep level "banket"[1]:—SiO_2 86·76, FeS_2 2·75, Fe_2O_3 2·65, Al_2O_3 6·91, CaO trace, MgO 0·70%. The composition is, of course, not precisely the same throughout the field, though the uniformity is greater than one would expect.

The distribution of the gold in the ore is somewhat remarkable. The pebbles are barren, or practically so. Contrary to expectation the pyrites also carries comparatively little gold, *i.e.*, in the same manner as galena carries silver. Weight for weight, pyrites certainly contains more gold than the pyrites-free ore, but not very much more. The following table is interesting as showing the relationship between "pyrite" and gold in a graded sample of sand:—[2]

Grade.	% Pyrite (FeS_2).	Dwt. gold per ton.	Dwt. gold per 1% pyrite.
+ 60 Mesh	0·36	1·57	4·36
— 60 + 90 "	0·62	1·36	2·19
— 90 + 125 "	2·46	2·30	1·07
—125 + 200 "	1·20	1·80	0·67
— 200 "	2·94	3·44	0·86

There has been great controversy as to the distribution of the gold, but nothing has been discovered which would invalidate the following statement:— "Although rarely visible in the hand specimen, the gold can be easily studied under the microscope if specimens known to be rich in it are examined. In the slides which we have examined the noble metal occurs in irregular angular particles often lying on the periphery of individual pyrites crystals or in the interstices between aggregates of that mineral. We have seen no instance of the gold lying inside a homogeneous crystal or piece of pyrites. In many cases perfectly round pieces of pyrites may be observed to be bounded by gold particles."[3]

The subject of mining hardly comes within the scope of this paper, but it is noteworthy that whereas in 1894 Mr. Mosenthal stated that the deepest workings were about 400 ft., to-day plans are being matured to mine at a depth of 7000ft.[4] Several mines are drawing ore to-day from 5500 to 6000 feet, *i.e.*, below sea level, for the Rand in places is almost 6000 feet above sea level. Along the row of mines there are several of the largest and the deepest in the world. Mining at this great depth has introduced problems which have not yet been satisfactorily solved.

---

[1] "Rand Metallurgical Practice," Vol. I., p. 382.

[2] *Ibid.*, Vol. I., p. 349.

[3] Geological Society of S. Africa, Nov., 1904 (Hatch and Corstorphine).

In the year 1920 there were forty-seven producing companies on the Rand. The smallest milled 57,000 tons during the year 1921 and the largest 2,200,000 tons; the total amount milled was 24,000,000 tons, and the mining operations absorb the products of three very large explosives factories, the combined output of which is from 800,000—900,000 cases or, rather over 20,000 tons of high explosives per annum. At no other centre in the world is to be found such a concentration of mining and metallurgical operations.

In 1884, when the first record of gold production was made, the value was only £10,096. This had become £16,240,000 by 1898, and £39,500,000 by 1915—the year of greatest production.[5] In 1921 the production had fallen by rather more than 10% as compared with 1915, but owing to the gold premium the declared value was £42,000,000.

Under ordinary circumstances it takes from three to six years to develop and equip a mine, the period depending on the size of the proposition, the depth of the workings, and many other factors. Prior to the great war the capital involved in equipping a mine of economic size was about 1½ million sterling. To-day it would be doubled, and this expenditure includes practically nothing for power, for it is now generally purchased in bulk from a large power company.

I shall now proceed to describe in general terms the metallurgical plant of the modern section of the New Modderfontein Gold Mining Co., which produced gold to the value of £2,800,000, including premium, during the year 1921. This plant is in two sections, and for the present I only propose to deal with the section which has been quite recently erected.

When the ore reaches the surface it is tipped into huge storage bins. These discharge on to two conveyor belts, each of which is 193 feet long, and which run at a speed of 200 feet per minute. These belts convey the ore to a building in which the following operations, (*a*), (*b*), (*c*), and (*d*), take place:—

(*a*) The ore is first sprayed with water to free it from dust and so-called "fines." Unless this is done it is difficult to distinguish ore proper from barren rock in subsequent operations; the "fines" amount to about 40% of the total.

(*b*) The ore is discharged into cylindrical screens or trommels, which separate the "fines" from the coarse ore. These "fines" miss several of the subsequent operations. Nowadays they generally go to storage bins, and are fed either direct to the crusher stamps or to the tube mills. A plant milling 2000 tons of ore per day will therefore handle 800 tons of "fines."

(*c*) The bulk of the ore, which consists of the large pieces, is discharged from the interior of the screens on to long, continuously moving sorting belts which are slightly inclined. Along their whole length are the native sorters, who are very expert at their work. The waste rock is thrown into shoots, and is carried away by suitable transport arrangements to the waste dump. The amount of sorting varies very greatly. Some mines do not sort at all; others reject nearly 20%. Waste dumps, when carefully sampled, seldom go as high as 1 dwt. per ton=4s. 2d. The sorting depends very largely on the width and nature of the reef mined. It is, of course, impossible to sort the "fines."

(*d*) The large pieces of ore in due course reach four gyratory crushers, each driven by a 60-h.p. motor. These reduce the ore to a size suitable for the crusher plant. At the same time a certain proportion is set on one side in the form of pebbles for the tube mills and conveyed to bins in their neighbourhood by long belt conveyors.

(*e*) The crushed ore on leaving the gyratory crusher drops on to another conveyor belt, 3 ft. wide and 130 ft. long, which runs in an upward direction and delivers the ore by subsidiary belts to the stamp mill bins. From these the ore is discharged by feeders to stamps of the Nissen type. The crushed product is discharged as a pulp through the stamp screens; the coarser the mesh of these discharge screens the coarser the product and the higher the tonnage per stamp. A stamp has generally a drop of 8½—9 in., and the number of drops per minute is about 90. They are generally arranged in batteries of five, the five dies on which they drop being contained in one so-called mortar box. An 1850-lb. stamp on one mine crushes 28·5 tons per 24 hours through a screen aperture of 0·625 of an inch square. At the particular mine now being described a 1900-lb. Nissen stamp crushes 31·5 tons per 24 hours through a somewhat finer screen.

(*f*) The crushed ore, or pulp as it is now called, since it is mixed with several times its weight of water, is carried away from the stamps by launders or open channels and discharged into conical vessels called classifiers, which automatically separate out the finest pulp, usually called slime. This slime by-passes the immediately succeeding operation and goes direct to the slime department. The slime floats off at the top, while the coarser portion is discharged from the bottom of the cones direct to tube mills.

(*g*) Tube milling, the next operation, is perhaps the most important of all the mechanical processes connected with the treatment of the ore. Tube mills now do a great deal of the crushing work formerly done by stamps, and to a very large extent are displacing them altogether. The standard tube mill of to-day is 22 ft. long and 5 ft. 6 in. diameter, lined with a special steel or other material to resist wear. They make 28 revolutions per minute. The pebbles referred to under (*d*) are fed into the tube mill along with the coarse pulp, and by attrition reduce it to the required degree of fineness. The general practice is to have one tube mill for every ten stamps so that each tube mill has a grinding capacity of 200—300 tons per day, but the actual amount passed through is very much greater. The tube mill product nowadays is so fine that 90% passes the 90 linear mesh screen. As in the case of stamps, the output depends on the required degree of fineness.

(*h*) The crushed product now reaches the first stage in extracting the gold. This consists of amalgamation, and accounts for 45—65% of the precious metal. At a lower level than the tube mills there is a series of amalgamating tables which in the main consist of copper plates 53 sq. ft. superficial area. These slope away from the tube mill; there are five such plates for each mill. The preparation of these plates and their subsequent dressing or cleaning during operation require a high degree of skill. The process described by Mosenthal (*loc. cit.*) for the treatment of the amalgam is, apart from minor improvements, the same as is carried out to-day. In the early days of the Rand, and indeed up till about 1893, amalgamation was the only process in use for extracting the gold. The returns were so good that 40% of the gold content contained in the tailings could be neglected altogether. Later on those dumps of tailings, which survived the disintegrating effects of wind and rain, made a fine treasure trove to many an adventuring metallurgist.

---

[4] Institution of Mining and Metallurgy, 1921 (Clifford).
[5] Report of Transvaal Chamber of Mines, 1921, p. 187.

(*i*) The cyanide process in the aggregate treats 24 million tons of ore per annum at an over-all cost of only 2d.—3d. per ton for cyanide of sodium.[6] One mine in particular has reduced its consumption of cyanide to 0·18 lb. per ton of ore treated. On leaving the amalgamating plates the pulp, from which most of the coarse gold has been extracted by amalgamation, falls to a series of so-called sand pumps (centrifugal pumps of special construction to resist the abrasive effects of the sharp-edged pulp particles). Each pump is capable of lifting 1300 tons per hour to a height of 65 ft., and it discharges its contents into conical classifiers. These reject a certain proportion of their charge as being too coarse, and it goes back to the tube mills for re-grinding, appearing again in the same classifiers after undergoing further attrition.

(*j*) The uniform pulp from these cones is next sent to other cones, where it is separated into a coarse and fine product termed "sand" and "slime." These are treated separately with cyanide. The fine product is brought into intimate contact with an aerated dilute alkaline solution of sodium cyanide which dissolves the gold.

The sands are pumped to very large steel tanks. In the plant under discussion there are six such tanks each measuring 52½ ft. diam. by 10½ ft. deep. By appropriate appliances the cyanide solution is made to percolate through the contents, and is circulated by centrifugal pumps to aerate solution and sands. The great distinction between sand and slime is that the latter does not permit percolation. In practice sands present no treatment difficulties; they contain anything from 2·5 dwt. of gold per ton and upwards, depending on the grade of the original ore, and an extraction of 90% is easily obtained.

The slimes as they leave the cones gravitate to six special settling tanks—Dorr thickeners. In this plant, as its name indicates, the surplus water is removed, leaving a thick, easily manipulated slimy mass, which is pumped along with dilute cyanide solution to so-called Brown tanks. These are tall cylinders 45 ft. in height provided with air-agitating appliances which have the effect of bringing the minute particles of slime into most intimate contact with the dissolving solution. When all the gold is dissolved the contents of the Brown tanks are discharged into an immense storage tank in which there is air agitation to keep the contents fluid. From here the slime is fed to a Butters vacuum filter installation consisting of 300 filter leaves capable of handling 20,000 tons of dry slime per month. The extraction of gold is very high, as the residual slimes are practically barren. Before treatment they contain 1·5 dwt. per ton upwards.

The huge quantities of barren sand and slime produced are handled very cheaply by mechanical contrivances.

One of the features of the Rand is the immense sand dumps made up of untold millions of tons of tailing. They have formed the basis of certain small industries, but nowadays immense quantities are made up into a pulp and sent back into the stopes or mine workings, from which the material originally came as ore. In time it consolidates into a sort of friable sandstone which supports the roof or hanging wall and thus renders the workings much more safe. At the same time it permits more ore to be drawn from the mine than would otherwise be the case, for in mining at depth, so-called pillars have to be left to support the roof, otherwise the whole mine would collapse.

The wonderful developments of flotation within recent years have suggested the possibility of applying it to the ore of the Rand for the concentration of the gold. The proposition from the economic point of view is exceedingly attractive. According to the Minerals Separation Co., experiments have been very satisfactory. I quote the following:[7] *Crude ore from mine.* Assay value 9·9 dwt.; concentrate 14·8% of total; value 65·9 dwt.; residue value 0·42 dwt.; extraction 98·5%. *Slimes (untreated).* Assay value 1·34 dwt.; concentrate 16·4% of total; value 7·2 dwt.; residue value 0·20 dwt.; extraction 88·1%. *Old sand residues.* Assay value 1·75 dwt.; concentrate 10·3% of total; value 12·6 dwt.; residues 0·45 dwt.; extraction 74·1%. This looks poor, but it is in effect extraordinarily good under the circumstances, for through oxidation of the pyrites old tailings or residues are always very difficult to treat. No details are given as to how these results were obtained, but they indicate the possibility of entirely revolutionising all the intermediate stages of current metallurgical practice for certain classes of ore.

I now come to the alternative processes to which reference has already been made. On one point practically everyone is agreed nowadays—viz., that in the long run it pays to grind the ore as fine as possible. Gold is made more accessible, whether in the silicious matrix or in the pyrites and whether amalgamation is retained or not. To give an idea of what this means, I may say that 1d. per ton increased or decreased working costs or improvement in extraction, or the reverse, means to the industry rather more than £100,000 per annum.[8] Twenty years ago a 90% extraction of the total gold content was considered very good work. To-day anything lower than 95% is considered poor and this will certainly be improved upon. This means, translated into practice, that residues are being sent to the dumps which only contain gold to the value of 1s. per ton or about 0·25 dwt. These excellent results have not been brought about through radical departures, but by slow, persistent effort.

Early attempts to concentrate the gold into one product of small bulk in order to minimise treatment costs failed, as they were bound to do in the light of the distribution of gold in the ore. A good many years ago, however, G. A. and H. S. Denny suggested two radical departures from the orthodox practice—viz., (*a*) sliming the product from the stamps instead of segregating it into sands and slimes; (*b*) continuous circulation of cyanide solution from the stamps onwards.[9] These were to a certain extent carried into practice, but they did not commend themselves to the orthodox school.

No one has suggested that alternative processes will give much better extraction results. Indeed it would be difficult to conceive any process which could improve on the figures just quoted. The whole question, therefore, resolves itself into one of economics.

Metallurgical plants per ton of ore treated per day cost £215 in 1903.[10]. In 1914–15 this had been reduced to £107, but probably to-day the cost is higher than it was in 1903. The main claim for the alternative process is that while reducing working charges it will also materially reduce capital outlay. The problems involved belong essentially to the domain of the engineer, for Rand metallurgy being comparatively simple, costs depend mainly on the efficient and rapid handling of large masses of material.

The fact that there are three definite steps in the extraction of gold—viz., amalgamation, treatment of sand by cyanide, and treatment of slime by cyanide, leads to complication of plant, and moreover, although about 60% the free gold is won at a very early stage of the treatment process by amalgamation, gold amalgam is easily stolen, and there is a considerable leakage from this cause. Another undesirable feature of the orthodox process is the fact that the treatment of the sands, for instance, involves immense outlay in the way of tanks, for, from the beginning to the end of the process, it takes 10-12 days. The brothers Denny suggested the use of tube mills as a substitute for stamps a good many years ago.[11] Their contention was that on the one side ore breakers were encroaching on the domain of the stamp, while on the other side the tube mill was equally aggressive. Although the duty of the stamp was being gradually increased through the production of a coarser pulp, this was really being accomplished in a machine which was unsuited for the purpose from every point of view, and moreover the capital expenditure for stamps was very high. I now come to the latest scheme which is already working on a fairly large scale. There has been a good deal of general information about the new process in the technical press, but I am indebted to Mr. Carl Davis, consulting engineer to the Anglo-American Mining Corporation, for the details which follow. Associated with him in working out the process were Messrs. J. H. Willey and S. E. T. Ewing. Mr. Davis has had the courage of his convictions and has put his ideas into practice. In these days of high capital costs this is a far greater act than the bald statement would indicate.

---

[6] Chem. Met. and Min. Soc. of S. Africa, Oct., 1921 (Wartenweiler).

[7] S. African Mining J., Oct., 1921, p. 239 (Homersham).

[8] S. African Assoc. for Advancement of Science, Vol. XII., p. 121 (Caldecott).

[9] S. African Assoc. of Engineers, Vol. XI., p. 215 (Denny).

[10] "Rand Metallurgical Practice," Vol. II., p. 337.

"The original plant is laid out on standard lines, viz: separation of the ore hoisted into oversize and undersize by means of a grizzly; the undersize being sent direct to the mill storage bin and the oversize passing to sorting belts, where the waste and the tube mill feed rock is taken out; the balance is then passed through single stage gyratory crushers to the mill storage bin.

"From the mill storage bin the ore is crushed by heavy gravitation stamps, the ratio of stamps being ten to one tube mill; after leaving the mortar box the crushed ore is sent to a de-watering cone, the underflow of which enters the tube mill; the tube mill discharge is joined by the overflow from the de-watering cone, and the combined pulp is then passed over the amalgamating plates; from thence the total pulp is elevated to the primary classifiers, the underflow of which is returned to the tube mill circuit for re-grinding, whilst the overflow, which is the final pulp, passes to the secondary classifiers, which separate the pulp into sand and slime.

"The sand is caught in collecting tanks, and is then transferred in cyanide solution to the treatment tanks. The slime is caught in the slime collecting tanks and is then transferred to Pachuca (Brown) tanks for treatment and thence to the Butters plant for recovery of the gold-bearing solution.

"In the extension of the Springs Mines plant, the alteration from existing practice is as follows:—The average size of the fines is smaller on account of the total run of the mine ore being passed over a finer set grizzly, and the oversize after leaving the sorting belts goes to a steady head bin which will maintain a 'choked feed' to the crushers.

"This crusher portion, together with the 'fines,' passes to the tube mill storage bin, from which it is fed direct to the tube mills. The tube mill discharge flows into a Dorr classifier, the oversize returning to the mill for re-grinding, whilst the overflow, which is the final pulp, is elevated to the slime collectors, and is then transferred to the Pachuca tanks and the Butters plant as already described.

"With direct tube milling as above, the amount of reject pebble is very large, roughly about 20% of the total feed. This reject pebble is separated from the tube mill discharge by means of a trommel attached to the mill, and is then returned to the stamp mill bin by means of conveyor belts and a bucket elevator. In a new plant it would be necessary to instal a small breaking plant to deal with the reject pebbles, but the stamps being available, it was decided to utilise them.

"In the suggested plant the main differences compared with the new plant at Springs are as follows:

"Firstly, crushing in cyanide solution, and zinc dust precipitation (the Merrill process) and secondly, using a tube mill of very much larger capacity than the present standard 22 ft. by 5 ft. 6 in. tube mill—this mill to have a capacity of, say, 600 tons per 24 hours, and then stage classification by Dorr classifiers.

The saving in capital cost is very considerable, probably in the neighbourhood of 20—40%, and it is estimated that the saving in working costs will be from 20 to 25%. A plant of this design lends itself very readily to grinding in cyanide solution. This, in conjunction with zinc dust precipitation in Merrill presses, reduces the possibility of gold theft to a minimum.

"In addition to the foregoing, the above method, which renders finer grinding economically feasible, will, it is confidently anticipated (as a result of lengthy full-scale trials) result in a higher total extraction of the gold contents of the ores of the Far East Rand district."

The radical departures from orthodox practice consist in:—(*a*) The elimination of the stamp mill as a crusher. (*b*) The elimination of amalgamation. (*c*) The elimination of sands treatment by cyanide and the substitution therefor of one product "slimes," which is treated by cyanide. (*f*) The continuous presence of cyanide solution within a closed circuit right from the tube mills onward.

With reference to (*a*) the accepted practice is to crush in two stages after the breakers have done their work, viz., stamp milling followed by tube milling. In the "tubes" the main crushing is performed by selected pebbles of the ore itself consisting of 6 in. to 7 in. cubes which are withdrawn on the sorting tables before the ore reaches the breakers. The breakers are called upon to do more work than they did formerly and the capacity of the tube mill has also been increased through the feeding to it of a coarser product. With regard to (*b*) no comment is required.

Item (*c*) involves much finer grinding than was practiced before, and to this extent will probably be slightly more costly, but on the other hand will make for higher extraction of the gold content.

In regard to (*f*) as the cyanide will be in contact with the ore all the time, maximum extraction should be secured and there should be a minimum loss of cyanide through oxidation.

When the cyanide process was introduced, it was found that the slimes, which formed about 25% of the product (Mosenthal says 40%), could not be leached, and they were therefore discarded, but this meant the construction of expensive slime dams. Moreover they contained anything from 1½ dwt. per ton of gold upwards, equal in value to rather more than 6s. As the difficulties of treating slimes were gradually overcome these slimes became in turn treasure troves, as the tailings did before them, and treatment of accumulated slimes has assisted in swelling the profits of many a mine, whose profits from ordinary sources were commencing to dwindle. In the early days it was found advisable to add lime at the earliest possible stage, in the first instance to counteract acidity, but it was subsequently found that it assisted in the settling of the slimes and protected the cyanide. Indeed, it was along the lines of settling and decantation that the problem was solved in the end, and apart from improvements made in settling, there has been little change in slimes treatment for many years.

---

[11] Chem. Met. and Min. Soc. of S. Africa, Vol. IV., p. 217 (Denny).

To-day slimes are not only treated more cheaply than sands, but, as might be inferred, the extraction is also better.

As showing the changes brought about by improvement and modifications in the processes, the following tables are of interest.[12]

		1903	1905	1910	1917
		%	%	%	%
Work done by	stamp mill	100	95	65	50
„	tube „	Nil.	5	35	50
„	concentrating	5·5	4·5	1·0	Nil.
„	sand plant	75·0	72·5	67·0	60
„	slime „	19·5	23·0	32·0	40

Thus, so far as crushing is concerned, nineteen years ago the stamp did all the work: in 1917 it did only 50%, the tube mills being responsible for the rest. To-day tube mills do even more, and as has been indicated, it is proposed that the stamp should be eliminated altogether. Concurrently, and owing to finer grinding, the percentage of slime produced and treated had risen to 40% by 1917. To-day the figure must be considerably higher, and if the new processes are generally adopted, sands, as such, will not be produced at all.

The solution of gold by cyanide takes place according to the equation:—

$$2Au+4NaCN+O+H_2O=2AuNa(CN)_2+2NaOH.$$

Working cyanide solutions contain, in addition to sodium cyanide, potassium and calcium cyanides, as well as thiocyanates and most probably ferrocyanides. Efficient aeration is essential for the success of the reaction. The gold in solution is precipitated or deposited on zinc shavings:—

$$2NaAu(CN)_2+2NaOH+Zn=2Au+Zn(OH)_2+4NaCN.$$

Compared with other wet metallurgical processes, that of gold extraction on the Rand can be classed as simple, for, apart from pyrites, there are no ingredients which can cause complications. The ore can be classed as free milling, for with the fine grinding which is now universal, even pyrites yields up its gold without trouble. Successful extraction depends in the main on fine comminution with consequent exposure of the gold particles. Moreover, the gold does not exist in an ultra-fine form, otherwise the physical process of amalgamation would not have been so successful in the past. Such complications as do arise in practice are mainly due to weathering of the ore underground or when stored at the surface in dumps; before the ore reaches the mill one or several of the following reactions are possible.[13] $FeS_2=FeS+S$; $S+O_2=SO_2$; $SO_2+O+H_2O=H_2SO_4$; $H_2SO_4+FeS=FeSO_4+H_2S$; $2FeSO_4+H_2SO_4+O=Fe_2(SO_4)_3+H_2O$; $Fe_2(SO_4)_3+2H_2O=Fe_2O_3SO_3+2H_2SO_4$; $Fe_2O_3SO_3+4H_2O=2Fe(OH)_3+H_2SO_4$. All these reactions actually take place and the mine water is invariably acid. This causes great wear and tear on pipes, pumps and machinery generally, notwithstanding a generous employment of lime. The free acid also decomposes the silicates present in the ore and the liberated gelatinous silica interferes with the subsequent slime settling.

Later on when the ore reaches the stamps and the tube mills the pyrites seems liable to reduction to ferrous sulphide by metallic iron. This serves as a starting point for a series of reactions similar to the above, but later on in the process.

That the amount of sulphuric acid produced is great is indicated by the fact that during cold weather the service pipes become choked with calcium sulphate which is very difficult to remove. However, the presence of calcium sulphate in these relatively large quantities apparently does no particular harm chemically.

Theoretically one pound of cyanide dissolves one and a half pounds of gold in the presence of one ounce of oxygen, but in practice the consumption of cyanide is much greater, for the oxygen is used up in other directions, as is also the cyanide itself. The following reactions are indicative of these possibilities[14]:—

(*a*) $FeS+6NaCN=Na_4Fe(CN)_6+Na_2S.$
$Na_2S+NaCN+O+H_2O=NaCNS+2NaOH.$
(*b*) $2FeS+9O+3H_2O+2CaO=2Fe(OH)_3+2CaSO_4.$
(*c*) $Fe(OH)_2+6NaCN=Na_4Fe(CN)_6+2NaOH.$
(*d*) $2Fe(OH)_2+O+H_2O=2Fe(OH)_3.$

So far no reference has been made to the presence of soluble sulphides, but that this is a possibility is indicated by equation (*a*). Moreover, all commercial cyanide contains sulphide in small quantity. These sulphides are rendered partially innocuous by sprinkling the sands or slimes with lead acetate or nitrate, but the lead sulphide also uses up available cyanide and oxygen; the alkali sulphides which escape the action of the soluble lead salts most likely behave as follows:—$Na_2S+NaCN+O+H_2O=NaCNS+2NaOH$. All of the foregoing indicate that the working cyanide solution is a much more complicated affair than it is generally supposed to be.

In the precipitation of gold from the sodium auro-cyanide by means of zinc nascent hydrogen is in reality the active precipitant. The process is therefore a reducing one, whereas the solution of the gold in cyanide is an oxidation one. About forty times the theoretical quantity of zinc is used up during preciptation, but as lead-coated zinc in filiform condition is very readily oxidised both in the moist and wet state the explanation for this excess consumption is not far to seek. In this connexion the Crowe process is now being generally introduced into modern plants. It consists in getting rid of the dissolved oxygen by evacuation and through this means the zinc consumption has been very considerably reduced; indeed, the reduction is so great that it is not necessary to treat the zinc-gold slime with acid.

Zinc hydroxide readily dissolves in fairly strong cyanide solution forming double zinc cyanide and sodium zincate—the so-salled "white precipitate" which is so troublesome in cold weather; but even zinc itself is attacked by cyanide as follows:—

$$Zn+4NaCN+2H_2O=Na_2Zn(CN)_4+2NaOH+H_2.$$

This sodium zinc cyanide is itself a solvent for gold in the presence of alkali which, however, is always produced as has just been shown.

Now the gold-bearing solutions do not readily part with their gold to the zinc even in the form of very fine shavings, 0·002 in. thick, and from what has just been said the reasons are not far to seek. One pound weight of zinc in the form of shavings exposes thirty square feet of surface and one ton has therefore a surface of 1·4 acres. An ordinary precipitation plant has from 10—20 tons of shavings in the "boxes" and this cannot be materially reduced, for the actual zinc surface available for precipitation is small. A great advance in acceleration of precipitation was made when the zinc-lead couple was introduced. The zinc shavings are merely dipped in a solution of a soluble lead salt such as nitrate or acetate, when a coating of metallic lead is formed. This facilitates the evolution of hydrogen from the decomposition of the water, for the essential requisite for the precipitation of gold from the sodium aurocyanide is intimate contact with the nascent hydrogen.

We have now reached the stage of having the gold precipitated on the zinc. In the subsequent operations the mixture of zinc, gold, base metals, and impurities generally is treated with sulphuric acid or nitre cake; the residue is filter pressed, calcined, melted down with appropriate fluxes and cast into ingots which, until quite recently, have been shipped to London for refining.

In 1894 the lowest consumption of cyanide per ton of tailings was 1·16 lb.; the quantity occasionally exceeded 2 lb. per ton. To-day the amount, in a few mines at any rate, is just one-tenth of this. In 1894 the strength of the cyanide solutions seemed to vary between 0·3 and 0·6%. To-day the solutions are only one-fifth to one-tenth as strong. There are naturally no figures available for zinc consumption, but in 1914 the consumption was only 0·32 lb. per ton, and to-day it is even lower, with every prospect of becoming lower still. Mercury—another somewhat expensive item on the "stores" side—disappeared to the tune of ½ lb. per ton in 1894; to-day's figure is the remarkably low one of 0·1 oz. per ton milled. Then in 1914 caustic soda was the protective alkali used, and sometimes the consumption was as much as ½ lb. per ton. To-day lime has taken its place, and besides being equally effective as a protector it has the great advantage, as already pointed out, of facilitating the settling of the slimes.

---

[12] "Rand Metallurgical Practice," Vol. II., p. 12.

[13] Chem. Met. and Min. Soc. of S. Africa, Vol. II., pp. 98, 112; Vol. VII., p. 315.

As on the mechanical side, there have been no epoch-marking developments in the cyanide process during the last twenty years. Indeed, the figures just quoted indicate rather steady and continuous improvement in detail, and this process still goes on. Some years ago J. S. McArthur,[15] the father of the cyanide process, suggested the substitution of zinc wafers or strips for the shavings, as he had found them an improvement in another connexion. Practical trials proved very unsatisfactory. Mention has been already made of the Merrill process of precipitation, which is perhaps the most radical departure within recent years. In essentials it consists of emulsifying zinc dust with the gold-bearing cyanide solution and forcing the mixture through a filter-press of special construction. In the case of fairly strong solutions 80% of the gold is precipitated at once, and the balance is precipitated completely on the leaves where the zinc-gold mixture has already accumulated. It is claimed that by this method the zinc consumption is materially reduced; but as the total is now only about 0·3 lb. per ton of ore crushed, the actual saving under this head cannot be very great.

Prior to the Boer War the old Transvaal Republic had its own refinery and mint at Pretoria. Naturally, it was on quite a small scale. When war broke out in 1914 it was decided that both refining and minting should be revived. Fortunately much of the old Boer plant was available, and it was indeed put into working order, but was never worked. The idea, however, of South Africa having its own refinery and mint caught the popular fancy. The refinery, which started up quite recently, is situated on the Rand a few miles from Johannesburg, but the mint is at Pretoria. It is the largest of its kind in the world, but the mint is not on such an ambitious scale.

In the refining process the bullion[14] is first melted in a plumbago crucible with suitable fluxes, which gives a preliminary purification. The ingot produced is next assayed, and if it contains too much refractory metal, or metal which would interfere too much with the ordinary refining process, it is submitted to a second and more drastic fusion, treatment with air, chlorine, nitre, or possibly all three. For the final stages batches of about 700 oz. are melted with a borax flux in clay crucibles, standing in plumbago guard crucibles for safety. When the bullion is melted a clay pipe-stem is introduced and chlorine and air passed through the molten mass. The base metals and the silver are converted into chlorides, which float on the surface and are baled off. The end-point is much the same as in a gold assay. This fine gold is re-melted in a large tilting furnace and cast into bars of about 400 oz. each for export.

Communications.

ORGANIC IMPURITIES IN COMMERCIAL NITRIC ACID AND THEIR EFFECT IN THE MANUFACTURE OF NITROGLYCERIN.

BY F. A. F. CRAWFORD, B.A., A.I.C.

The following investigation was undertaken for the purpose of explaining certain irregularities in the manufacture of nitroglycerin.

In the manufacture of nitroglycerin which is to be used in the preparation of either blasting explosives or cordite, it is usually stipulated that the finished nitroglycerin shall stand the Abel heat test for not less than 10 minutes. Practically every nitroglycerin factory has, at one time or other, experienced periods during which the nitroglycerin produced failed to pass this test, and although many efforts have been made to ascertain the cause of the low heat test, no explanation has been put forward which would satisfactorily account for all the variations which have been noted. A very pronounced period of low heat tests has recently been experienced at the Ardeer nitroglycerin factories of Nobel Industries, Ltd., and as most careful analyses failed to detect any abnormality in the materials used, and as no modification had been introduced into the process of manufacture, the following investigation was instituted in order to determine the cause of the trouble.

Tracing cause of low heat test.

Since no help could be obtained from analysis, the only method of attack was to duplicate the manufacturing results by experiments on the small scale and then by a process of elimination to determine the factor or factors causing the trouble.

Nitroglycerin is manufactured by adding glycerin to strong mixed acid of the composition, HNO_3 40—44%, H_2SO_4 55—59%, H_2O 0·5—2·0%. After nitration is complete the mixture is allowed to stand and the nitroglycerin, which separates above the acid layer, is removed and washed with water and sodium carbonate solution.

It was found that when plant materials were used on a small scale the resulting nitroglycerin showed low heat tests; the tests, however, varied with the washing process, so that washing conditions had to be standardised to give results similar to the manufacturing figures and these conditions were then kept constant throughout the investigation. Nitroglycerin made with chemically pure materials gave good heat tests, and by gradually substituting plant instead of chemically pure materials it was ascertained that the introduction of plant nitric acid invariably lowered the heat test, as shown in the following table:—

Average heat tests of nitroglycerin made on small scale with various materials.

Mixed acid composed of.		Glycerin.		Average heat test of N/G. min.
Plant mixed acid No. 1	..	Plant No. 1538	..	9½
" " " No. 2	..	" "	..	5½
Pure oleum and pure nitric acid	..	Price's treble distilled glycerin	..	14½
Pure oleum and pure nitric acid	..	Plant No. 1538	..	14½
Plant oleum and pure nitric acid	..	" "	..	15½
Pure oleum and plant nitric acid	..	" "	..	8

The heat tests given by mixed acid No. 2 were so exceptionally low that it was decided to investigate the acid as well as the plant nitric acid and for convenience the results with mixed acid are described first.

---

[14] "Rand Metallurgical Practice," Vol. I., p. 387.

[15] Chem. Met. and Min. Soc. of S. Africa, Vol. XIV., p. 310 (McArthur).

[16] S. African Mining J., Dec. 3rd, 1921, p. 467.

Investigation of a mixed acid which gave nitroglycerin of low heat test.

Mixed acid No. 2 was distilled and the nitric acid driven off was collected in four equal fractions, sufficient acid being distilled to enable small-scale charges of glycerin to be nitrated with each fraction. The heat-tests of the nitroglycerins for the respective fractions were 3½, 9, 13½, and 13½ mins. respectively, the last figure being obtained for the residual nitric acid. These results show that the impurity causing the low heat test passed over almost completely with the first fraction, very little being present in the second fraction, and practically none in the last two fractions. The next question was whether the substance actually causing the low heat tests was formed during nitration or whether it was present as such in the acid before nitration. Some first fraction nitric acid, obtained as above, was diluted with water to 5% strength; nitroglycerin of good heat test was then shaken with this dilute acid and the nitroglycerin separated and given the standard washing treatment. The nitroglycerin before treatment gave a 14 min. heat test, whereas after treatment the heat test was only 5 min.; now, as it is highly improbable that any reaction would have taken place with this dilute acid, the impurity must be present as such in the original acid and is merely extracted by the nitroglycerin in the nitration process.

Distillation of the first fraction nitric acid alone did not effect a further concentration of the impurity, but it was found that if the nitric acid were carefully diluted by means of ice below 68% strength and then distilled, the first portion of the distillate had a very marked effect on the heat test of nitroglycerin. About 300 lb. of mixed acid was gradually treated in above manner, namely, 25% of the nitric acid was distilled over; this nitric acid was then poured on to ice and again distilled. The first fractions obtained in this last operation were then fractionated, particular care being taken during all the operations to allow no volatile matter to escape, when finally a distillate was obtained which contained drops of oil. One part of the oil added to 20,000 of nitroglycerin lowered its heat test from 16 to 5 min. The oil had a peculiar odour and responded to the qualitative tests described later, but owing to the small amount of oil available a full analysis could not be made on this sample. A more convenient source of supply of this oil was found in plant first runnings and therefore experiments on mixed acid were discontinued.

In addition to the oil mentioned above, a small amount of a white solid was isolated in the distillation of the nitric acid. This solid distilled over after the oil, but as it had no effect on the heat test of nitroglycerin, its properties have not yet been investigated.

Isolation of impurity from plant nitric acid.

The nitric acid used in making mixed acid is manufactured by distilling sodium nitrate with 94% sulphuric acid; samples of nitric acid from the receivers were drawn throughout a large-scale distillation, and small-scale nitrations were then performed and gave products with the following heat tests: Product from first runnings 3, middle runnings 10, end runnings 11, absorption tower 10 mins. These results are similar to those obtained by the distillation of mixed acid and show that the impurity passes over in the first stages of distillation. The plant "first runnings," however, contain a considerable quantity of iodine, and when the acid is diluted iodine is liberated and passes over with the distillate and contaminates the oily impurity, from which it cannot be separated. To overcome this difficulty the nitric acid was mixed with sulphuric acid and one third of the nitric acid distilled off. This treatment was useful for two reasons, viz., the iodine remained behind, probably as iodic acid, and a distillate richer in impurity was obtained. The dilution and subsequent distillation of the nitric acid was carried out in one continuous operation by means of a small glass tower partially packed with glass beads. The nitric acid was mixed with water at the top of the tower, and then the introduction of a jet of steam supplied sufficient heat to distil off the impurity, while the diluted nitric acid passed to the bottom of the tower and was run away by means of a swan-neck tube. The distillate obtained in this latter operation was fractionated and yielded drops of oil. The oil was collected, washed with sodium carbonate solution and water, dried, filtered, and subsequently distilled *in vacuo* in a special micro-apparatus. The yield of oil from the nitric acid was about 0·005%.

Identification of impurity causing low heat tests.

Attempts were made to fractionate the oily im- that of tetranitromethane, but with a very satisfactory; evidence was, however, obtained that the oil was a mixture, but owing to the small quantity available this method of separation was abandoned.

The oil is colourless, with an odour resembling that of tetranitromethane, but with a very unpleasant action on the eyes and nose; it is insoluble in water and in sodium carbonate solution, but dissolves slowly in caustic potash, giving a yellow solution; the yellow colour gradually disappears on addition of a strong mineral acid, indicating the presence of a pseudo-acid, and the solution obtained gives the tests for a chloride. The oil quickly evolves nitrogen with hydrazine and caustic potash in accordance with the reaction for tetranitro- and monochlorotrinitro-methane described by Macbeth[1], it dissolves in sodium sulphite solution, liberates iodine from potassium iodide, and forms a yellow crystalline precipitate with alcoholic potash similar to potassium nitroform. The sp. gr. of the oil is 1·6646 at 15·5° C. At −10° it deposits a few crystals and freezes to a white solid when placed in a freezing mixture of solid carbon dioxide and ether. The oil boils at 119° C. (Siwoloboff's method) with decomposition and is very volatile. It gives a red coloration with anisol (tetranitromethane gives an intense red, monochlorotrinitromethane a deep yellow, dichlorodinitromethane a very pale yellowish green, and chloropicrin none.)

The impurity also gives the following colour reaction which denotes the presence of dichlorodinitromethane: 2 c.c. of 50% caustic potash is placed in a test tube and 1 drop of impurity and 1 c.c. of absolute alcohol added; the tube is gently shaken, but not sufficiently to mix the two layers, and the whole warmed. A deep wine-red colour appears at the junction of the two liquids.

Difficulty was experienced in the estimation of carbon in the impurity, the rapid evolution of nitrous fumes tending to give results more than 10% too high; with a specially long combustion tube and careful regulation of the combustion, however, good results were obtained. No special precautions were taken with the nitrogen estimations and the figures are therefore probably a little low. The analyses are shown in comparison with theoretical figures for compounds which might be present.

The molecular weight shown for the impurity was determined by the freezing point method, using benzene as solvent. The low molecular weight, low carbon content, and physical properties preclude the presence of anything but methane derivatives—except in small amounts—and as the oil does not react with sodium carbonate solution and is stable in hot strong nitric acid, nitroform and unsaturated compounds must be absent. The oil must therefore be a mixture of chloronitro derivatives of methane, and the analysis agrees with the supposition that it is a mixture of approximately 40% of tetranitromethane with 60% of chlorotrinitromethane, but it could also represent a smaller percentage of dichlorodinitromethane or chloropicrin with a correspondingly larger proportion of tetranitromethane.

---

[1] Chem. Soc. Trans., 1921, 119, 354.

Elementary analysis of impurity and possible constituents.

Substance.	H %	C %	N %	Cl %	O (Diff.). %	Mol. wt.
Impurity	—	6·22	24·4	11·12	58·24	189
Tetranitromethane ..	—	6·12	28·57	—	65·31	196
Monochlorotrinitromethane	—	6·47	22·64	19·12	48·23	185·46
Dichlorodinitromethane	—	6·86	16·01	40·54	36·59	174·9
Chloropicrin	—	7·30	8·52	64·73	19·45	164·38
Nitroform	0·6	7·95	27·81	—	63·64	151
Monochloropentanitroethane	—	8·29	24·18	12·24	55·29	289·5

It is very difficult to separate or estimate the various constituents of a mixture of chloronitromethanes with tetranitromethane owing to their closely allied properties, but an approximate estimate of the composition was obtained as follows: Samples of the chloronitro derivatives of methane were prepared, as will be described in a subsequent paper, and the formation of the potassium salts by means of potassium ethoxide was studied. When a strong alcoholic solution of tetranitromethane is mixed with potassium ethoxide an almost theoretical yield of potassium nitroform is precipitated as a yellow powder mixed with a small percentage of potassium nitrate[2]; with chlorotrinitromethane the potassium nitroform is mixed with potassium chloride. Dichlorodinitromethane gives a precipitate of potassium chloronitroform, $KCCl(NO_2)_2$, mixed with potassium chloride, but chloropicrin is completely decomposed, giving a precipitate of potassium chloride mixed with potassium nitrite, tetra-ethyl orthocarbonate remaining in solution.[3]

The percentage of dichlorodinitromethane in a mixture of tetranitromethane and chloronitromethanes can be roughly determined by treating the mixture with potassium ethoxide and analysing the precipitate. The potassium chloride is determined by direct titration with silver nitrate and the total chlorine by Carius' method; the difference between these two results gives the organic chlorine which represents one half of the chlorine originally present as dichlorodinitromethane. Experiments with pure dichlorodinitromethane and with synthetic mixtures gave low figures for the amount of dichloro compound, but by applying a correction an approximate idea of the dichloro compound present in the impurity can be obtained, as shown below. It should be noted that these determinations were carried out in strong solution, under standard conditions, and the salts were analysed as quickly as possible, as they decompose very readily.

Analysis of mixed potassium salts from impurity:

Mixed potassium salts; yield on weight of oil 99·0%, potassium chloride in salts 4·6%, total potassium in salts (actual) 22·7%, total potassium in salts (theoretical) 22·2%, organic chlorine 2·12%, dichlorodinitromethane in oil 10·6%, dichlorodinitromethane in oil (corrected result) 13—14%.

In calculating the theoretical percentage of total potassium in the salts it has been assumed that the ionic chloride is present as potassium chloride, the organic chlorine as the salt obtained from dichlorodinitromethane and the remainder of the salt is calculated as potassium nitroform; it will be seen that both the actual and calculated figures are close, although the "actual" figure is slightly high, due to the presence of a small amount of potassium nitrate. The results show 13—14% of dichlorodinitromethane to be present in the oil. The remaining chlorine may be present as the monochloro-derivative or as chloropicrin, and to decide this point the effect of these compounds on the heat test of nitroglycerin was tried. The method employed was to add known weights of these substances to nitroglycerin of good heat test and then subject the nitroglycerin to double the normal washing process, the heat test being taken before and after each washing. The results are given below.

Effect of nitrochloro compounds of methane on the heat test of nitroglycerin:

Substance added.	Percentage added.	Heat test of nitroglycerin. Before addition. min.	After addition. min.	After 1st wash. min.	After 2nd wash. min.
Tetranitromethane	0·01 ..	16	2	7	13
Monochlorotrinitromethane ..	0·01 ..	16	1½	2	2
Dichlorodinitromethane ..	0·01 ..	17	17	—	—
Chloropicrin	0·01 ..	16	16	—	—
Impurity	0·01 ..	16	2	5	7

The above results are very interesting; chloropicrin and dichlorodinitromethane in the concentrations used have no effect on the heat test, whereas monochlorotrinitro- and tetranitro-methane have a marked effect. There is, however, an essential difference between the last two compounds in that tetranitromethane can be fairly readily removed by washing, but the monochloro compound is very difficult to remove and it is undoubtedly this last compound which causes the worst trouble in manufacture. The low heat test caused by the presence of the impurity is more difficult to improve by washing treatment than that shown by the presence of tetranitromethane, and it may therefore be inferred that practically the whole of the remaining chlorine, after allowance has been made for the dichloro compound, is present as monochlorotrinitromethane, although a trace of chloropicrin may also be present. The approximate composition of the impurity is therefore: Tetranitromethane 50—55%, monochlorotrinitromethane 30—35%, dichlorodinitromethane 12—15%. It should be understood that although the above represents the impurity actually isolated, the relative proportions of the constituents will vary from time to time, according to circumstances as described in the next section.

Origin of impurity in nitric acid.

As already mentioned, the impurity passed over with the first runnings in a large-scale distillation, and to ascertain what gave rise to its formation, small-scale distillations were carried out using pure and also plant material, sufficient nitric acid being distilled to enable nitroglycerin to be made and washed, as previously described.

One sample of sodium nitrate gave good tests (14 min.) even with plant sulphuric acid. The other two samples gave low tests with this acid (5 and 2 mins.), and the tests were not improved by the substitution of pure for plant sulphuric acid; there is little doubt, therefore, that the cause lies with the nitrate.

In a paper by Datta (J. Amer. Chem. Soc., 1916, 1813) it is stated that chloropicrin and chloronitromethanes were obtained by treating a large number of substances with *aqua regia*; now commercial sodium nitrate always contains chlorides and traces of organic matter, and when it is considered that during the distillation process there is a large excess of nitric acid present, it is not surprising that tetranitromethane and chlorotrinitromethane should be formed. Further evidence on the formation of the monochloro compound will be given in the subsequent paper. Sodium nitrate No. 3, which gave good tests, was a very "clean" sample, while sample No. 2, which gave the worst tests, contained a considerable amount of visible organic impurities such as pieces of wood, bag, etc.; starch was also found in certain portions of it, and any of these in the presence of chloride would be capable of giving rise to the impurity. It is highly probable that traces of chloronitromethanes will be formed in almost any nitric acid prepared by distillation of sodium nitrate and sulphuric acid, as it is almost impossible to exclude a small amount of organic matter. The relative proportion of the various chloro compounds will, of course, depend on the relative proportion of chlorine and organic matter present and possibly also on the nature of the organic matter.

---

[2] Schmidt, Ber., 1921, 54, 1483.

[3] Bassett, Annalen, 1864, 132, 54.

Summary.

An oil has been isolated from commercial nitric acid and has been shown to be composed of a mixture of tetranitromethane, monochlorotrinitromethane, dichlorodinitromethane, and possibly a trace of chloropicrin.

The formation of these compounds is probably due to the presence of traces of chlorides and of organic matter in the sodium nitrate from which the nitric acid is made, and these substances are therefore probably present to a greater or less extent in all samples of commercial nitric acid. The question of the occurrence and possible effect of organic matter in certain types of sulphuric acid used for the preparation of nitric acid is being investigated.

The above oil has been shown to cause very low heat tests of nitroglycerin in concentrations of 1 in 20,000; the active ingredients are tetranitromethane and monochlorotrinitromethane, the latter causing most trouble in manufacture owing to the difficulty experienced in washing it out of the nitroglycerin. Dichlorodinitromethane and chloropicrin in small concentration have no effect on the heat test of nitroglycerin.

In conclusion I wish to express my thanks to Messrs. Nobel Industries, Ltd., and particularly to Mr. Wm. Rintoul, O.B.E., for permission to publish this paper.

My thanks are also due to Mr. W. J. Boyd for carrying out experimental work in connexion with the identification of the compounds.

STUDIES IN VULCANISATION.

SOME FURTHER EFFECTS OF ACCELERATION ON THE RUBBER STRESS-STRAIN CURVE.

BY P. SCHIDROWITZ AND P. L. BEAN.

In a previous paper,[*] the effect of an active organic accelerator on the vulcanisation properties of rubber-sulphur mixings in the presence or zinc oxide was dealt with. A section of this paper dealt particularly with the effect of varying the amount of the accelerator, using a constant proportion of sulphur to rubber. The present communication deals with the reverse conditions, the proportion of accelerator to rubber being kept constant, with varying amounts of sulphur.

The accelerator employed, as before, was piperidyldithiocarbamate of piperidine, dispersed on colloidal clay, the proportion of the organic compound being 25%.

The rubber used was throughout the same batch of a standard thin pale crêpe. The base mixing consisted of rubber 100, zinc oxide 2½, accelerator 0·5, colloidal clay 1·5, and on this basis six mixings were made up, the amount of sulphur added varying from 1 to 4 parts. The mixings were made in the usual way on open rolls, the accelerator being added last, mixed with the zinc oxide, the temperature of the rolls being kept as low as possible. The total sulphur in the mixings was then estimated by a standard method. 24 hours elapsed in every case between mixing and vulcanisation, which was carried out in ring moulds in the press, at a temperature of 141° C. (=40 lb. steam), the plates being heated before introduction of the moulds, and no rise given. After resting for five days, ring test pieces were cut and tested on the Schopper machine. Simultaneously estimations of the free sulphur were made by the usual method, the combined sulphur being estimated by difference. The times of cure were 1, 2½, 5, 10, 20, 30, 40 minutes. Finding that mixes A and B were greatly undercured at both 20 and 40 minutes, shorter cures were not employed; similarly, E and F were found to be greatly overcured at 10 minutes, and therefore longer cures were not carried out in these two cases.

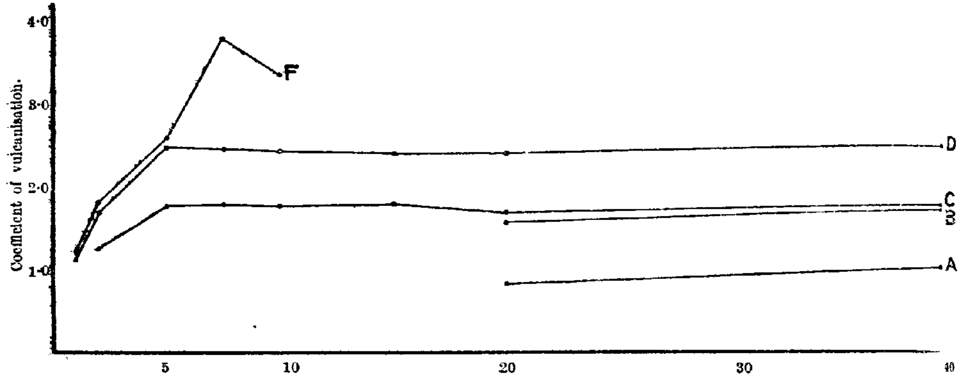


Fig. 1.

The results obtained were as follows:—

Table I.

Total sulphur in mixings.

Mixing.	A	B	C	D	E	F
Total S %	1·01	1·59	1·79	2·33	3·38	4·10
% S to rubber	1·07	1·69	1·90	2·49	3·66	4·49

Coefficient of vulcanisation.

The coefficient of vulcanisation results will be found in Fig. 1. The curves in this figure show the progress of curing so far as combination with sulphur is concerned for mixes A, B, C, D, and F. Curve E is omitted as the results obtained obviously involved some experimental error. It will be observed that in all cases, as has been noted by previous workers, combination is comparatively

---

[*] J., 1921, 268 T.

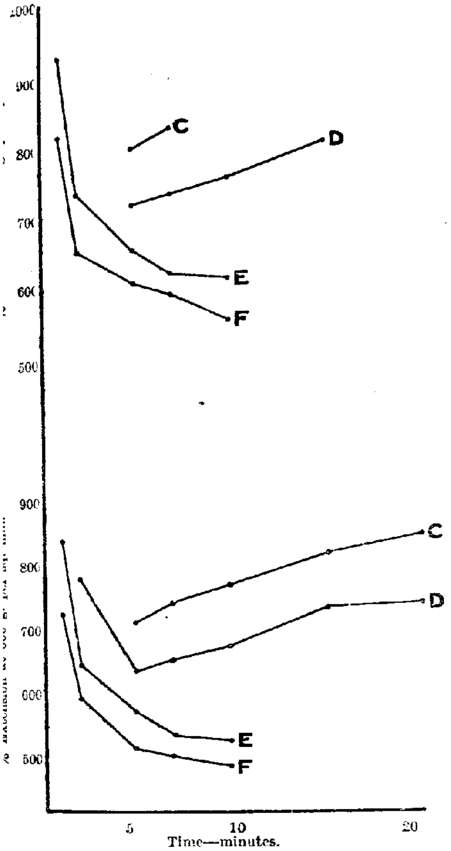


FIG. 2.

TABLE II.

	Mix	Cure, mins.	E[1]	E_1[2]	Type[3]	B[4]	E at B[5]
1·07% Sulphur[6]	A	1	—	—	—	—	—
	,,	2	—	—	—	—	—
	,,	5	—	—	—	—	—
	,,	7½	—	—	—	—	—
	,,	10	—	—	—	—	—
	,,	20	—	—	—	699	>11
	,,	40	—	—	—	402	>11
1·09% Sulphur.	B	1	—	—	—	—	—
	,,	2	—	—	—	—	—
	,,	5	—	—	—	—	—
	,,	7½	—	—	—	—	—
	,,	10	—	—	—	—	—
	,,	20	—	—	—	1018	9·86
	,,	40	—	—	—	792	9·87
1·90% Sulphur.	C	1	—	—	—	—	—
	,,	2	—	—	—	—	—
	,,	5	706	796	36	1583	9·09
	,,	7½	734	824	36	1530	9·30
	,,	10	755	—	—	1308	9·25
	,,	15	796	—	—	1028	9·27
	,,	20	825	—	—	868	9·26
	,,	40	—	—	—	836	9·69
2·49% Sulphur	D	1	—	—	—	—	—
	,,	2	766	—	—	950	8·84
	,,	5	639	720	32	1890	8·49
	,,	7½	654	735	32	1775	8·66
	,,	10	672	755	33	1708	8·77
	,,	15	725	804	32	1578	9·11
	,,	20	733	—	—	1317	9·00
	,,	40	795	—	—	1228	9·36
3·00% Sulphur.	E	1	817	924	43	1834	10·76
	,,	2	650	737	35	2426	9·23
	,,	5	585	660	30	2572	8·60
	,,	7½	553	626	29	2743	8·21
	,,	10	545	619	30	2890	8·17
	,,	15	—	—	—	—	—
	,,	20	—	—	—	—	—
	,,	40	—	—	—	—	—
4·49% Sulphur.	F	1	720	819	40	2296	10·15
	,,	2	603	687	34	2453	8·73
	,,	5	539	614	30	2816	8·25
	,,	7½	524	598	30	2686	7·96
	,,	10	511	587	30	2859	7·94
	,,	15	—	—	—	—	—
	,,	20	—	—	—	—	—
	,,	40	—	—	—	—	—

[1] E = elongation % at a load corresponding to 600 g. per sq. mm. of cross-section.

[2] E_1 = elongation % at a load corresponding to 1040 g. per sq. mm. of cross-section.

[3] Type (slope) = $(E_1—E)/2·5$.

[4] B = breaking strain in lb. per sq. inch.

[5] E at B = elongation at break, taking the original length as = 1.

[6] Total sulphur calculated to 100 of rubber.

rapid in the early stages, the steepness of the curve increasing with the total sulphur. The sulphur figures are not put forward as being exhaustive, inasmuch as gross over- or under-curing was not desired.

Mechanical properties.

Fig. 2 indicates the progress of curing illustrated by means of extensions at loads of 600 g. and 1040 g. per sq. mm. respectively. Fig. 3 shows the progressive effect on the breaking load. The figures obtained for tensile strength, type, etc. will be found in Table II.

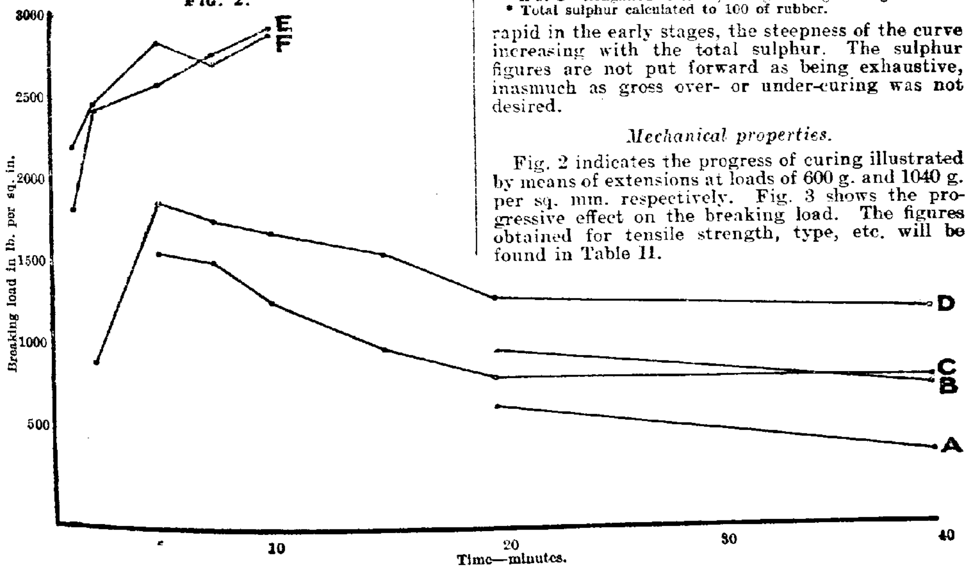


FIG. 3.

The following observations may be made on the results recorded above:—

1. As is evident from Fig. 2, and the data in the tables, "reversion" occurs at a comparatively early period when the quantity of sulphur does not exceed, in round numbers, 2½%.

2. As is evident from Fig. 3, and the data in the tables, moderate curing takes place with a sulphur content of 2½%, but below this results are poor.

3. In a previous paper,* it was shown that excellent results could be obtained with a minimum of 2% of sulphur. It would appear, therefore, that the accelerator used required 2 to 2·75% of sulphur (allowing for variations in materials and conditions) to attain reasonably full activity.

The work described above was carried out at the Northern Polytechnic Institute, N. 7, and we wish to express our thanks to the Governors for facilities afforded.

THE EFFECT OF THE ACETONE-SOLUBLE CONSTITUENTS OF RUBBER ON THE VULCANISING PROPERTIES.

BY HENRY P. STEVENS.

Much time has been devoted to the study of the accessory substances present in Para rubber which are believed to give rise to variations in rate of cure (or vulcanisation), but the position remains obscure and progress is slow. It is the object of this paper to summarise briefly the present position, particularly as regards the acetone-soluble constituents, and at the same time to publish certain results which have been obtained by the author in a recent investigation while working on behalf of the Rubber Growers' Association.

Mainly as the result of the work of D. Spence, L. Weber, and the author,† it was shown ten years ago that the rate of vulcanisation and physical properties of rubber were dependent upon certain active ingredients present in small amounts in the crude rubber. These could be removed (1) with the insoluble matter (mainly nitrogenous) or (2) with the acetone-soluble portion. This latter also contains nitrogen but in relatively small amount. The complete removal of the insoluble constituents resulted in a rubber which, when mixed with sulphur, would hardly vulcanise (as shown by the physical properties and small proportion of the sulphur combined). Extraction with acetone had little or no effect on rate of vulcanisation of this rubber-sulphur "mix," whether the rubber had been previously freed from the insoluble constituent or not. If, however, vulcanisation be carried out with a "mix" containing litharge as well as sulphur, it was found that previous extraction of the rubber with acetone has a profound effect on rate of vulcanising; the rubber shows very inferior mechanical properties and a low percentage of combined sulphur. The acetone-soluble constituents appear to play the same part in a litharge mix as do the insoluble (nitrogenous) constituents in a simple rubber-sulphur mix.

It should be noted that the process of extraction of the constituents, whether insoluble or acetone-soluble, is not the cause of differences in behaviour as the rubber regains its normal properties on putting back into it the constituents which have been removed.

The next stage was the discovery of the rapid vulcanising properties of "matured," that is putrefied coagulum (Eaton and others), and the separation from such rubber of the nitrogenous bases which were apparently the cause of the rapid vulcanising properties. These bases were not found, or were present in a very small proportion, in crêpe as ordinarily prepared. Little doubt exists that these bases are putrefaction bases, as such are known to act as vulcanisation catalysts. These observations threw some light on the variations noted in the rate of vulcanisation of Para rubber, but it soon became evident that much still remained obscure. For instance, rubber normally prepared contains but little nitrogenous base, and removal of this base by extraction with acetone, or treatment with weak acid, has relatively little effect on the rate of vulcanisation. It is obvious that the insoluble matter (as removed by benzene treatment) must contain the bulk of the substances which enable the ordinarily prepared rubber to vulcanise normally and that these substances are not readily soluble bases like the putrefaction bases extracted from "matured" rubber.

As already stated, these acetone-soluble bases* account for the fast vulcanising properties of "matured" rubber. Ordinary crêpe contains little or no soluble bases, consequently acetone extraction has only a slight effect on the rate of cure. Crêpe will, however, vary in this respect, and accordingly it is not surprising to find that some samples do respond to a greater extent than others to acetone extraction when vulcanising with sulphur only. Martin and Elliott in a recent paper (J., 1922, 226 T) have shown that sheet rubber is more susceptible than crêpe rubber in this respect, while "matured" (slab) rubber is markedly affected. The rate of vulcanisation of ordinary crêpe rubber can be almost doubled by the addition of 2% of acetone extract from "slab" rubber. These authors also show that there is probably some correlation between the amount of acetone extract and rate of vulcanisation.† These results fall in very well with the foregoing conclusions that slab rubber owes its rapid rate of vulcanisation to putrefactive bases. On the other hand, there are certain published data which are difficult to reconcile with the views expressed. Kratz and Flower, in the course of their work on accelerators, record an instance in which the coefficient of a sample of rubber was *increased* from 0·58 to 0·83 as a result of 36 hours' acetone extraction. Another sample of rubber treated in the same manner gave a negligible decrease (J. Ind. Eng. Chem., 1920, 12, 971).

As already explained, the insoluble constituents must contain a catalyst or catalysts insoluble both in benzene and acetone, and these probably consist of nitrogenous substances more complex than the acetone-soluble bases. It is well known that rubber obtained by evaporating latex to dryness on a steam bath vulcanises rapidly, and in this respect is comparable with "slab." As, however, the temperature employed excludes the possibility of putrefaction, the fast vulcanisation properties of evaporated latex cannot be attributed to putrefaction bases; moreover, extraction with acetone or water, as will be seen from the figures recorded below, has no appreciable effect on the coefficient. This applies to latex whether air-dried, sun-dried, or steam-oven-dried. So prepared the rubber vulcanises approximately three times as fast as ordinary crêpe. The specimens examined were as follows:—(A) Air-dried and sun-dried. Evaporation was accompanied by some putrefaction. (B) Steam-oven-dried. (C) As A, but with 0·2% of boric acid added to the latex before drying. This did not prevent putrefaction, nor did a much larger proportion of boric acid do so. (D) Crêpe rubber as a control prepared from the same latex as the three foregoing samples. (E) Rubber prepared by pouring latex into alcohol.

---

* Loc. cit.

† For references see "Plantation Rubber and the Testing of Rubber," by G. S. Whitby.

* Soluble in acetone such as commonly used for extraction. The bases might not dissolve in carefully dried acetone.

† This had already been found by van Rossem, who calculated the correlation coefficient for 315 samples. (Comm. Neth. Govt. Inst., 1917, 196.)

Samples of each were treated as follows:—(1) Dry êped, that is, run out into crêpe on dry rollers; small amount of sticky substance was deposited on he rollers, but it may be assumed that no subantial loss ensued and that the dry crêped rubber ontained practically all the original ingredients.) Crêped and washed in a stream of water on the ollers, so as to remove as much as possible of the ater-soluble ingredients. After this treatment the ubber was air-dried. (3) Part of the rubber which ad been dry crêped as in (1) was extracted with hot cetone in an all-glass Soxhlet extraction apparatus s in the determination of "resin."

The fifteen specimens thus obtained were mixed ith sulphur in the usual proportion of nine parts f rubber to one part of sulphur, and vulcanised ogether for the usual time and temperature (2 ours at 138° C.). The resulting specimens were xhaustively extracted with acetone and the comined sulphur estimated in the residue in the usual anner with the following results:—

Coefficients.

	1. Dry crêped.		2. Crêped and washed.		3. Acetone-extracted.
. Air-dried and sun-dried	6·28	..	6·00	..	6·18
. Steam-oven-dried ..	7·16	..	5·48	..	6·94
. As A, but with 2% boric acid	5·75	..	4·70	..	5·60
. Ordinary crêpe as control	2·20	..	2·38	..	2·22
. Alcohol-coagulated ..	3·94	..	4·43	..	4·65

A comparison of columns 1 and 2 for samples A, , and C shows that washing had the effect of reoving a little of the accelerating ingredients. If olumns 1 and 3 be compared it will be seen that cetone extraction had practically no effect on amples A, B, and C, or at the most reduced the ure very slightly.

The control sample of pale crêpe as ordinarily repared shows a slight increase in rate of vulcanisation after wet crêpeing, possibly due to slight utrefaction of the rubber on account of moisture aken up, although no odour of putrefaction was oticeable. Acetone extraction was without effect n the rate of vulcanisation.

The alcohol-coagulated rubber vulcanises appreiably faster than the control. Wet crêpeing ncreased the rate of cure which, as before, may be ttributed to putrefaction, but it is difficult to ccount for the increased rate of cure of the acetonextracted rubber. The case is analogous to the bservations of Kratz and Flower already referred o.

The acetone extracts were examined, but the mounts of base and the precipitates obtained with he phosphotungstate reagent were very small. It an only be said that A, B, C, and E gave rather eavier precipitates than the control sample D. he following figures give the weights of the queous and acetone extracts of the dry crêped ubbers:—

		Aqueous extract. %		Acetone extract. %
A	.. ..	0·0035	..	4·47
B	.. ..	0·0140	..	4·95
C	.. ..	0·0320	..	5·80
D	.. ..	0·0170	..	2·40
E	.. ..	0·0140	..	3·80

The figures for acetone extract for A, B, C, and are high, due no doubt to the retention of the reater part of the serum. The main constituent f these extracts is methylinositol or allied subtances.

Portions of the dry crêped rubbers were placed to oak in water in separate stoppered bottles with the ddition of a little chloroform in each case to revent putrefaction. The soaking was continued or some weeks, and the water changed two or three imes. The rubber was dried, mixed with the rdinary proportion of sulphur, and vulcanised under the same conditions as before. The combined sulphur was then estimated in the vulcanisates.

The following figures give the coefficients for the dry crêped rubber (from the previous table) and the coefficients after soaking and drying:—

Coefficients.

		1. Dry crêped. %		2. Same after soaking in water. %
A	.. ..	6·28	..	6·42
B	.. ..	7·16	..	7·16
C	.. ..	5·75	..	5·34
D	.. ..	2·20	..	2·58
E	.. ..	3·94	..	5·27

The figures show that for samples A to D but little change is produced by long soaking. The small increase shown by some of the samples may have been due to putrefaction, for although the presence of chloroform would inhibit these changes during the soaking process, the chloroform would soon pass off when the crêpe was hung up to air-dry, and putrefaction might then ensue. The increase in rate of cure of sample E is remarkable. The alcohol-coagulated rubber gives, in the first place, a coefficient of 3·94, which is increased to 4·65 by acetone extraction, and to 5·27 by soaking in chloroform water and drying. Alcohol, acetone, and chloroform would all presumably inhibit bacterial changes. It might be assumed that putrefaction would set in at the last stage of drying after the chloroform had evaporated. This, however, could not apply in the case of the acetone-extracted sample, which was not moistened. Moreover, the alcohol-coagulated specimen, which was washed with water and air-dried, showed a smaller increase in coefficient than the acetone-extracted specimen (4·43 as against 4·65). Also the effect of water washing or soaking on samples A to D was to reduce rather than to increase the rate of vulcanisation. The behaviour of the alcohol-coagulated rubber is therefore exceptional, and the increase in rate of cure resulting on aqueous or acetone extraction cannot be attributed to putrefactive changes.

Attempts to characterise the putrefactive change have not met with success; we do not know whether the bacteria are aerobic or anaerobic. The interior of a mass of putrid coagulum is acid, but the exterior is covered with an alkaline slime. It is in this alkaline slime that the putrefactive base should be found. Experiments were undertaken to compare the rato of vulcanisation of the interior and exterior portions. Omitting some earlier experiments, the following figures may be quoted:—

	Crêped and air-dried.			Smoke-dried.	
	Time of cure, min.	Rate of cure,* %		Time of cure, min.	Rate of cure,* %
Acetic acid coagulated—					
(1) Inside portion ..	75	272	..	48	430
(2) Outside ,, ..	142	143	..	75	272
Spontaneously coagulated—					
(1) Inside portion ..	161	127	..	99	206
(2) Outside ,, ..	127	160	..	141	145

* Ordinary pale crêpe taken as standard.

In the preparation of these samples the surface portions were thin slices so as to comprise as large a proportion of the actual surface as possible, and the mass of coagulum was dried down so as to include any basic substances present in the slimes on the surface of the rubber. It will be noted that there is a considerable difference in the rate of vulcanisation. Except in the case of the air-dried spontaneously coagulated specimen the interior portions vulcanise much faster than the exterior.

To carry the inquiry a stage further, a quantity of this alkaline slime was collected and forwarded for examination. It consisted of a thick, greasy liquid with an abominable odour. A small quantity (5 c.c.) was distilled in steam (1) alone, (2) with the addition of magnesia. The latter was added to

B

facilitate the decomposition of any salts of basic volatile constituents, and enable them to pass over into the distillate. In both cases the distillates and the residues gave copious precipitates with the phosphotungstate reagent (after suitable treatment), showing the presence of simpler nitrogenous bases, such as are normally present in the products of putrefaction. The mixed bases were separated from the phosphotungstates by the appropriate procedure and dried in a vacuum desiccator. The effect on the rate of vulcanisation of rubber was then ascertained by mixing the separated bases (each from 5 c.c. of slime) with the same quantity of ordinary pale crêpe rubber (90 g.) compounded with sulphur in the usual proportion (10 g.). Part of the pale crêpe, without addition of bases, was taken as a control, and to a further portion was added 5 c.c. of slime. This was added gradually to the rubber and worked in on the rollers before mixing in the sulphur. All samples were vulcanised together under the same conditions. The samples were then analysed, and the combined sulphur determined. The distillate in the case of (1) was lost and therefore does not figure in the table.

	Description.	Combined sulphur, %		Rate of cure, %
(1)	Control, pale crêpe	3·09	..	100
(2)	Control with the addition of the bases (amounting to 0·0280 g.) from the residue of steam distillation	3·25	..	105
(3)	Control with the addition of the bases (amounting to 0·0073 g.) from the distillate of steam distillation with magnesia	3·29	..	106
(4)	Control with the addition of the bases (amounting to 0·0398 g.) from the residue of steam distillation with magnesia	3·21	..	104
(5)	Control with the addition of 5 c.c. of slimes.	4·43	..	143

These figures show that the bases separated from the slimes have a negligible effect on the rate of vulcanisation. The slimes untreated have an appreciable effect. The separation of the bases used in (2), (3), and (4) seems to have resulted in the loss of the active ingredients, as the slimes alone (5) have a much greater accelerating effect.

Similar distillation experiments were made with sample A (air-dried and sun-dried latex) by allowing the dry crêped rubber to soak in water and distilling the extract. This yielded an alkaline distillate, and both distillate and residue (after extraction of the base with lime and acetone) yielded fairly copious precipitates with phosphotungstate in contrast with the amounts of precipitate yielded by the acetone extract.

Similar tests were carried out by steam distillation in the presence of magnesia. Twenty g. yielded bases from the distillate requiring 4·1 c.c. of $N/10$ acid to neutralise and from the residue 5·1 c.c. of $N/10$ acid for neutralisation. The separated bases from 20 g. of the sample were incorporated with 20 g. of a control pale crêpe and the usual proportion of sulphur and vulcanised. The following figures were obtained:—

	Coefficient.		% Control.
Control (pale crêpe)	3·09	..	100
Steam and magnesia distilled, bases from distillate	3 29	..	107
Steam and magnesia distilled, bases from residue	3·21	..	104
Residual rubber from steam distillation	6·53	..	211
Original rubber as dry crêped ..	7·16	..	232

It appears that the bases separated, whether volatile or not, had but a slight effect on the rate of cure. The rubber (sample A, dry crêped) lost slightly in rate of cure by the treatment. Generally, therefore, the experiment confirms the previous conclusion that the separated bases do not account for the fast vulcanising properties of rubber obtained by evaporation of latex.

As further proof I may recall experiments made some years ago with latex treated with formalin. An appreciable amount of formalin was added to the latex, which showed the usual premature coagulation and was full of minute clots. This latex could not possibly have undergone putrefaction after the addition of the formalin. Yet when evaporated to dryness on a water-bath it gave a very fast vulcanising rubber.

Conclusions.

(1) Extraction of evaporated whole latex with water or acetone either causes a small decrease in rate of vulcanisation or it is without effect.

(2) Extraction of ordinary pale crêpe may increase or slightly decrease the rate of vulcanisation or may be without effect. The specimen examined on this occasion was unaffected by acetone, but showed a small increase as the result of water extraction.

(3) Extraction of alcohol-coagulated latex with water or acetone results in an appreciable increase in rate of vulcanisation.

(4) The alkaline slimes from the surface of matured rubbed contain appreciable quantities of organic bases, part of which is volatile. Similar bases are obtained by soaking evaporated latex in water. The accelerating effect of these bases is small.

(5) The surface and interior portions of putrefied coagulum may show considerable differences in rate of vulcanisation.

(6) The formation of putrefaction bases is probably sufficient to account for the high rate of vulcanisation of "slab" or other "matured" rubber, but does not account for the high rate of vulcanisation of evaporated "whole" latex or of alcohol-coagulated latex.

(7) The correlation between the amount of acetone extract and rate of vulcanisation is not directly connected with the presence of putrefaction bases, as acetone extraction, which should remove the bases, may result in a more rapid vulcanising rubber.

THE TRANSFORMATION OF METHYL α-ELÆOSTEARATE INTO METHYL β-ELÆOSTEARATE.

BY R. S. MORRELL, M.A., PH.D., F.I.C.

K. Bauer and K. Herberts (Chem. Umschau 1922, **29**, 229) have published the results of an investigation on tung oil, from which they conclude that α-elæostearic acid is transformed during esterification into the β-modification, but if the α-acid be heated with acetic anhydride and the excess of anhydride distilled off at 110° C. *in vacuo* subsequent saponification with alcoholic potash gives the α-acid (m.p. 46° C.) only. In 1918 I communicated a paper to the Birmingham Section of the Society (J., 1918, 181 T) in which I proved that methyl α-elæostearate was transformed into the β-variety on distillation *in vacuo*. The undistilled methyl α-ester, prepared from thickened tung oil by the action of sodium methoxide at the ordinary temperature, gave on saponification a syrupy acid from which a cerium salt soluble in ether was obtained, indicating the absence of the β-acid. I would not have called attention to my communication if Bauer and Herberts had acknowledged my work on methyl elæostearate or on the bromination of β-elæostearic acid. I am of the opinion that the conclusions drawn from their results are incorrect. There is the possibility that the formation of solid tetrabromide obtained from α-elæostearic acid is due to the transformation of the α-variety into the β-variety by the action of bromine. Nicolet (J. Amer. Chem. Soc., 1921, **43**, 938) considers that this suggestion requires confirmation, but it seems plausible. The yield of solid tetrabromide from the α-acid is small. Bauer and Herberts had difficulty in obtaining the solid tetrabromide and make no mention of the fact that the β-acid yields a solid and fluid tetrabromide on bromination.

Manchester Section.

Meeting held at Textile Institute on March 3, 1922.

DR. E. ARDERN IN THE CHAIR.

NOTE ON THE CAUSE OF THE "SPLITTING" OF A POTTERY BODY.

BY MAY B. CRAVEN, M.SC.TECH., A.I.C.

The following is a brief account of an investigation carried out during the war in connexion with the "splitting" of a pottery body. The investigation concerned an English ring support required to carry incandescence mantles, which ring split off, or splintered, under the effect of heat, whereas the German rings, which were used almost exclusively before the war, withstood perfectly much greater variations of temperature. Having regard to the use of the rings, it was obviously essential that the pottery body, of which the ring was made, should withstand heat suddenly applied.

When made, the highest temperature which the ring has to withstand is reached during the manufacture of the mantle. The mantle, which is made from knitted material (cotton, silk, ramie fibre, etc.), is tied on to the ring, dipped into the solution of rare earth compounds, and then put on to a gas fitting and fired by compressed gas at about 1100° C. This treatment burns off the fibre and eaves the framework of thorium oxide which carries the essential cerium oxide (98% ThO_2, 2% CeO_2 approx.). It is during this firing that the quality of the ring shows itself. If it be a poor ring, either it breaks, or small splinters fly from it, and usually some of these pierce the mantle. In either case there is a loss—in the former case complete, n the latter case partial, because the pierced mantles cannot be sold as perfect ones.

During use the heat effect is as a rule that of urning ordinary gas, and "splitting" from the lay ring is not so likely to occur, although with a poor ring the life of the mantle is comparatively hort; the greatest damage, however, is incurred during manufacture. Where the mantle is used with a compressed gas supply the piercing takes place each time the mantle is in use owing to the nability of the ring to withstand the temperature o which it is subjected.

The delicate form of the ring, with its tying groove and three lugs, by which it is supported on he burner, preclude the use of any pottery material incapable of delicate treatment. The material must be fine in grain and coherent, and he more homogeneous the mixture the fewer trains there will be.

It was considered probable that the difference etween the English body and the German one was chemical difference, that is, one of chemical composition, and this was rather indicated by the name f the German body, "Magnesia." A bone-ash body would also withstand heat well. So, having regard o the possibilities of bone-ash and magnesia bodies, xceedingly careful chemical analyses were made. The porosities of the bodies were also determined. At the same time, for the purpose of comparison, n analysis was made of an English clay ring, made y a different firm; this was certainly better than he ring first examined though inferior to the German one.

Chemical analyses.

In the following statement, A refers to the German body, B to the superior English body, and C o the body first under investigation.

The porosities (weights of water absorbed by 100 grams of body) were:—A, 12·6; B, 10·2; C, 12·7 g.

The analyses show ordinary pottery bodies approximating to earthenware in type, though as a rule earthenware bodies contain at least 70% of silica.

	A.	B.	C.
SiO_2	66·25	66·17	61·00
Al_2O_3	31·93	29·40	36·06
Fe_2O_3	0·72	0·65	0·80
P_2O_5	1·03	0·77	0·18
CaO	0·03	0·35	0·08
MgO	0·70	1·41	0·39
K_2O and Na_2O (by diff.)	—	2·00	1·44
Loss on ignition	0·22	0·25	0·05

The alkalis were not determined separately because they were present in the usual small percentage. TiO_2 was estimated, but it also was present in the usual small percentage, and has no significance in this instance, so the figures are omitted.

It is evident from the analysis that the German body is not specially a "magnesia" body, neither is it a bone-ash body, for the lime content is low, even unusually low.

The good English body approximates in composition to the German body, and the body under investigation differs from it, the silica content being about 5% lower and the alumina content about 4% higher than that of the German.

The porosities are much the same, and are not remarkable.

The usual earthenware materials are ball clay, china clay, and flint.

The analysis showed that the German raw materials were extremely well washed—the almost complete absence of alkali (0·12%, and this is probably experimental error) shows this. The difference in chemical composition is not enough to account for the success of the German and the failure of the English body, *i.e.*, conclusions drawn from the analyses are mainly negative.

Ordinary visual examination of the fractured rings showed a great difference, the German fracture being granular and the English one striated.

Sections were cut and examined, and the cause of the trouble was plainly to be seen.

At a magnification × 30 the German body, Fig. A, showed finely ground, evenly sized particles. There were no stratifications, the mass being homogeneous throughout. Black iron stains, due to ferri-ferrous silicate, occurred here and there, but as the ring was almost perfect when in use the presence of the iron oxide was evidently not detrimental. The good English ring approximated to the German in texture, though where the lugs join the ring there was not perfect cohesion, and slight striations were faintly visible.

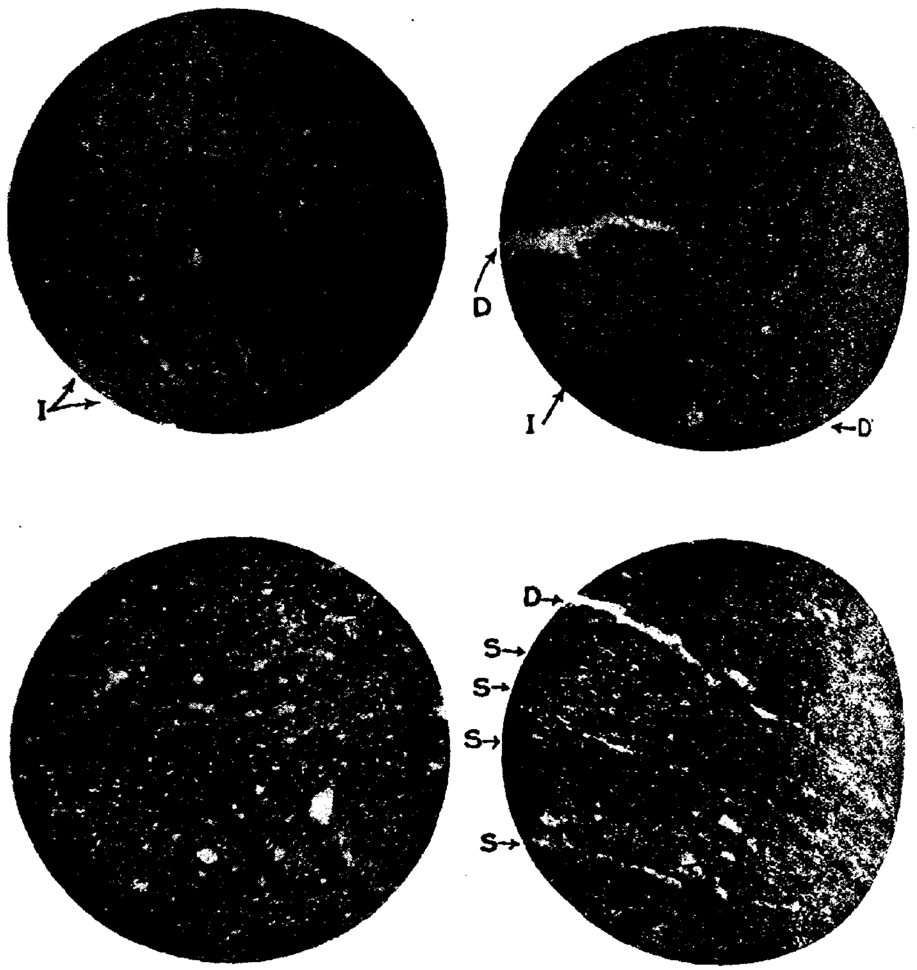
Two sections of the inferior English body are shown, Figs. C1 and C2. The former is a section cut at 45°, and the latter is a vertical section. Both photomicrographs show plainly the extremely unevenly sized particles. Figure C2 shows layers of material and air spaces running more or less transversely. In fact, the ring is striated throughout.

The difference between the German ring and the English one is thus a difference of mechanical treatment of the material. The actual pressing of the rings had evidently taken place in three operations —first ring, then ring with lugs, and then the complete shape with the tying groove.

The direction of the striations in the English ring showed plainly that they were the result of pressing. If the die is not working in perfect mechanical adjustment this would at once affect the stresses in the presser ring. The English die is certainly not "true." A die mechanically more perfect would prevent the formation of the layers in the ring.

The unevenly sized particles of the English body indicated that the raw materials had not been evenly ground. Of the raw materials the ball clay and china clay present no difficulty; they are soft and are very easily ground. The third body, flint, is the most difficult to grind to an impalpable powder. The imperfect grinding of the flint is another cause of the trouble. The best grinder for flint is the old chert mill and this type of mill—where a homogeneous material is required—should certainly be used. Silica occurs naturally in a fine state of division as diatomite or kieselguhr. The fine, even texture of the German body might be due to the use of kieselguhr, and all the sections examined under polarised light (D×360) showed crystalline particles in the English body and no crystalline particles in the German one. In the former body silica is certainly introduced as flint but it could not be positively asserted that the German body contained kieselguhr. In any case the silica here, whether derived from flint or kieselguhr, was extremely finely ground, and that fact helped considerably to ensure the success of the German body.

Photomicrographs of ring sections. ×30.



Vertical section.—A. German body.

Vertical section.—B. Good English body.

Oblique section.—C1. English body.

I. Staining due to iron oxide.
D. Crack where the foot joins the ring.

Vertical section.—C2. English body.

D^1. Air spaces.
S. Striations.

There can be no doubt that the superiority of the German body was due to the superiority of the mechanical treatment of the German raw materials. They were much better washed, better ground, and better pressed than were the English raw materials.

Where a body has to withstand heat treatment no precaution should be spared to ensure homogeneity and to have arrangements for pressing such that the product has no laminations, air films, or strains of any kind.

Communications.

THE ACTION OF OZONE ON HYDROCARBONS WITH SPECIAL REFERENCE TO THE PRODUCTION OF FORMALDEHYDE.

BY T. SHERLOCK WHEELER, B.SC.(LOND.), A.R.C.SC.I., A.I.C., AND E. W. BLAIR, B.SC.(LOND.), D.I.C., A.I.C.

Part I. The action of ozone on methane.

The action of ozone on methane was first investigated by Otto (Ann. Chim., (7), 13, 109), who proved that at 100° C. a very slow reaction takes place; he detected formaldehyde and formic acid among the products. His results were afterwards confirmed by Drugman (Trans. Chem. Soc., 1906, 89, 939). Both these researches, however, were purely qualitative; accordingly the present authors, having completed a quantitative investigation of the production of formaldehyde from ethylene by interaction with ozone, decided to study the interaction of methane and ozone on similar lines.

Experimental methods.

The methane and oxygen for these experiments ere prepared and stored as described by Bone and Vheeler in their paper on the slow oxidation of ethane (Trans. Chem. Soc., 1903, 83, 555); the nalysis of the gaseous mixtures obtained is also escribed therein. The ozoniser employed gave bout 4% ozone from oxygen under the conditions f our experiments; the ozone was estimated by ieans of neutral potassium iodide.

In our first experiments mixtures of methane and xygen which had been dried over sulphuric acid nd phosphorus pentoxide were passed through the zoniser and led into a hard glass tube 80 cm. long y 2 cm. diam., placed in an electric furnace so that lmost its whole length could be heated to any esired temperature. The volume of the tube was 50 c.c., and as the gas mixture was in each experinent passed at the rate of 1 litre in 10 mins. the eriod of heating was about 2½ minutes. The issung gas was washed in two water-worms and with ieutral potassium iodide to remove any residual zone, after which it was collected in a gas-holder illed with 50% glycerin and water. Ground glass oints were used in all portions of the apparatus in ontact with ozone.

Before starting an experiment the apparatus was illed with pure oxygen—at the end of the experinent it was washed out into the final gas-holder vith several litres of the same gas. The pressures, emperatures, and volumes of the initial and final gases were measured and compared as described in our paper on the production of formaldehyde from ethylene (J., 1922, 303 T). Our methods of estinating solutions containing formaldehyde, formic acid, and hydrogen peroxide will be described in another paper.

In a second series of experiments oxygen alone was passed through the ozoniser and methane was mixed with it before entering the reaction tube. To each 5 litres of oxygen 1 litre of methane was added. The oxygen was passed at the same rate as before to obtain the same concentration of ozone; to have the heating period the same a slightly wider tube was used.

Finally in a third series of experiments equal volumes of methane and ammonia were mixed in a 500-c.c. bulb and the mixture added to the ozonised oxygen at the rate of 2 litres of mixture to 5 litres of oxygen. The reaction tube was further correspondingly increased in size so as to ensure the same time of heating. The volumes of the gases were compared as before.

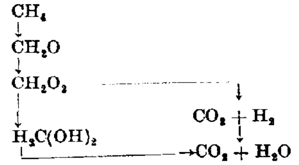
Experimental results.

Ozonisation of mixtures of methane and oxygen.—In these experiments in which methane and oxygen were passed directly through the ozoniser, it was necessary to use mixtures outside the explosive limits, which are 4% and 60% of methane. The following is a summary of some of our experiments using mixtures of oxygen 97% and methane 3%. It is to be noted that in these and in all our experiments more or less white fumes were present in the gases issuing from the reaction tube. They probably consisted of water in a finely-divided form.

Experiment ..	1	2	3	4	5
Temp., °C ..	15	100	200	300	400
mmg. CH_2O per litre of mixture used ..	0·3	0·8	1·5	2·2	0·5
CH_2O_2 ..	Trace	Trace	Trace	Trace	Trace
c.c. CO_2 per litre mixture used	—	5	7	6	5
%$CH_4 \rightarrow CH_2O$	—	9	14	20	9
%O_3 reacting	5	53	76	68	52
%O_3 directly decomposed..	Nil	15	15	32	48

At 15° C. the action is very slow; it increases with temperature until at 100° C. 53% of the ozone present reacts in about 2 mins. The rate of decomposition of ozone also increases; above 400° practically all the ozone decomposes. It is probable that at these higher temperatures the oxidation is rapid and that any that does occur takes place during the period of heating up the gas, for even at 250° the decomposition rate of ozone is very rapid.

The first isolated product of the interaction is formaldehyde. It is quickly further oxidised by ozone but its oxidation rate does not at first increase as fast as that of methane, so there is an initial slight rise in the percentage isolated on the methane oxidised. At all temperatures, however, the greater portion of the methane oxidised is obtained as carbon dioxide. No carbon monoxide was detected in any experiment, so probably little is formed as it would not be completely oxidised. This can be explained by assuming that the ozone oxidises formaldehyde to formic acid which is then rapidly oxidised *via* carbonic acid to carbon dioxide and water. At 200° formic acid decomposes mostly to carbon dioxide and hydrogen (it may be noted that at 500° it decomposes to carbon monoxide and water)—above 100° ozone attacks hydrogen. The action of ozone on methane may then be represented—



Owing to the low concentration of carbon dioxide in the residual gases the quantities given are only approximate. The percentages of ozone decomposing are obtained by estimating the ozone absorbed in the potassium iodide solution and assuming that formaldehyde and carbon dioxide are formed according to the following equations:

$$CH_4+2O_3=CH_2O+H_2O+2O_2$$
$$CH_2O+2O_3=CO_2+H_2O+2O_2$$

While the first equation is probably correct, all three atoms of the ozone molecule may go to oxidise formaldehyde. This of course increases very largely the amount of ozone decomposing. It is difficult to decide this point, as at low temperatures where ozone can be safely assumed not to have decomposed, the amount of carbon dioxide formed is difficult accurately to estimate (*cf.* Z. Elektrochem., 17, 634).

Experiments were also made using mixtures containing over 60% of methane; similar results were obtained, but less interaction occurred as the concentration of ozone was low, and owing to the dilution of the oxygen. Some transformations of the methane to unsaturated products by the discharge was noticed.

Addition of methane to ozone.—In the next series of experiments methane was added to ozone as described above. The results were similar to those quoted, the amount of interaction being slightly increased owing to the greater concentration of methane. Thus at 300° C. 2·5 mmg. of formaldehyde was obtained per litre of the mixture in a yield of 17% on the methane burned. The percentage yields of formaldehyde were throughout some 5—10% lower. In these experiments no special precautions were taken to dry the methane added to the ozone; this was done later, and the yields rose to the figures obtained with the dried mixtures of methane and oxygen.

Experiments were then made using catalysts and surfaces to try if the interaction of ozone and methane could be accelerated without accelerating the action of ozone on formaldehyde. It was found that surfaces such as ignited pumice had very little if any effect. Catalysts such as nickel oxide pumice, aluminium oxide pumice, ferric oxide pumice, platinised asbestos, etc. accelerated the decomposition of ozone even below 100° so that very little oxidation of methane occurred.

In some further experiments methane preheated to 500° was added to 4% ozone in the hope that all interaction to formaldehyde might take place before the ozone could decompose or carbon dioxide be formed. The results, however, did not differ appreciably from those of the previous experiments.

Experiments using ammonia.—In a third series of experiments mixtures of ammonia and methane were added to ozone and passed through the furnace as described above, the ammonia being added to stabilise the formaldehyde as hexamethylenetetramine. In each experiment dense white fumes were formed and deliquescent white crystals were deposited at the entrance to the furnace tube. On examination these proved to be ammonium formate, mixed with a little hexamethylenetetramine and ammonium carbonate. On dismantling the apparatus a smell of formamide was noted. The reaction tube was washed out thoroughly with distilled water and the washings added to the water from the worms. The liquid was distilled with moderately dilute sulphuric acid and formaldehyde and formic acid estimated in the distillate.

There were never more than traces of hydrogen peroxide or of nitrates or nitrites present. The yield of formaldehyde at various temperatures was much the same as in experiments where ammonia was not added but the yield of formic acid was very much increased, the quantity at each temperature being about equal to the formaldehyde isolated. It varied slightly directly as the amount of ammonia used and rose slightly if both ammonia and methane were thoroughly dried before adding to the dry ozonised oxygen. The non-stabilising of formaldehyde is due to the necessity of ten molecules interacting to form hexamethylenetetramine; this does not readily occur especially at low temperatures and with such low concentrations of formaldehyde. On the other hand, to stabilise formic acid as ammonium formate only a bimolecular reaction need take place.

These experiments with ammonia support the oxidation scheme set out above. It is to be noted that methyl alcohol was never detected among the products in our experiments, but it is so very readily oxidised in comparison with methane that it is not unlikely that it is first formed, more especially as it would result from the interaction of 1 mol. of methane and 1 mol. of ozone. The oxidation scheme is similar to that put forward by Bone for the interaction of oxygen and methane (Trans. Chem. Soc., 1903, 86, 1074); since the ozone oxidises by means of atomic oxygen, it would appear that in the interaction of oxygen and methane, atomic oxygen also comes into play. The fact that moisture increases the amount of formaldehyde slightly corresponds with the observations of Bone and Andrew on the interaction of hydrocarbons and oxygen in the absence of moisture (Trans. Chem. Soc., 1906, 89, 652). They note that in their experiments the accumulation of aldehyde was somewhat greater in the dried than in the undried gases. They formed the opinion that the greater accumulation was due to a slight increase in the initial rate of oxidation of the hydrocarbon, the further rates of oxidation being unchanged. The slight increase in formaldehyde in our experiments when both gases were dried may be due to the same cause, but it is also possible that the absence of moisture does not affect the rate of interaction of ozone and methane, but inhibits slightly the oxidation of formaldehyde. It may be that absolutely dry formaldehyde and oxygen would not react.

This work was carried out for the Chemistry Research Board of the Scientific and Industrial Research Department to whom we are indebted for permission to publish our results.

Main Laboratory,
R.N. Cordite Factory,
Holton Heath, Dorset.

THE DETERMINATION OF SULPHUR IN VULCANISED RUBBER.

BY J. W. W. DYER, M.SC.(LOND.), AND AMY E. WATSON, B.SC.(LOND.).

With reference to the method described for the determination of combined sulphur in vulcanised rubber (J., July 31, 1922, 251—252 T), our attention has been called, by Mr. A. R. Pearson, to his prior description of the method and application to the determination of total sulphur (Analyst, 1920, 45, 405). We were not aware of this at the time of publication of our paper and regret the oversight. Although we published our method only recently, it was in constant use in our laboratory in the autumn of 1920. We prefer to use it for combined sulphur only and not for total sulphur, unless the amount of free sulphur is small.

ERRATUM.

In the paper on "Organic impurities in commercial nitric acid and their effect in the manufacture of nitroglycerin," by F. A. F. Crawford (J., Sept. 30, 1922), an error occurs on page 322 T, col. 2. Line 19 "that of tetranitromethane . . . very" should be replaced by "purity by distillation but the results were not."

Communications.

TES ON A MANCHURIAN COAL FROM FUSHUN.

BY GODFREY W. HIMUS.

he Fushun colliery is situated in the Fushun fecture, Fengtien Province, some twenty miles t of Mukden, on a branch line of the South nchurian Railway, and is administered by the lway company. The coalfield has an area of ut 24 square miles, being some ten miles in gth from east to west, by 2·4 miles in width from th to south. The colliery is on a table-land 600 700 feet above sea level, which descends pre- itously to the Hun Ho River on the northern e, and on the south side somewhat less steeply.

The lowest formation in the coalfield is granite eiss, which is overlain by reddish-green tuffs longing to the Cambrian system which are lowed by alternate layers of tuffaceous sand- nes and shales of Mesozoic age. The coal-bear- g strata occur in Tertiary rocks consisting of eccia, sandstone and shale, and comprise a number seams of which the aggregate workable thick- ss averages 130 feet, rising to a maximum of 0 feet.

Later intrusions consisting of porphyritic dykes d basalt laccolites occur which cause a certain nount of alteration in the coal deposits.

The coal deposits are dated as of Miocene age, the ajority of the associated organic remains being lants, amongst which the following may be men- oned:—*Osmunda* sp., *Parrotaia* sp., *Salix* sp., *yptostrobus ungeri*, *Populus glandulifera*, *Styrax* ., *Tilia* sp., *Thuja* sp., *Quercus* sp., *Sequoia* sp., *agus feroniæ*, *Aphnantha* sp., *Ginkgo* sp.

The estimated reserves of coal are eight hundred llion tons, and the output has risen from 233,325 ns (British) in 1907, to 3,158,000 tons in 1920.

The coal is a poorly-coking gas or almost a sand al, the amount of volatile matter being over 40% d the coke presenting a somewhat sandy rather an a well-fused surface.

The average of the analyses given by the Publicity partment of the South Manchurian Railway mpany is:—Volatile matter 39·2%; fixed carbon 3%; ash 4·5%; B.Th.U. per lb. 12,900. Another of averages from the same source is:—Volatile tter 43·9%; fixed carbon 53·0%; ash 3·1%; Th.U. per lb. 12,530. C 74·15%; H 6·41%; 1·98%; O 13·59%; S 0·77%.

Analyses made in the author's laboratory of mples from consignments aggregating some 10,300 ns of Fushun dust coal, and about 100 tons of shun unscreened coal gave:—

	Dust. %	Unscreened. %
Volatile matter	41·8	41·7
Fixed carbon	47·3	48·5
Ash	10·9	9·8
B.Th.U. per lb.	12,345	12,410
Sulphur	0·5	0·5

he calorific values are gross, and were deter- ed in a Berthelot-Mahler bomb calorimeter in e two cases. The calorific value of the coal stance is somewhat less than that of the general of Far Eastern coals of similar proximate lysis.

t was observed that the unscreened coal con- ned a large percentage of lumps, varying in size m about two inches to six inches cube, many of ch showed yellow transparent or translucent mmy drops and bands resembling resin; other ps appeared to be practically free from these ps. By extraction with chloroform the gummy material could be isolated as a dark brown substance with an odour of heavy petroleum. The two sets of lumps in the coal contained very different amounts of material soluble in chloroform, those with much "gummy" material giving 10·5% of extract, the other lumps giving 2·8%, and the average sample of the coal, 3·3%.

Analysis of the extracted material showed:—Volatile matter 97·3%; fixed carbon 1·1%; ash 1·6%; B.Th.U. per lb. 16,550. C 79·22%; H 9·60%; O 10·19%. No sulphur or nitrogen could be detected. The above ultimate analysis was kindly made for the author by Mr. R. Bachrach, of the Shanghai Chemical Laboratory.

This analysis agrees fairly well with that given by Carrick Anderson and Roberts for the resinic constituents of certain Scottish non-caking coals, which they obtained by heating to 300°—315° C. in a current of carbon dioxide (*cf.* J., 1898, 1019).

A sample of ordinary rosin gave volatile matter 98·5%; fixed carbon, trace; ash 1·5%; B.Th.U. per lb. 15,710. Saponification value 177.

The resin-like material from the Fushun coal had a saponification value of 130 and melted at about 140° C.

The two sets of lumps into which the coal could be separated differed considerably in proximate analysis and in calorific value, as will be seen from the annexed table:—

	Coal. %	"Resinous" lumps. %	"Non-resinous." %
Volatile matter	41·7	51·5	46·0
Fixed carbon	48·5	28·8	49·2
Ash	9·8	19·7	4·8
Sulphur	0·5	0·15	0·75
B.Th.U. per lb.	12,410	12,530	13,920

If the results be reduced to dry ashless coal, the figures are more striking and can be seen in better perspective:—

	Coal. %	"Resinous" lumps. %	"Non-resinous" lumps. %
Volatile matter	46·3	64·1	48·3
Fixed carbon	53·7	35·9	51·7
B.Th.U. per lb.	13,780	15,660	14,670

Analysis of the "resinous" lumps after extraction with chloroform gave:—Volatile matter 45·6%; fixed carbon 33·4%; ash 21·0%. B.Th.U. per lb. 10,810.

Examination of the powdered coal or of the powder derived from either the "resinous" or "non-resinous" lumps, in water under the microscope, showed a considerable proportion of lemon to orange-yellow irregular lumps most of which vanished after extraction of the powder with chloroform.

Following the observation recorded by Wheeler and Burgess (Trans. Chem. Soc., 1913, **103**, 1704, 1705), pieces of the coal, one of which showed a prominent light-coloured band, and which was therefore classified as a "resinous" lump, and the other of which showed only one or two small gummy drops, were smoothed on one face and placed on a photographic plate in a light-tight box in an incubator at about 40° C. for 48 hours. On development, it was found that the "non-resinous" lump had had a considerable photographic action on the plate, a number of streaks and bands being shown, none of which corresponded to any obvious markings on the original lump. In the case of the "resinous" lump there was scarcely any action.

Summary.

The Fushun coal is a high-volatile coal of Miocene age formed apparently of the remains of coniferous plants, and, in common with many other coals, contains appreciable quantities of comparatively little altered resin-like substances which are ex-

tractable with chloroform. These substances make up about 3·3% of the coal, there being a tendency for them to be concentrated in certain bands and lumps together with a considerable amount of mineral matter. On the other hand, other lumps of the coal contain only about one-fourth the amount of chloroform-soluble material, and these lumps are much freer from mineral matter and have a strong action on a photographic plate. The calorific value of the resin-like material is very high, the contribution of the 3·3% of resinous substances to the heat value of the coal amounting to 4·4% thereof.

The author desires to express his thanks to Professor Hiroshi Yamada, of the Tung Wen College, Shanghai, China, for the information regarding the Fushun coal mine.

DETERMINATION OF PHENOL IN MIXTURES OF TAR ACIDS.

BY W. H. HOFFERT, M.A., B.SC.

Owing to the similarity in properties of phenol and its homologues, the accurate determination of phenol in a mixture of tar acids is a matter of considerable difficulty.

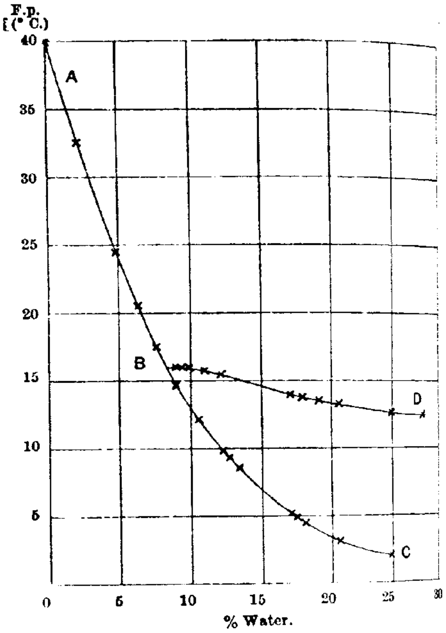
Numerous methods have been proposed from time to time. The most important papers dealing with this subject, recently published, are those of Fox and Barker (J., 1917, 842; 1918, 265 T; 1920, 169 T), and Dawson and Mountford (Chem. Soc. Trans., 1918, 113, 923). A fairly complete summary of important papers previously published is given in the second of the papers by Fox and Barker referred to above.

The above authors utilised the freezing point relations of phenol and the cresols in determining the phenol in a mixture of phenol and its homologues. Since, however, the lowering of the freezing point of phenol by equal weights of the three cresols differs considerably, owing to the variable tendency of the three cresols to form mixed crystals with phenol, they found it necessary first to separate the whole of the phenol originally present in the mixture, entirely or almost entirely in conjunction with *o*-cresol.

The method worked out by Fox and Barker was devised for the determination of the residual phenol in cresylic acid. The cresylic acid is first fractionated with an efficient column up to 210° C., when all the phenol, practically all the cresols, and a little xylenol come over. This distillate is then again fractionated up to 195° C., after the addition of sufficient *o*-cresol (if necessary) to bring over all the phenol in the fraction up to 195° C. The phenol in this fraction is then determined by application of the freezing point curve for mixtures of phenol and *o*-cresol, which was shown to be practically identical, for mixtures containing more than 80% of phenol, with that obtained from mixtures of phenol with the distillate collected up to 195° C., obtained from commercial cresylic acid free from phenol. Accordingly, if to an aliquot part of the distillate up to 195° C. sufficient pure phenol is added to yield a mixture containing at least 80% of phenol, and the freezing point of the mixture so made is determined, the percentage of phenol in the distillate up to 195° C. and hence in the original cresylic acid can be calculated.

The method gives fairly good results for mixtures having a low phenol content (less than 10%). When, however, the phenol content is high, a preliminary fractionation with an efficient column is necessary, in order to reduce the percentage of phenol in the mixture, two fractions being thus obtained:—(1) consisting chiefly of phenol and *o*-cresol, the phenol content of which can at once be determined by application of the freezing point curve of phenol and *o*-cresol; (2) consisting chiefly of *o*-cresol, *m*-cresol, and *p*-cresol, with only a small percentage of phenol, the phenol content of which is determined, after the addition of sufficient *o*-cresol to bring over all the phenol in the distillate up to 195° C., as already described.

The method proposed by Dawson and Mountford (*loc. cit.*) for the determination of phenol in a mixture of phenol and the three cresols, is similar to the above, the mixture being mixed with about half its weight of *o*-cresol, so as to yield on distillation with an efficient column two fractions:—(1) consisting of a mixture of phenol and *o*-cresol, and (2) consisting of a mixture of *o*-cresol, *m*-cresol, and *p*-cresol. The percentage of phenol in (1) can then be determined by application of the freezing point curve of phenol and *o*-cresol.



Freezing points of mixtures of phenol and water.

FIG. 1.

Experiments carried out by the author to separate a mixture of phenol and cresols in this way were, however, not in general successful, since even when using an efficient column it was only when the phenol content was very low that all the phenol passed over in the distillate up to 191° C., the boiling point of *o*-cresol.

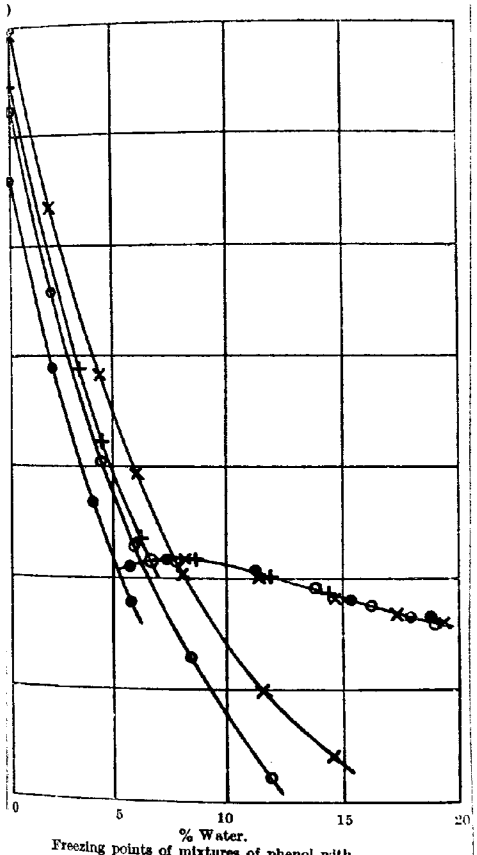
The method to be described enables the phenol, in any proportion, in a mixture containing any or all of the three cresols to be directly determined, and depends on the fact that the lowering of the freezing point of phenol hydrate by equal weights of each of the three cresols is the same.

Phenol hydrate.—It has long been known that phenol forms a definite crystallisable hydrate with water, m.p. +16° C.

The freezing points of mixtures of phenol and water were determined in an apparatus of the Beckmann type, the freezing points recorded being the temperatures at which liquefaction is complete, since these temperatures would correspond with those at which crystallisation of the liquid would gin in the absence of supercooling. The results e plotted in Fig. 1.

It will be seen that a continuous curve, A C, is tained for the lowering of the freezing point of enol by addition of water. When, however, the rcentage of water exceeds 8·5%, phenol hydrate n crystallise out (as shown by the branch curve, D) at temperatures considerably above those rresponding to the freezing points of phenol and ater. The hydrate curve is fairly flat, and reaches maximum at 16° C., with 8—9% of water (*cf.* also ig. 2), corresponding to the formation of phenol drate $2C_6H_5OH,H_2O$ (water 8·75%). The ends of e curve, C and D, indicate approximately the mits of solubility of water in phenol at these mperatures.

With mixtures of phenol and the cresols, it was und that phenol hydrate could be crystallised out hen the proportion of phenol was greater than out 55%, the limiting proportion depending on e nature of the admixed cresol or cresols.



Freezing points of mixtures of phenol with
(1) *o*-Cresol, 25% by weight, o—o—o
(2) *m*-Cresol " " ×—×—×
(3) *p*-Cresol " " ●—●—●
(4) Cresylic acid and water. " " +—+—+

Fig. 2.

The freezing point curves of various mixtures of enol and the cresols with water were also deter- ined. These curves showed that the lowering of e freezing point of phenol hydrate by each of the three cresols was the same within the limits of experimental error. As an example, the curves obtained with mixtures containing 75% of phenol in admixture with (1) *o*-cresol; (2) *m*-cresol; (3) *p*-cresol; (4) commercial cresylic acid free from phenol (fraction to 203° C.) are given in Fig. 2.

The freezing points of the above anhydrous mixtures of phenol and the cresols were very different, owing to the fact that the lowering of the freezing point of phenol by equal weights of the three cresols varies considerably, as already indicated, the actual freezing points obtained being in close agreement with those of Dawson and Mountford (*loc. cit.*). The lowering of the freezing points of these mixtures by addition of water is shown in the figure. It will be observed, however, that the freezing points of phenol hydrate separating from these mixtures all lie on one curve within the limits of experimental error. The maximum of the hydrate curve is clearly shown at 5·8° C., corresponding to about 8·5% of water. Similar results were obtained with mixtures containing larger and smaller percentages of phenol.

The lowering of the freezing point of phenol hydrate by addition of any or all the three cresols may, therefore, be represented by a single curve. For the application of this curve to the determination of phenol in admixture with cresols, it was found most convenient to construct the curve for mixtures of phenol and the cresols after the addition of water amounting to 10% of the weight of the mixture taken (*i.e.*, the mixture contained 9·1% of water by weight), since a definite percentage of water must be present, and the freezing point of the phenol hydrate varies least with slight alterations in the water content when the water is approximately 9·0%.

The experimental results recorded for such mixtures are given in the table below:—

(1)
Phenol + *o*-cresol (f.p. 30·5° C.).

Phenol %	F.p of hydrate. ° C.
100·0	16·0
95·0	14·25
86·2	10·8
75·0	5·8
70·8	3·9
62·9	—0·5
58·6	—3·0

(2)
Phenol + *m*-cresol (f.p. 10·4° C.).

Phenol. %	F.p. of hydrate. ° C.
100·0	16·0
90·8	12·6
80·0	8·1
75·0	5·8
62·4	—0·8
58·4	—3·2

(3)
Phenol + *p*-cresol (f.p. 34·2° C.)

Phenol %	F.p. of hydrate. ° C.
100·0	16·0
85·4	10·4
75·0	5·8
64·7	0·5
56·6	—4·2

(4)
Phenol + cresylic acid.

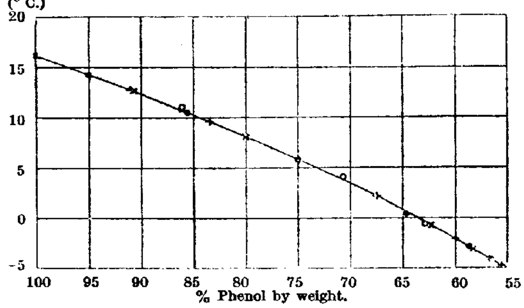
Phenol. %	F.p. of hydrate. ° C.
100·0	16·0
90·9	12·6
83·4	9·7
75·0	5·8
67·4	2·2
60·0	—2·0
55·5	—4·8

The cresylic acid used in (4) was a fraction obtained from commercial cresylic acid (b.p. 195°—203° C.), which had previously been freed from phenol by adding *o*-cresol and fractionating twice to 195° C. The results are plotted in Fig. 3.

This curve may be used to determine the percentage of phenol in mixtures of phenol and the cresols. If the percentage of phenol exceeds 55%, the determination of the freezing point of the hydrate after addition of water amounting to 10% of the weight of mixture taken, enables the percentage of phenol in the mixture to be read off at once from the curve. If the percentage of phenol in the mixture is below 55%, a known proportion of standard phenol (f.p. 40·5° C.) is added to the mixture to bring the percentage of phenol above 55%.

By a determination of the freezing point of the hydrate in this mixture it is then possible to calculate the percentage of phenol in the original mixture containing less than 55% of phenol.

Process.—The method of determining the percentage of phenol in a mixture of tar acids is as follows:—The mixture is first examined for neutral hydrocarbons and pyridine bases. If more than 2—3% of these impurities is present, a quantity of the sample is freed from them, either by steam distillation of the solution in sodium hydroxide or by extraction of the solution with ether or benzene, as described by Fox and Barker (*loc. cit.*). In recovering the tar acids by acidification of the alkaline solution with sulphuric acid, the acid layer should be extracted to recover any phenol present in the sodium sulphate solution.



Freezing points of phenol hydrate, phenol-cresol mixtures, containing 9·1% water.

FIG. 3.

If a preliminary distillation test shows that the mixture of tar acids, thus treated, distils over entirely below 205° C., the determination of the phenol may at once be proceeded with. If, however, the presence of more than traces of xylenols and higher homologues is indicated, these should first be removed by a preliminary fractionation with an efficient column to 203° C. In this connexion it may be mentioned that when a large proportion of phenol is present, the distillate obtained above 203° C., even with an efficient column, may still contain appreciable quantities of phenol. In most samples of cresylic acid, however, the phenol content is fairly low and all the phenol distils over below this temperature. Moreover fractions with high phenol content obtained in works practice (except in the case of crude carbolic acid itself) have usually been obtained by the fractionation of crude carbolic acid and are entirely, or almost entirely, free from xylenols and higher homologues. The method of determining the phenol in crude carbolic acid will be described later.

The mixture of tar acids obtained above should have been freed from water.

A known weight of standard phenol (f.p. 40·5° C.) is then added to a weighed portion of the above mixture (X), so as to yield a mixture containing at least 55% of phenol, and 10% of its weight of water is run in from a burette. For the determination of the freezing point of the phenol hydrate, 12—15 g. of this solution is required. The freezing point apparatus is similar to that described by Fox and Barker, and consists of a thin-walled test tube, inserted into another tube of slightly larger diameter acting as an air bath, at the bottom of which some dry calcium chloride is placed to keep the air dry and prevent the formation of mist.

The temperature of the solution is read on a thermometer graduated from +20° to −10° C. and reading to tenths of a degree. The liquid is stirred regularly by means of a stout spiral copper wire stirrer. A preliminary freezing point determination is first made. The apparatus is placed in a freezing mixture of ice and salt and cooled, with constant stirring, until crystals of the hydrate appear. It is advisable to seed the cooled solution with a crystal of phenol hydrate, to ensure that phenol hydrate crystallises out and not mixed crystals of phenol and the cresols. A tube containing phenol hydrate should be kept in the freezing mixture for this purpose. The crystals of the hydrate are fairly easily distinguished from those of the mixed crystals of phenol and the cresols. The apparatus is then removed from the freezing mixture and allowed to warm up, with constant stirring, and the temperature at which the crystals of hydrate just disappear is read off on the thermometer.

A more careful freezing point determination is then made. The tube is again cooled, a freezing mixture being employed, if necessary, until the liquid in the freezing point tube is a few degrees below the preliminary freezing point determined above. The cooled liquid is then seeded with a crystal of phenol hydrate and stirred rapidly. In this way a fine "cloud" of hydrate crystals is formed. The apparatus is now removed from the cooling bath and placed in a bath of water cooled with ice to a temperature 1°—2° above that of the preliminary freezing point already determined. The solution is constantly stirred and the temperature read off at which the fine "cloud" of crystals just disappears. By taking the above precaution of obtaining only a fine "cloud" of crystals, and not allowing large crystals to form, the temperature at which the crystals just disappear may be found with precision and successive determinations should not differ by more than 0·1° C.

Having obtained the freezing point of the hydrate, the percentage of phenol in the mixture is then read off from the curve $(=p)$, and the percentage of phenol (x) in the original mixture (X) of tar acids calculated from the formula:—

$$x = \{ p(a+b) - 100b \} \div a$$

where a is the weight of original mixture (X) taken and b the weight of standard phenol added.

The table below gives the data from which the phenol hydrate curve used is constructed:—

% Phenol in mixture.	F.p. of hydrate (9·1% water).
100	16·0
95	14·25
90	12·25
85	10·25
80	8·1
75	5·8
70	3·4
65	0·75
60	—2·2
55	—5·2

The above method has been used for the determination of phenol in cresylic acid, and also for the determination of phenol in the numerous fractions with higher phenol content, obtained in the working up of crude carbolic acid.

Where a comparison has been made between the present method and that of Fox and Barker, the results obtained have been in fairly good agreement, as shown in the table below:—

% Phenol determined.

Hydrate method.	Fox & Barker's method. (curve corrected for phenol, f.p.=40·5° C.).	Cresols present (approx.).
65·3	65·9	*o*-cresol, 20%; *m*+*p*-cresols, 14·5%
62·8	61·8	*o*-cresol, 19%; *m*+*p*-cresols, 19%
57·5	57·1	Chiefly *o*-cresol.
49·1	48·5	*o*-cresol, 30%.
40·8	40·4	*o*-cresol, 15%; *m*+*p*-cresols, 33%.
15·2	14·6	*o*-cresol, 16%.
13·1	13·0	*o*-cresol, 15%; *m*+*p*-cresols, 60%.
6·2	5·8	*o*-cresol, 30%.

The method described in the present paper ha the following advantages over that of Fox an

Barker:—(1) It is more rapid and more generally applicable as a works test, since there is no preliminary fractionation (or fractionations) to separate the phenol with *o*-cresol. (2) The effect of small traces of moisture left in the phenol-cresol mixture is practically negligible in the hydrate method, since the hydrate curve is almost flat (9% water). In using Fox and Barker's method, it is necessary to dry the mixture thoroughly over freshly ignited calcium chloride before determining the freezing point. (3) A greater degree of accuracy is attainable when the phenol content of a mixture of phenol and the cresols is low, since although the slope of the hydrate curve is approximately the same as that of the phenol-*o*-cresol freezing point curve, the range of the hydrate curve is more than double that of the latter curve.

In the above investigation the freezing point of the phenol used was 40·5° C., since phenol of this freezing point is readily prepared from ordinary samples of phenol. Probably the most accurate determination of the freezing point of phenol is that of Leroux (J. Pharm. Chim., 1919, (7) **20**, 88), who found that pure anhydrous phenol melts at 40·85° C.

Determination of phenol in crude carbolic acid.

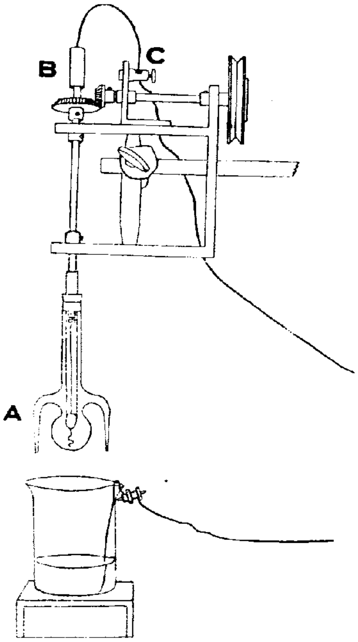
The hydrate method enables the phenol content of samples of crude carbolic acid to be readily determined. The sample should first be freed from neutral hydrocarbons and pyridine bases, if these amount to more than 2—3%. A weighed quantity of the sample is then fractionated with an efficient column. The water is collected separately, "salted out," and the oil returned to the distillation flask. The oil is fractionated to 202° C. (distillate A). To the weighed residue about half its volume of *o*-cresol is added, and the resulting mixture again fractionated to 202° C. (distillate B). In this way the small amount of phenol left in the residue boiling above 202° C. is removed. A determination of the phenol in the weighed distillates, A and B, by the hydrate method enables the percentage of phenol in the original crude carbolic acid to be calculated.

The thanks of the author are due to Messrs. Bowdler and Bickerdike, in whose research laboratory the work described in this paper was carried out, for kind permission to publish the results.

A SIMPLE APPARATUS FOR ELECTROMETRIC TITRATION.

BY W. E. GARNER AND C. A. WATERS.

During the course of a number of experiments on the methods of electrometric analysis devised by Treadwell and Weiss (Helv. Chim. Acta, 1919, 2, 680), a simple apparatus was devised which differs in certain essential details from the apparatus described by these authors. This apparatus, as may be seen from the illustration, consists of an electrode vessel attached to a rotating stirrer. The electrode vessel, A, carries a small bulb, which is convenient in the preparation of a calomel electrode, and two side tubes turned downwards and constricted at the ends. The appropriate metal used as an electrode is either fused or waxed into a thin glass tube, and attached by means of a small binding screw to a rotating spindle, electrical connexion being made through a small steel mercury cup, B, to a binding screw, C. The constricted side tubes of the electrode vessel are packed with asbestos as described by Treadwell, and the vessel completely filled with electrolyte and supported from the glass tube by means of a waxed cork. To prevent the formation of small bubbles in the constricted tubes, it is advisable to store in a solution of the electrolyte of the same strength. It is also essential to avoid the presence of a bubble of air in the electrode vessel itself, for this makes it more sensitive to temperature changes and leads to leaks during the analysis. The down-turned capillaries make it possible to start a titration with 5 c.c. of solution in the beaker, whereas an apparatus of the type described by Treadwell of corresponding capacity required nearly 50 c.c. before the ends of the capillaries were immersed. The electrode is best driven at a rate of 80—90 revolutions per minute. The outer electrode may be of any convenient form such as that shown.



The electromotive force generated between the electrodes was measured by a high-resistance millivoltmeter (1000 ohm) which was connected to one of the arms of a resistance box. The electrodes were connected across the whole resistance of the box (10,000 ohms) and the resistances in the two arms of the box were so adjusted as to give the maximum deflection in the millivoltmeter.

In the case of silver titrations

$$\underbrace{\mathrm{Ag}\;\Big|\;N/10\,\mathrm{AgNO_3}}_{\text{inner electrode.}}\;\Big|\;N/100\,\mathrm{AgNO_3}\;\overset{\downarrow N/100\,\mathrm{NaCl}}{\Big|}\;\mathrm{Ag}$$

results giving an end-point within 0·05 c.c. $N/100$ NaCl were readily obtained and reproduced (see Treadwell, *loc. cit.*). Equally good results were obtained with zinc titrations with potassium ferrocyanide.

$$\underbrace{\mathrm{Pt}\;\Big|\;N/10\,\mathrm{K_4Fe(CN)_6}}_{\text{inner electrode.}}\;\Big|\;N/10\,\mathrm{K_4Fe(CN)_6}\;\overset{\downarrow N/10\,\mathrm{ZnSO_4}}{\Big|}\;\mathrm{Pt}$$

An attempt was made to apply this method to the titration of sulphates by means of barium salts but it was found impracticable except in the titration of the alkali sulphates, when it worked very well. The arrangement

$$\underbrace{\mathrm{Hg}\;\Big|\;\mathrm{HgSO_4}\ N/10\ \mathrm{H_2SO_4}}_{\text{inner electrode.}}\;\Big|\;N/10\ \mathrm{SO_4''}\;\overset{\downarrow N/20\ \mathrm{Ba(OH)_2}}{\Big|}\;\mathrm{Hg}$$

in which the mercury electrode consisted of a fine stream of mercury, gave satisfactory results.

The method is inapplicable to the sulphates of metals giving insoluble hydroxides.

The Physical Chemical Laboratories,
University College, London.

CRESYLIC ACID.

BY J. J. FOX.

Corrigenda.

In a paper dealing with the composition of cresylic acid (J., 1920, 169 T) a method for determining the proportion of *o*-cresol was described depending upon the specific gravity of the cresylic acid. The formula given was calculated from the products of the percentages of the various cresols and their specific gravity, but the accurate method of calculation is, of course, to add the volumes of the constituents.

The correct formula is:—

$$8210—(8529 \div G)—(P \times 2{\cdot}942) = \%\ o\text{-cresol},$$

where G is the specific gravity of the mixture, and P the percentage of phenol; or in the absence of phenol:—

$$8210—(8529 \div G) = \%\ o\text{-cresol}.$$

In practice the results obtained with either formula do not differ greatly because it happens that the specific gravities of the cresols are fairly close together.

The table of the "Specific gravities of phenol with a mixture of *o*-cresol and *m*-cresol" (J., 1917, 845) should be deleted, as the specific gravities shown refer to an entirely different series of mixtures of the three cresols and phenol.

THE MANUFACTURE OF 1.3.5-TRINITROBENZENE.

BY ALAN A. DRUMMOND, M.SC.

This paper gives an account of an investigation of methods for the economical production of *s*-trinitrobenzene with a view to its large-scale manufacture. Several workers have examined methods of direct nitration (Hepp, Annalen, 1882, **215**, 345; Lobry de Bruyn, Rec. Trav. Chim., 1891, **13**, 149; Radcliffe and Pollitt, J., 1921, 45 T). An indirect method involving nitration has been proposed by Frankland, in which 1-chloro-2.4-dinitrobenzene is nitrated to form picryl chloride and the chlorine group subsequently replaced by hydrogen. No large-scale production has been mentioned, however.

Radcliffe's work (*loc. cit.*) showing the comparative ease of nitration of dinitrobenzene using 100% nitric acid and oleum containing 60% free SO_3, and also the good result obtained by Frankland and Garner (J. 1920, 257 T) by nitrating chlorodinitrobenzene led to the work described in this paper. Hepp obtained a yield of 45% of theory of trinitrobenzene using highly concentrated acids, whilst Radcliffe and Pollitt claimed yields of 70% of theory.

The strongest acids readily available in quantity in the factory were oleum containing about 20% free SO_3 and nitric acid containing at a maximum not more than 95% HNO_3. These acids were therefore used in the experiments and applied in the first place to the nitration of pure *m*-dinitrobenzene recrystallised from alcohol (m.p. 89·5° C.). The methods adopted in the nitration work were modelled on those employed in the nitrating factory in the nitration of mono- and dinitrotoluene (see Technical Records of Explosives Supply. 1915–1918. No. 2. Manufacture of Trinitrotoluene; J., 1921, 3 R) and on the method employed by Frankland and Garner (*loc. cit.*) in nitrating 1-chloro-2.4-dinitrobenzene. Methods for the isolation of trinitrobenzene from the crude nitration product containing dinitrobenzene were also investigated, including those of crystallisation and also formation of additive compounds (Hepp, *loc. cit.*, and Sudborough, Chem. Soc. Trans., 1916, **109**, 1339). In this connexion a setting point-composition curve was constructed for mixtures of *m*-dinitrobenzene and 1.3.5-trinitrobenzene.

Work on the following lines was carried out: The materials used were oleum containing about 22% of free SO_3 (100 parts being equivalent to 104 parts of 100% sulphuric acid); nitric acid of 90% strength, and dinitrobenzene, m.p. 89·5° C. The nitrations were carried out with systematic alteration of variables, viz., proportion of nitric acid, concentration of nitric acid and sulphuric acid, proportion of sulphuric acid, time of nitration, temperature of nitration, and mode of mixing the reaction materials. Comparative nitrations were carried out with dinitrobenzene and chlorodinitrobenzene under similar conditions.

The apparatus used was a round-bottomed nitrating flask with long glass air condenser attached to it by a ground glass joint. The flask was heated by an oil bath, and agitation was effected by periodical vigorous shaking.

Two methods were adopted in the initial mixing of the materials:—

(1) "*Hot mixing.*" The charge of dinitrobenzene, dissolved in the required amount of nitric acid and warmed to 80°—90° C., was added gradually to the required amount of oleum, also heated to 90° C., with continual shaking, keeping the temperature of the mixture at about 95°—100° C. External heating was not required to maintain a temperature of 100° C. until the bulk of the solution had been added.

(2) "*Cold mixing.*" The dinitrobenzene, dissolved in nitric acid, was run cold into oleum, also at ordinary temperature, without cooling. The maximum temperature reached was 110° C., and as the final portions of the nitric acid solution were added the temperature fell. In each method the temperature was subsequently raised at the rate of about 1° C. in two minutes. The proportion of sulphuric acid to nitric acid was chosen so that the waste acid after nitration and before dilution was not more than about 97% H_2SO_4. Dilution to 75% H_2SO_4 was found to precipitate the bulk of the nitration product. The yield was determined on the nitration product from the completely "drowned" nitration charge.

The reaction mixture after each nitration was poured into 2—3 times its weight of water with cooling. The solid product was filtered off and washed twice by steam-blowing and granulating in cold water, dried in the steam-oven, and weighed. The proportion of trinitrobenzene in the itration product was determined from the setting oint curve for **mixtures** of trinitrobenzene and initrobenzene (*cf. infra*).

TABLE 1.

No.	Wt. of DNB. g.	104% H_2SO_4. g.	90% HNO_3. g.	HNO_3. mols.	Calc. strength of spent acid. %	Temp. °C.	Time. hrs.	Mode of mixing.	Yields. TNB. % on theory.	DNB. unchanged % on DNB.	Loss % on DNB.
1	20	144	32	4	96·6	130	12	Hot	18·8	46·5	30
2	20	150*	29	3·6	93·5	130	12	Cold	18·4	47·0	30
3	20	144	32	4	96·6	130	6	Hot	19·0	43	33
4	20	144	32	4	96·6	130	6	Cold	19·6	47·5	28
5	20	144	32	4	96·6	130	3	Cold	23	46·5	26
6	20	296	60	7	97	130	3	Cold	29·4	23·5	42·5
7	20	308	60	7	93·5	130	12	Cold	30	17	4·8
8	20	144	32	4	96·5	120	6	Hot	14	50·5	31
9	20	188	32	4	93·5	120	6	Hot	13	61	21
10	20	141	30†	4	98	130	3	Cold	22	43	30·5
11	20	144	30†	4	96	130	3	Cold	23	46·5	26
12	30	666	135	11	96	130	6	Cold	32	1·3	64·5

* 100% H_2SO_4. † 100% HNO_2,

The effects of the two methods of mixing are hown in Nos. 1—4. A twelve-hour nitration gives he same result by both methods, but after a sixiour nitration the method of hot mixing, as might e expected, appears to have increased oxidation vith consequent loss of product.

The time factor is an important one in the itration of dinitrobenzene. It has previously been hought that long nitration, extending to a number f days, was essential. It has, however, been found hat the limit of nitration is reached in a much horter period, further action only leading to oxidaion. By reducing the time of nitration to 3 hours rom the start of mixing the materials, marked mprovement over the result of 6- and 12-hour nitraions was obtained (*cf.* Nos. 2, 4, 5, 6, 7).

The effect of temperature is seen in two experinents (Nos. 8 and 9) carried out at 120° C. (*cf.* No. 3). Nitration at this temperature evidently equires a longer time for completion.

In Nos. 10 and 11 the concentration of the nitric cid was raised to 100%, but with 4 molecules HNO_3 nd three hours' nitration no improvement was btained.

Reference to the results of Nos. 5, 6, and 12 shows hat the yield of trinitrobenzene increases with the mount of nitric acid taken. The amount of oxidaion also increases at a rapid rate. It would appear rom the figures that a further increase of nitric cid beyond 11 mols. and under the same conditions vould not effect any marked improvement in the ield.

Setting points of mixtures of trinitrobenzene and dinitrobenzene.

Dinitrobenzene. %	Trinitrobenzene. %	Setting point. ° C.
0	100	121
22·4	77·6	96·3
30·4	69·6	85·7
36·9	63·1	75·3
41·2	58·8	70·7
44·8	55·2	64·9
47·0	53·0	61·4
49·5	50·5	57·2
50·7	49·3	57·8
53·4	46·6	57·8
57·2	42·8	60·3
62·8	37·2	65·2
71·3	28·7	71·5
75·1	24·9	74·5
80·8	19·2	78·0
87·3	12·7	82·0
100·0	0	89·5

An indirect method of preparing trinitrobenzene involved the preliminary nitration of chlorodinitrobenzene, and it was therefore desirable to compare the relative ease of nitration in each method, the tests being carried out under exactly similar conditions of nitration. A yield of 68% of picryl chloride is obtained as compared with 18% of trinitrobenzene, the loss of chlorodinitrobenzene being 14—15% as compared with 35% of dinitrobenzene. The yields of picryl chloride and unchanged chlorodinitrobenzene were determined by the use of the setting point curve for mixtures of chlorodinitrobenzene and picryl chloride (Frankland and Garner, *loc. cit.*).

The above table has been obtained from the determination of setting points of artificially prepared mixtures of pure trinitrobenzene and dinitrobenzene. The curve plotted from these figures indicates that dinitrobenzene and trinitrobenzene form a compound between limits of 45% and 50% trinitrobenzene, with setting point 58° C. This compound occasions considerable trouble when mixtures rich in dinitrobenzene are being dealt with for the recovery of trinitrobenzene. It would seem to be the cause of the assumption of an isomeric trinitrobenzene made by Radcliffe and Pollitt (*loc. cit.*; see also Gibson, J., 1921, 90 T).

The yield of trinitrobenzene obtained in the various nitrations described has been determined by the use of a curve constructed from the above table. The setting point of the washed, dried nitration product was determined and the composition read off from the curve. Where there was uncertainty regarding the side of the curve to which the particular setting point referred, a known proportion of pure trinitrobenzene was added to the mixture and the setting point redetermined. The movement up or down of the setting point after the addition decided the original composition.

Separation of trinitrobenzene from mixtures with dinitrobenzene.

Attempts were made to separate trinitrobenzene from dinitrobenzene by:—

(1) Fractional crystallisation from alcohol and carbon tetrachloride. The following table gives the solubilities of dinitrobenzene, trinitrobenzene, and the 50% eutectic mixture in alcohol:—

Dissolved substance.	100 g. dissolves: At 100° C. g.	At 20·5° C. g.
DNB.	25·6	3·5
50% eutectic	18·2	—
TNB.	8·5	1·9

Mixtures of dinitrobenzene and trinitrobenzene of known setting point and composition were crystallised from alcohol, and the composition determined respectively of the portion crystallised out and that remaining in the mother liquor (by use of the setting point curve). The results of these experiments (see Table) indicate clearly the difficulty of separating mixtures of DNB and TNB by fractional crystallisation from alcohol.

Original mixture.		Crystallised out.			In mother liquor.	
Setting point. ° C.	Content of TNB. %	g. per 100 g. original mixture.	Setting point. ° C.	Content of TNB. %	Setting point. ° C.	Content of TNB. %
86·0	70	72·5	96·0	78·0	66·0	46
66·5	56	75·0	77·0	65·0	66·5	36
70·0	30	80·2	68·5	32·5	77·0	21

(2) Fractional precipitation from the nitrating acids, in which again the compound of trinitrobenzene and dinitrobenzene apparently prevents separation.

(3) Formation of compounds with aniline, α- and β-naphthylamine and subsequent recovery of trinitrobenzene. The aniline compound offered most promise, chiefly because of the readiness with which trinitrobenzene can be recovered by evaporation of aniline and simultaneous recovery of the aniline. From a mixture of dinitrobenzene and trinitrobenzene containing 50% of trinitrobenzene a recovery of 80—90% of pure trinitrobenzene was possible by this means.

The author's best thanks are due to Miss R. M. Duckham, B.Sc., for the determinations of the setting points of mixtures of trinitrobenzene and dinitrobenzene, for the determinations of the solubilities, and for the figures obtained in the recrystallisation experiments.

Conclusions.

From the foregoing work conclusions may be summarised as follows:—

(1) A yield of 29% of theory of trinitrobenzene with a 24% recovery of dinitrobenzene may be obtained by a three-hour nitration at 130° C. with nitric acid of 90% strength and fuming sulphuric acid containing 22% of free SO_3. The expenditure of nitric acid is equivalent to 7 molecules, using sulphuric acid in quantity calculated to give a spent acid of about 95% H_2SO_4. The destruction of dinitrobenzene amounts to 43% of the original weight of dinitrobenzene.

(2) Less nitric acid gives less trinitrobenzene but also less loss by oxidation; thus, 4 mols. HNO_3 gives 22% of trinitrobenzene in three hours at 130° C. and 30% loss of dinitrobenzene.

(3) A greater amount of nitric acid gives a larger amount of oxidation loss but a purer trinitrobenzene. Thus, 11 mols. HNO_3 gives 32% of trinitrobenzene in 6 hours, with about 1% of dinitrobenzene recoverable. The nitration product is a good crude trinitrobenzene of setting point 117°—118° C.

(4) From these results it appears that with the acids given the economical manufacture of trinitrobenzene by direct nitration is not practicable.

(5) The comparative nitration of chlorodinitrobenzene and dinitrobenzene shows that a yield of 68% of picryl chloride can be obtained as compared with 18% of trinitrobenzene, the relative losses of chlorodinitrobenzene and dinitrobenzene being respectively 15% and 35%. Trinitrobenzene can therefore be made more economically from chlorodinitrobenzene through picryl chloride, as the final replacement of the chlorine is readily accomplished.

The author's thanks are due to the Director of Artillery for permission to publish this paper.

London Section.

Meeting held at Institution of Mechanical Engineers on May 29, 1922.

MR. E. V. EVANS IN THE CHAIR.

THE STRUCTURE OF COKE: ITS ORIGIN AND DEVELOPMENT.

BY SIR GEORGE BEILBY.

In connexion with the work of the Fuel Research oard it was early recognised that for the study of ıe behaviour of different types of coal during car- nisation the ordinary laboratory methods of coal sting and analysis were quite inadequate, and ıat for the purposes of this inquiry a new method assay must be elaborated. A full description of ıe method which was ultimately devised and of ıe apparatus in which it was carried out has ready been published.* In this apparatus the ields of the principal products of carbonisation at ny given temperature are ascertained by direct eighing and measurement, while much useful formation is obtained as to the physical and other roperties of the products. Of no less importance re the opportunities which this method presents r the study of the behaviour of different types of al during carbonisation, *e.g.*, the stages in the volution of the hydrocarbon gases, the changes in mposition of these at each stage, and the influence f the fusibility of the coal on the ultimate form nd structure of the resulting coke. The last-amed study has a very direct bearing on the prac- cal side of the problem of industrial carbonisation, ot only for the production of a satisfactory smoke- ss fuel for domestic use, but also on the pro- uction of coke for metallurgical and other indus- ial purposes.

The following experimental observations were for ıe most part carried out on average samples taken om bulk deliveries of the different coals as these ere received at H.M. Fuel Research Station. The eliveries in some cases represented the whole coal om one definite seam, and in others the result f screening, or screening and washing, the small al from several seams. No attempt was made t this stage to carry out the separate examination f the distinct bands of which the seams were omposed.

The samples used were obtained by methods hich have been described in the reports of I.M. Fuel Research Station; but for the present urpose it is sufficient to note that a large bulk ample was crushed, mixed, quartered, and finally round till it would all pass through a 50-mesh ieve. The material carbonised in the assay pparatus in the laboratory and later in the trays f the horizontal retorts may therefore be regarded s a homogeneous mixture, the behaviour of which n carbonisation and the products obtained there- rom, accurately represent the characteristics of the oal as a whole.

Most seams are built up of bands of varying usibility, each of which would give different esults if carbonised by itself. When coal in the ough is carbonised in gas retorts it is often ossible to pick out pieces of the coke which have bviously resulted from bands of different fusibility. Vhen the more fusible parts preponderate, the usion may become so general as to absorb the less usible portions into one indistinguishable mass. In other cases the infusible portions retain their individuality, but are concreted by the fused material into a caked mass. The latter effect is very noticeable when a caking or partially caking coal is carbonised in continuous vertical retorts, while in heavily charged horizontal retorts, in which the charge is undisturbed from start to finish, the effects of general interfusion are more in evidence.

The results of carbonisation in the laboratory assay apparatus throw a great deal of light on the behaviour of coals of different fusibility in a fine state of division and in homogeneous mixtures. Coals for the purposes of carbonisation may be classed under two heads:—(*a*) those in which the resulting coke occupies a greater volume than the original coal, and (*b*) those in which it occupies a smaller volume. The behaviour of class (*a*) is often referred to as due to the "expansion" of the coal. This might be taken as implying that the actual coke substance, the material of which the coke structure is built up, may be less dense than the coal substance from which it is produced. This it never is, for the coke substance essentially consists of carbon in the vitreous state which in itself is structureless, and the density of which is in the neighbourhood of 1·9.

Microscopical study, which began with the examination of specimens of coke resulting from the laboratory assay of individual coals of different degrees of fusibility and of mixtures of these, naturally led to a more extended inquiry into the origin of coke structure and as to the means by which it can be modified and controlled.

In charcoal and coke, carbon appears as the non-volatile residue of destructive distillation or carbonisation. It results from the decomposition by heat of the complex organic substances of which wood, peat, lignite, and coal are composed, and the driving off by heat of the volatile products of this decomposition. The higher the temperature of carbonisation the more complete are the decomposition and volatilisation, and the smaller therefore are the percentages of hydrogen and other gaseous elements left in combination with the residual carbon. By carbonisation at 1100° to 1200° C. the volatile matter left in the residue may be reduced to less than 1%.

The non-volatile constituents of the original material are concentrated in the carbon residue, and may exercise a considerable influence on its structure. In the case of coke this influence will be traced with some detail in what follows, but it has a special significance in the case of wood charcoal, which may be referred to now. Even a superficial observation of the charcoal from various kinds of wood shows that the general features of the wood structure are preserved in the charcoal, but the microscope not only confirms this general likeness, it shows the persistence of the actual cell structure. Professor Farmer states that anyone familiar with the micro-structure of various kinds of wood can without difficulty identify the particular wood from which a specimen of finely-powdered charcoal has been prepared. It is perhaps not so generally known that this identification of cell structure can to some extent be followed to an even later stage by the study of the ash left on the combustion of wood charcoal. A piece of wood charcoal, if allowed to burn quietly away in the absence of draughts, leaves its mineral ash in the form of a delicate, lace-like skeleton in which the minute cellular structure of the wood is reproduced. This suggests that these mineral constituents may actually contribute to the preservation of the plant cell structure in the charcoal by providing infusible nuclei distributed through the cell walls, thereby minimising the obscuring effects of the fusion of the carbon compounds during carbonisation. For we must now recognise that the production of an infusible carbonaceous residue from organic materials is invariably preceded by the fusion of the compounds of carbon with hydrogen and oxygen (and in the case of coal, sulphur and nitrogen) which result from the decomposition of these materials by heat. For each type of organic substance there is a stage in carbon concentration at which fusibility ceases. In some cases the range of fusibility is extended by raising the temperature of carbonisation. This, as will be seen, is the case in coal and similar bituminous materials, while in carbohydrates like sugar and cellulose the carbon concentration, with the resulting infusibility, is definitely reached at a much lower temperature, and no fresh access of fusibility can be induced by the application of higher temperatures.

---

* Fuel Research Board, Technical Paper No. 1: "The assay of oal for carbonisation purposes," by T. Gray and J. G. King.

In sugar we are fortunately provided with a pure chemical substance from which a carbonaceous residue can be prepared which is practically free from mineral and other impurities. This residue contains only minute quantities of hydrogen and oxygen, and it approaches more nearly to elementary purity than any form of carbon other than diamond and graphite. Indeed, it is by no means certain that graphite is really carbon in the elementary state, as Sir William Bragg's work on the atomic structure of diamond and graphite indicates that in the relatively open packing of graphite there is room for a layer of hydrogen atoms between the more densely packed lamellæ which are in diamond formation. It may be, therefore, that graphite is not pure carbon but a definite compound of carbon and hydrogen.

It has hitherto been the custom to refer to all forms of carbon other than diamond and graphite as amorphous. In his work on "The Electric Furnace" Henri Moissan devotes a chapter to his study of amorphous carbon, in the opening paragraphs of which the following sentences occur:—

"Carbon is the element which presents the most interesting allotropic varieties. It has long attracted the notice of workers by its contradictory properties and by the differences existing between the specific heats of the diamond, of graphite and of lampblack. . . . Theses have often been written on the hypothetical shape of the carbon atom, but there are relatively few experiments on the physical and chemical properties of the same carbon. . . . In order to reproduce the diamond, we were led to take up again a general study of the different varieties of carbon. . . . In the first part we shall deal with the amorphous kinds of carbon."

While Moissan made full use of the microscope in the study of graphite and diamond, his references to the micro-structure of amorphous carbon are very casual, and amount to little more than the statement that the substance was "amorphous," which generally appears to mean that it was in the form of a brown or black impalpable powder. For the purpose of his experimental work on the artificial production of diamond, the study of amorphous carbon was mainly directed to its response to oxidation by oxygen and by chemical agents and its differentiation by these tests from graphite and diamond. His study of lampblack led him to the conclusion that the carbon in this substance can be polymerised by calcination. The temperature of combustion of purified lampblack in oxygen was found to be 371° C. This lampblack was calcined for five minutes in a porcelain crucible at 910° C., and its temperature of combustion rose to 440° C. After calcination for three hours the temperature of combustion rose to 476° C., and after six hours to 506° C. The density was raised by calcination to 1·87. No attempt was made to associate the increase of density and the reduction of reactivity with changes in the state of aggregation which should have been plainly seen in the micro-structure. In my opinion the changes in chemical activity may quite well be accounted for by alterations in molecular aggregation which in effect lower the reactivity of the carbon merely by reducing the surface exposed to oxidation.

The more careful study of the aggregation of solids which had already begun some years before the publication of Moissan's work, had shown that the word "amorphous" was too apt to be used to cover our ignorance of forms of aggregation in which the atoms and molecules are not in the orderly formation and equilibrium which is the essential feature of the crystalline state.

The vitreous state, to which we owe so much in our daily lives, where it is presented to us at every turn, not only in its more obvious forms as glass and porcelain, but equally in metals and alloys in the hardened state, is no longer regarded as outside the scope of physics, chemistry and metallurgy. It is a definite form of molecular aggregation which over a long range of temperature is thermally as permanent as the crystalline state, while in many cases it is physically the more stable form. We now know that the special rigidity of the vitreous state is always associated with a state of strain which impairs the elastic freedom of the individual molecules. The remarkable hardness of vitreous carbon is associated with the type of brittleness which results from this state of strain. It is by virtue of that state of internal strain that glass can be cut by the diamond. The diamond does not really "cut" glass; it cleaves it. The cleft which can be initiated by the pressure of the diamond on the surface, spreads indefinitely in the plane in which it was initiated owing to the state of elastic strain of the glass. In the crystalline state this elastic strain does not exist. A single well-developed crystal can be cleft along certain definite planes, but the cleavage in this case is due to the homogeneous aggregation of the molecules in definite lamellæ between which either cleavage or slip may occur.

My own study of the steps in the formation of carbon by the carbonisation of sugar and of the micro-structure and properties of this substance and of coke, have led to the conclusion that in most if not all of the carbonaceous residues with which we are familiar, from wood charcoal to hard coke, the carbon is in the vitreous state—it is a true glass. This glass-like character of the ultimate coke substance has from time to time been referred to by various observers, though its significance from the physical point of view and its influence on the structure and properties of coke have not so far as I am aware been hitherto recognised.

The first experiment on the carbonisation of sugar was made by slowly heating a small crystal which weighed a few milligrammes on a glass micro-slip on a hot plate heated by a ring burner. Fusion without discoloration took place at 180°—190° C. Evolution of gas—mainly water vapour—with bubbling and foaming, began at about 220°. This practically ceased about 240°—250°, and the brown viscous liquid became tranquil and remained so till about 260°—270°, when gas was again evolved with vigorous bubbling and frothing, and the colour of the residue became black except in films or layers of extreme thinness. The temperature was gradually raised to about 450° C. Fig. 11 is a photomicrograph of the carbon residue at a magnification of ×10. It is a black glass which has been blown into a sponge of communicating bubble cells. Round the edges some unburst bubbles are seen. The thinner films are transparent and brown by transmitted light. By direct inspection with the 16-mm. lens small burst bubbles were detected, the walls of which were so thin that they showed the soap bubble colours. This vitreous carbon is entirely without metallic reflection, its surface is as smooth as glass and does not scatter light even under concentrated illumination.

Mr. King, chief of the laboratories of H.M. Fuel Research Station, has carried out the carbonisation of sugar in the laboratory assay apparatus with the following results:—

Amount experimented with: 2·3 grams.

Temp. °C.	Time.	Behaviour.	
180	10.32	No gas. No change.	
200	10.34	Melting.	
220	10.36	Melted.	
240	10.40	Browning and frothing, the viscous material blown into thin films. Gas evolution: water distillate.	
250	10.43	Rapid evolution of gas.	
270	10.48	Vigorous frothing; charring of the bubble walls and films. Light brown coloured distillate.	
290	10.51	Gas evolution 9 c.c. per min.	
316	10.54	Black residue consisting of thin films. Gas evolution still strong.	
332	11.4	Gas evolution still strong. Further flaking of carbon substance.	
344	11.0	Gas 8·75 c.c. per min.	The carbon residue is becoming infusible and the blowing even of minute bubbles has ceased.
374	11.21	Gas 7·0 ,, ,, ,,	
380	11.28	Gas 7·0 ,, ,, ,,	
398	11.37	Gas 5·5 ,, ,, ,,	
400	11.44	Gas 3·75 ,, ,, ,,	
420	11.55	Gas 3·5 ,, ,, ,,	From this stage little or no fresh gas was evolved; the gas measured mainly resulting from the expansion of that in the apparatus through rising temperature.
468	12.20	Gas 3·0 ,, ,, ,,	
484	12.30	Gas 3·0 ,, ,, ,,	
495	12.35	Gas 2·75 ,, ,, ,,	
500	12.40	Gas 2·5 ,, ,, ,,	
508	12.39	Gas 2·5 ,, ,, ,,	
516	12.55	Gas 3·0 ,, ,, ,,	
528	1.0	Gas 2·5 ,, ,, ,,	
540	1.15	Gas 2·0 ,, ,, ,,	
550	1.25	Gas 1·75 ,, ,, ,,	
556	1.32	Gas 1·25 ,, ,, ,,	
562	1.38	Gas 1·25 ,, ,, ,,	

These results are not strictly comparable with my own experiments on single minute crystals, owing to the difference in scale, which was in the ratio of 1:1000, but taking into account the very great difference in the scale of the operations, and therefore in the part played by the time element, the results are in fair agreement.

Mr. King has also carried out carbonisation experiments in crucibles over a wider range of temperature to determine the density of the vitreous carbon. At a temperature of 850° C. a product of sp. gr. 1·8 was reached.

Winter and Baker* obtained a carbon of sp. gr. 1·76 by heating for 4 hours at 900° C. After heating for 40 hours the specific gravity rose to 1·84. Forster† found that sugar charcoal prepared at high temperature contained 95% of carbon and 1·1% of hydrogen.

Moissan used lampblack as a standard of comparison in his study of amorphous carbon. He states that the lampblack was purified by successive washings with benzene, alcohol and ether. "This is absolutely necessary, and the quantity of hydrocarbons so removed was considerable. After the ether washing, the air-dried powder is placed in an oven and the temperature slowly raised to 150° C. This lampblack floats on allyl iodide of 1·87 density and sinks in propyl iodide of 1·78 density. Lampblack so prepared is far from being pure. It holds tenaciously small quantities of hydrocarbons and water from which it cannot be freed. It contains also a little nitrogen.

"To analyse this variety of carbon, it is first heated *in vacuo*, at the softening point of glass, in order to cause it to polymerise and to be handled more easily. Some water and traces of hydrocarbons are set free. The black powder then gives the following figures:—

These were two different samples.

	No. 1.	No. 2.
	%	%
Ash	0·22	0·34
Carbon	93·21	92·86
Hydrogen	1·04	1·20

"If the hydrogen be expressed as water, it is seen at once that the figures add up to more than 100, which shows that a small amount of hydrogen, less than 1%, is still there in the form of hydrocarbon; the remainder comes from the water whose complete removal from lampblack is not possible."

For our present purpose the significance of the foregoing analytical results, taken in connexion with the physical properties of carbon produced from substances of known composition, is that its vitreous character becomes more marked as the state of elementary purity is approached by the driving off of hydrogen or hydrocarbons. Though the bubble sponge structure must be regarded as a survival of the fusible state and the evolution of gases, the fact remains that long after this stage of carbonisation has been passed the material retains its glass-like character and even the thinnest bubble walls are still vitreous. The micro-structure of lampblack films deposited on a glass surface has been dealt with in another connexion. ("Aggregation and Flow of Solids," page 64, Fig. 35, Plate XI.)

The hardness of vitreous carbon.

The conversion of the so-called amorphous forms of carbon into graphite by their exposure to high temperatures is well recognised not only among scientific workers but in industry. Whether this operation can be simply explained as the natural passage of the vitreous to the crystalline state, which occurs in a great variety of substances at a temperature much short of the liquefying point is, I think, still unproved. Experience in matters physical shows the need for caution in accepting what appears to be the most simple explanation of any phenomenon; and in this particular case the suggestion of Sir William Bragg that hydrogen may possibly take part in the building up of graphite supplies a definite reason for suspension of judgment. I can only refer very briefly to the significance of the suggestion that, in addition to the crystalline forms of carbon, diamond and graphite, there is a third form which is vitreous and of lower density than either of these.

If it is ultimately confirmed that vitreous carbon has a density of 1·85 as compared with 3·55 in diamond and 2·55 in graphite, interesting questions arise in regard to the atomic packing in the vitreous state which may have an important bearing on the whole theory of the rigidity of solids.

The relatively close packing of the atoms in diamond seems to fall naturally in line with the extreme hardness and rigidity of carbon in that form. The sectile quality of graphite, which causes it to flow like a liquid under moderate differential pressures and to act therefore as one of the most trustworthy of lubricants for moving surfaces under high pressure, is associated by Sir William Bragg with the alternation of closely packed layers in diamond formation with layers of wider spacing in which there is room for a layer of hydrogen atoms. The graphite which flows under differential pressure is composed of ultramicroscopic plates of diamond hardness which slip over each other with the freedom of a liquid. The question now arises, by what atomic arrangement can we account for the extreme hardness and rigidity of vitreous carbon in which the packing is on the average more open than it is in graphite?

---

* Chem. Soc. Trans., 1920, 117, 319.

† Chem. News, 86, 152.

Two points emerge very clearly from the consideration of the physical properties of the three forms of carbon. These are that the ultimate atoms of carbon in the solid state must in themselves possess great rigidity and hardness, and that the cohesive force within the molecule under the influence of which these atoms are built up in the rigidity of the vitreous state, must be used with a much higher efficiency than in the case of graphite.

The micro-structure of coke and charcoal.

The method of section cutting of coal developed by Mr. Lomax has placed in the hands of palæobotanists the means whereby the microscopical study of the constituents of coal as they occur *in situ* in the bands of which coal seams are built up, can be pursued on the well-established lines familiar to botanists and biologists: that is by the examination of extremely thin, transparent sections. From the microscopist's point of view, this method has many advantages. Not the least of these is that the examination can be made by light transmitted from below the stage of the microscope which passes through the section directly into the object glass. This means that light of any desired intensity can be used under the most critical conditions, and further that lenses of the highest resolving power can be employed, as there is no limit to the nearness of approach of the lens to the object. With lenses of high resolving power the picture as received at the eyepiece is a presentation of the object strictly in two dimensions. When lenses of longer focus and lower resolving power are used, however, the third dimension comes into the picture to a limited extent, and some idea may be gathered of the structure of the object as a solid.

For the study of the micro-structure of coke and other carbonaceous residues this method of section cutting is only available to a very limited extent. Carbon in this form is black by reflected light, but in very thin layers or films is brown by transmitted light. In the sponge-like form in which it occurs in coke it is glass-like and brittle, and is a peculiarly difficult material to prepare in the form of sections thin enough to be of any value for microscopical examination by transmitted light.

In a most interesting paper by W. Thörner in 1886 on the "Study of coal, coke, and charcoal,"[*] he describes how he succeeded in obtaining by grinding, thin sections of specimens of coke obtained from a number of different sources, and photomicrographs of these at a magnification of 50 diameters are given in the original paper. Two of these are reproduced, Fig. 1 being gas-retort coke and Fig. 2 pressed coke. These serve to show the inadequacy of this method for the study of the minute structure of coke. They are not even complete pictures in two dimensions, but are simply black and white silhouettes produced by light passing through holes in an opaque screen, which to all appearance is absolutely structureless. That Thörner did not recognise the limitations of this method of examination is quite clear, for he says:— "Coke made in gas retorts is the most unlike charcoal. It presents in various degrees massive pore walls with large cells which might almost be called caves. The coke substance is melted down until it has become an extremely close impermeable glassy mass."

My earlier work on the micro-structure of solids has shown the importance of bringing into view all three dimensions of the structure under investigation; for, however minute the elements of structure may be, they are solids of definite form which must be seen in relief if their nature and origin are to be properly understood. From the microscopist's point of view this means that lenses of great depth of focus must be used even though this necessarily involves a serious sacrifice of resolving power. Visually the heights and depths of a structure can be followed with the microscope by focussing up and down even with lenses of fairly high resolving power, but when photomicrographs are desired, only lenses of long focus and lower resolving power can be used. With this object planar lenses of 4·5 cm. and 7·5 cm. focus were used, and satisfactory photographs were obtained at magnifications from 5 to 12 diameters, the surface of the object being illuminated by a beam at an angle of about 45°. The more intimate structure was directly examined, using a 16-mm. apochromat of N.A. 0·3, the surface being preferably illuminated by reflected light from a north sky slightly condensed on the object by a double convex lens.

Carbon in the form of coke is a very difficult material to examine microscopically. As we have seen, it is a black glass, almost opaque and entirely without metallic reflection. From its glass-like surfaces light under ordinary conditions is reflected without scattering. With lenses of low resolving power the reflections from the surfaces of the more minute bubbles or cells give the effect of scattering. On examination with the 16-mm. lens it is seen that the surface of the minute bubbles or cells gives the effect of scattering, but on examination with the 4-mm. lens it is seen that the surface of the minute bubbles is still glass-like.

As grinding and polishing lead to surface flow, these operations, if resorted to, must be applied to coke with great caution, as they may obscure or even completely destroy the real structure. For this reason freshly broken surfaces are much to be preferred if these can be obtained reasonably flat. Broken edges often show details of structure which would have been missed on an unbroken surface.

The general method of examination was as follows:—

(1) The selected specimens were photographed at their natural size.

(2) They were then carefully examined in a good light with a hand lens and the portion best suited for microscopical examination was broken off and trimmed for mounting. In every case a specimen having an untouched broken surface and edges was prepared; but in some cases additional specimens were prepared by filing and grinding on fine emery, great care being taken to remove the resulting dust from the structure. All specimens were examined in this way, so that the structure was traced continuously from natural size down to the limits of resolution by lenses of N.A. 0·3 and 0·95. These limits are in the region of the one-thousandth and the forty-thousandth of a millimetre respectively.

(3) While photographs are of great value, they cannot take the place of patient and long-continued study at the microscope with gradually increasing magnification and resolution, and with varying illumination.

(4) The specimens were photographed at magnifications of from 5 to 12 diameters, using planar lenses of 4·5 and 7·5 cm. focus.

In each case the lens was stopped down till a clear picture with the necessary depth of focus was obtained.

(5) Many attempts were made to photograph the specimens using the 16-mm. and 4-mm. apochromats with the vertical illuminator, but the range of focus of even the 16-mm. is so small and the difficulty of satisfactorily illuminating a black glassy substance like coke is so great that no satisfactory results could be obtained in the time at my disposal. I hope, however, to have greater success when time permits.

These observations show that the coke structure, however minute, is due to the evolution of gas bubbles from the fused or partially fused coal

---

[*] Stahl und Eisen, 1886, No. 2.

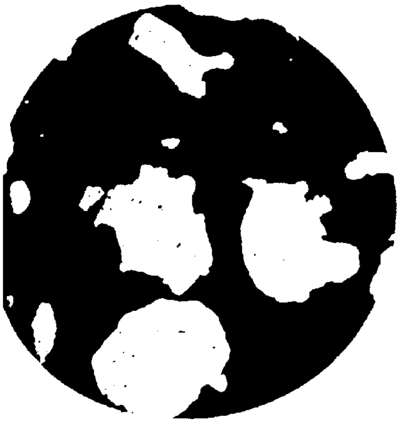


Fig. 1

Fig. 2.

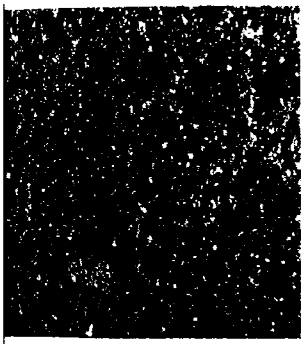


Fig. 3.

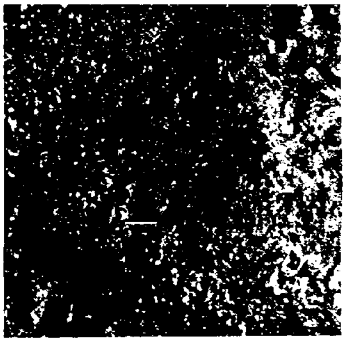


Fig. 4.

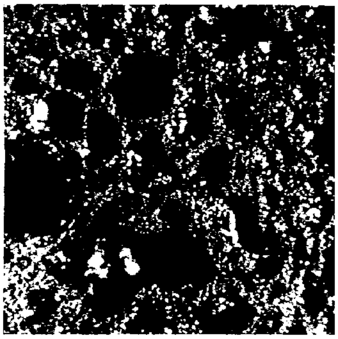


Fig. 5.

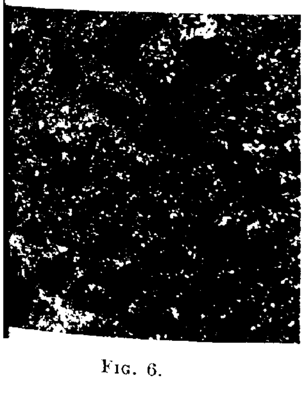


Fig. 6.

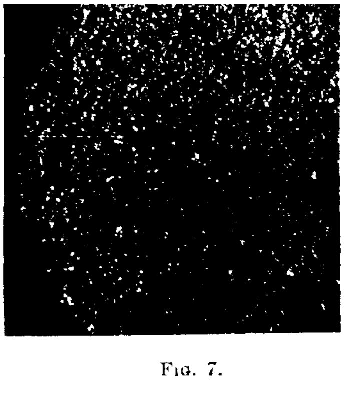


Fig. 7.

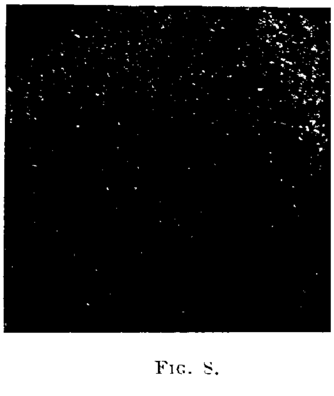


Fig. 8.

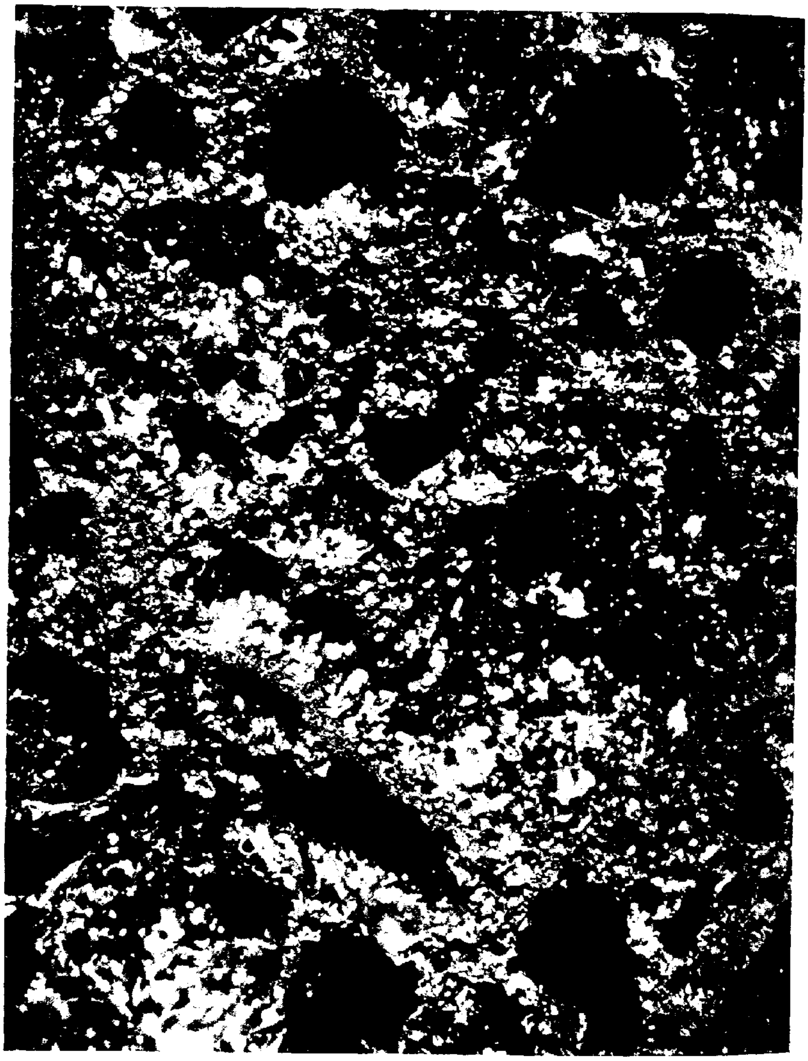


Fig. 9.

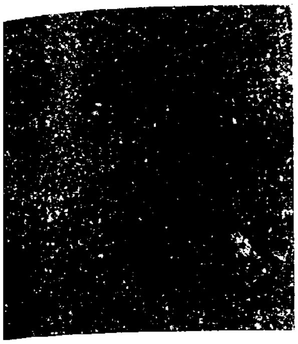


Fig. 10.

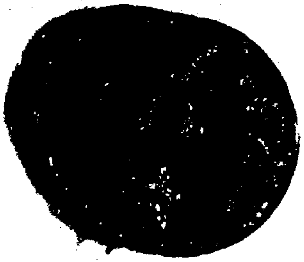


Fig. 11.

Fig. 12.

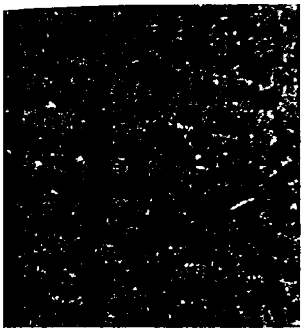


Fig. 13.

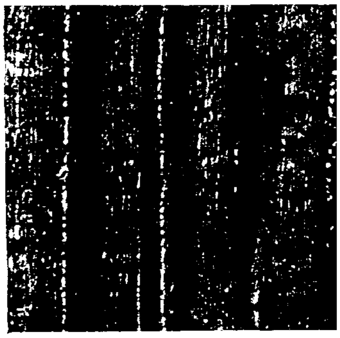


Fig. 14.

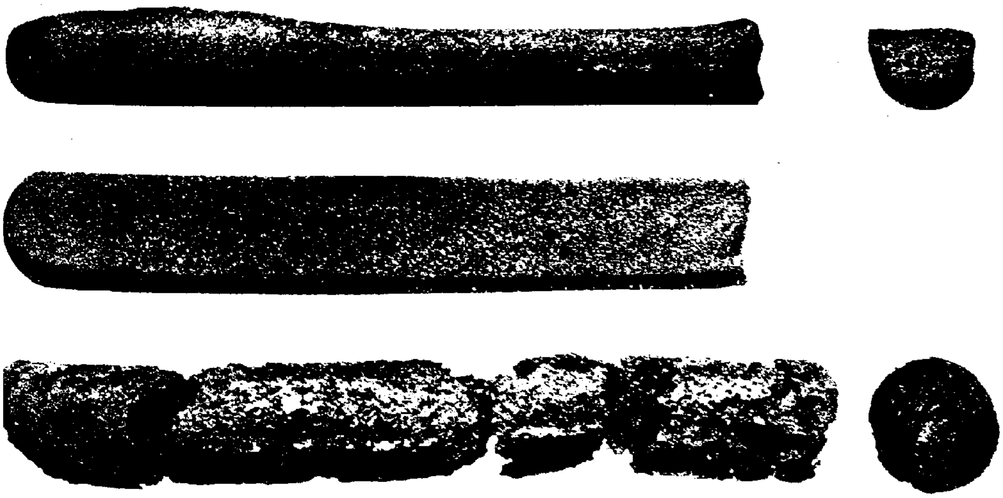


Fig. 15.

Fig. 16.

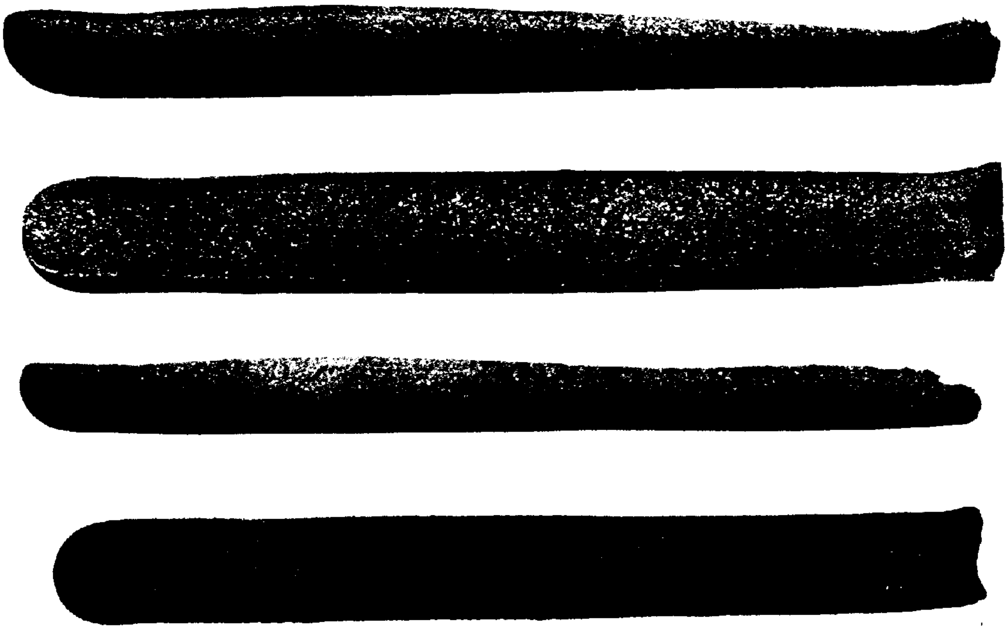


Fig. 17.

bstance. Probably the first step in this operation sults in the formation of a foam in which each bble is a self-contained cell, but by the mutual rforation of these bubble cells at their points of ntact, a sponge is produced through which the ses ultimately escape to the outside of the mass. e special characteristic of fused coal substance ich leads to the continuous development of this ructure is that its decomposition with the evolu- n of gas continues as the temperature is raised. s which begins to come off at about 400° C. is ll being evolved at 1000° or even higher; and the lls of the bubbles which are generated at lower mperatures continue to give off gas and to nerate more and more minute bubbles as the mperature rises.

Bubbles, however, can only be blown so long as e mass is sufficiently plastic. This places definite nits of time and temperature on the development this structure, which ceases when decomposition s reached the stage at which rigidity of the cell lls has set in. Though gas may continue to be olved after this stage is reached, it can only cape from the surfaces which have already been veloped and through the more intimate molecular ructure of the vitreous substance.

The complex character of the decomposition of the sible constituents of coal during carbonisation akes it difficult to ascertain the limits of time and mperature at which rigidity sets in, especially as ese vary considerably with different types of coal. e can, however, say with confidence that the rbon of which all forms of coke and charcoal are ilt up, is a fairly homogeneous, vitreous solid in hich the vitreous properties become more and more arked as the state of elemental purity is proached and further, that the bubble structure hich is developed during the fluid or plastice stage carbonisation through the evolution of hydro- rbon gases, is finally stereotyped in this rigid treous material.

The experiments on the carbonisation of sugar, hich have already been referred to, throw a useful ght on the subject, for in this case these limits ave actually been defined. Rigidity sets in at 350° ., and at 400° C. frothing and bubble-blowing have ased. No change in the minute structure occurs hen the temperature is raised to 800° C. or higher. the experiments with single minute crystals the ement of time was almost eliminated, for the ystals only weighed a few milligrammes. When e scale of the operation was raised in the assay pparatus by about 1000 times, the element of time viously played a considerable part. The assay be which under normal conditions is sufficiently rge for the carbonisation of 20 g. of coal, was mpletely filled by the frothing of the viscous aterial from 2·3 g. of sugar and the ultimate resi- ue consisted of thin films of vitreous carbon.

Even in the small assay tube it is evident that the enetration of heat through the frothing material as comparatively slow and that it did not all reach he rigid state of carbonisation at the same time. he time element therefore entered much more rgely into the operation than it did in the case f the single crystal experiments.

In the carbonisation of coal on an industrial scale, n coke ovens and gas retorts, the influence of the ime element is generally recognised and has been arefully studied by many observers. I venture to ope, however, that the definite association which as now been traced between what occurs during the usion and frothing stage in carbonisation and the ltimate structure of the coke, may prove to be a ew starting point in these inquiries.

Frothing with the formation of large bubbles only ccurs when the froth is free to expand without the ntervention of solid surfaces against which the ubbles burst and the gas they contain can escape. This was demonstrated by R. Lessing in 1912,* in the laboratory assay apparatus which he had devised. In this apparatus ground coal was carbonised in an externally-heated silica tube placed vertically, the excessive foaming of fusible coals being completely controlled by allowing a loosely fitting plunger to press lightly on the surface of the molten coal. This caused the bubbles to burst while the resulting gas escaped by the narrow annular passage between the plunger and the inner walls of the tube. Lessing's method includes the measurement of the volume of the resulting coke as compared with the original volume of the ground coal. Though this information is of value in the laboratory study of carbonisation, it is not directly applicable to works practice. The pioneering work of Lessing is of the greatest importance in connexion with this fundamental feature of carbonisation, which goes far to explain the mechanism of the production of dense coke in modern coke oven practice, where the finely-divided coal is tightly packed in the ovens by the application of pressure.

In modern coke-oven practice the advantages of fine crushing and blending of the various bands of one seam or of several distinct seams are only partially recognised as the means by which homogeneity in composition and uniformity of any desired texture in the coke can be secured with certainty. It is hoped that the detailed study of the subject which has been involved in the researches of the Fuel Research Board on carbonisation will throw useful light on the structure of coke and on the methods by which this may be modified at will, so as to adapt this fuel more perfectly to the metallurgical and other purposes for which it is produced.

Some two years ago we discovered that the excessive foaming of the more fusible coals could be completely arrested by a totally different method from that of outside restraint which results from confining the coal in a restricted space during carbonisation. This method we have generally referred to as blending. It consists in the intimate mixing of fusible with an infusible or less fusible coal. The proportions in which the selected coals should be mixed can be quickly determined by a few preliminary trials in the laboratory assay apparatus. When the proper mixture has been arrived at, little or no foaming occurs during carbonisation, and the resulting coke occupies a smaller volume than the original coal. This has already been described and is illustrated in detail in Figs. 16 and 17.

By ensuring the shrinkage of the coke one of the most serious of the difficulties in the carbonisation of fusible coals is removed. For the past two years this method has been in regular use at H.M. Fuel Research Station for the adjustment of fusibility so as to ensure that the coke will contract and occupy a smaller volume than the original coal. The idea has been taken up by other workers and is being practically applied in various directions.

As a variation on the method referred to, pulverised coke or breeze has been successfully used as the infusible material in blends or mixtures. The most obvious disadvantage in the use of coke for this purpose is that, while it contributes no gas and no oil to the output of the operation, it occupies space in the carbonising apparatus, and involves costs for handling and fuel which could be more profitably expended on the carbonisation of coal of low fusibility and high volatile content.

Mr. E. V. Evans has, however, shown that an admirable smokeless domestic fuel can be produced by carbonisation of a blend of gas-retort breeze with a fusible coal (*cf.* J., 1922, 206 T). It is a remarkably homogeneous material in which the bubble sponge structure is uniformly developed, and on just the right scale for a fuel which is to be used for domestic purposes.

---

* "A laboratory method for comparing the coking properties of coal." Inst. of Gas Engineers, June 13, 1912.

My own interest in the micro-structure of coke was greatly stimulated by the remarkable work of Messrs. E. R. Sutcliffe and E. C. Evans* on the briquetting of pulverised coal as a preliminary to carbonisation. This at once appealed to me as the logical sequence of the work on the blending of coal crushed to a moderate degree of fineness. It has been proved by these pioneers that the control of bubbling and frothing by grinding and blending which made it possible to develop the reactive surface within the mass without too great a sacrifice of density and robustness could be almost indefinitely extended by the briquetting of finely ground coal by pressure as a preliminary to carbonisation. It has therefore been a work of great interest to trace the absolute continuity of the bubble sponge structure from its most obvious appearance in the carbonisation of a highly fusible coal through all its intermediate stages to the remarkable absorbent carbon which was produced by Sutcliffe and Evans to replace the most absorbent forms of wood and nut charcoal for the gas masks supplied to our soldiers at the front.

It is stated that this material has at least three times the gas-absorbing capacity of the best wood charcoal. My belief is that the absorbing capacity is mainly if not entirely a question of surface, and that the conversion of vitreous carbon into thin films by the blowing of bubbles is the most effective known means for the development of enormous internal surfaces.

The continuity of the bubble sponge structure can be followed so far in the photomicrographs, Figs. 3 to 8, and in the enlargement of Fig. 6 on Fig 9. By direct observation with lenses of higher resolving power it has been followed down to a minuteness which is expressed in ten thousandths of a millimetre.

It is evident that Thörner's conclusion cannot be supported that the relatively large pores or cells which were disclosed by his method of examination were bounded by walls consisting of "an extremely close, impermeable, glassy mass." We have seen on the contrary that this glassy mass is possessed of a sponge cell structure which under suitable conditions may have a minute porosity which is not only comparable with that of wood charcoal, but may far exceed it.

The structure of coke has been considered by metallurgists from three points of view. These are, porosity, density, and reactivity. Reactivity appears to be generally regarded as depending on chemical rather than structural changes in the carbon. Porosity and density are treated as purely reciprocal, the ratio of the relative volumes occupied by the actual coke substance and by "pores" in any given specimen being calculated from the apparent and real specific gravities. It is obvious that this method of estimating porosity gives no indication whatever of the relative area of the internal surfaces which have been thereby developed, for this involves a knowledge of:—(1) The size of the pores. (2) Their number and distribution in the mass. (3) The thickness of their dividing walls.

Consider the case of a coke in which the ratio is as 1:1, the specific gravity of the carbon substance being 1·9 and of the coke 0·9. One cubic inch of coke will contain half a cubic inch of carbon substance and half a cubic inch of air space. Assume that the whole of the carbon is concentrated in the lower half of the cubic inch, and that this can be sliced horizontally into sections 1/1000 of an inch in thickness, and that the 500 slices so obtained are extended upwards at intervals of 1/1000 of an inch, so that they occupy the whole of the cubic inch. We should then have a block of coke the specific gravity of which would still be 0·9, and its reactive surface would be about 1004 square inches as compared with a reactive surface of 4 square inches in the solid block of carbon substance. It is obvious that by making the slices of carbon substances and the spaces between them 1/100 of an inch in thickness and width, the specific gravity of the block would still be 0·9, but its reactive surface would now be 204 square inches instead of 1004. By reducing the spaces between the slices of 1/1000 of an inch to one half the thickness, the specific gravity of the block would be raised to 1·2 and the reactive surface to 2667 square inches.

So far therefore as reactive surface is concerned, the ideal condition would be the subdivision of the whole of the carbon mass into films of minimum thickness separated by spaces of equal width. This ideal can most nearly be approached by the bubbling method, pulverising and pre-briquetting suitable blends of coal so that the sponge cells are small and their walls as thin as possible. The apparent density of coke obtained in this way may reach 1·33 sp. gr.; the air space must therefore be of the order of one fourth of the volume.

Let us turn now to the other aspect of porosity, its influence on the accessibility of the reactive surfaces within the mass to oxidising gases. The users of metallurgical coke have in the past attached great importance to this function of porosity, in the belief that full advantage of the reactivity of the internal surfaces can only be secured by free access of the oxidising gases and the equally free removal of the products of oxidation. If it be assumed that Fig. 4 may be taken as a metallurgical coke which meets this condition, it is of interest to determine the size of the larger bubble units. These range from 3 to 4 mm. down to about 0·5 mm. in diameter. We may take it therefore that free circulation of gases will mainly occur through the larger of these, as they have probably been opened up and kept open by the rapid discharge through them of the carbonisation gases. They have formed ducts through which the gases from the areas of the more minute bubbles have escaped.

In the much denser pre-briquetted coke, Fig. 8, the larger pores range from 0·5 mm. down to 0·1 mm., and it is evident that in this case also these have been the main ducts for the escape of gases, but the fact that the combustion of these briquettes proceeds definitely from the outer surfaces inwards shows that the internal circulation of the oxidising gases is much more restricted than in the case of metallurgical coke. Sutcliffe and Evans believe that the reactive surface of the coke briquette is so immensely greater than that of metallurgical coke that the increased rate of combustion more than compensates for the less free circulation throughout the mass. This question of the relation of "accessibility" of surfaces to rate of combustion is now being investigated by Mr. E. C. Evans and Dr. Wheeler, and also at H.M. Fuel Research Station.

Descriptions of photomicrographs.

Figs. 1 and 2.—Coke structure. Reproduction of micrographs at a magnification of ×50, which were published by Dr. Thörner in "Stahl und Eisen" in 1886.

Fig. 1.—Gas retort coke.

Fig. 2.—Metallurgical coke.

Sections of coke were prepared by grinding and were photographed by transmitted light. As the thickness of these sections, unlike those which can be prepared from coal, cannot be so far reduced that they become transparent.

---

* J., 1922, 196—206 T.

he resulting pictures are simply silhouettes produced by the passage of light through holes n an opaque screen. There is not even any ertainty that the holes really represent the size r shape of the pores or elements of structure, for n so fragile a material as vitreous carbon in the orm of thin films the grinding of the section might asily lead to the destruction of the more minute lements.

Figs. 3—8.—Coke structure. Photomicrographs y G. Beilby in 1922. These were obtained by the use of a planar lens of 3 inch focus stopped down o give depth of focus. The illumination was by eflected light at an angle of about 45°. The magnification was from 5 to 10 diameters.

Fig. 3 is gas coke from horizontal retorts using Durham coal.

Fig. 4 is blast furnace coke from recovery ovens. Compare with that shown in Figs. 1 and 2.

Fig. 5 is a cross section of laboratory assay coke rom Mitchell Main, a fairly fusible coal. Considerable frothing has occurred during carbonisation. Compare with Fig. 15c.

Fig. 6 is gas coke from vertical retorts using Arley, a fairly fusible coal. Compare with the enlargement of this, Fig. 9.

Fig. 7 is a cross section of laboratory assay coke from Dalton Main. Compare with Figs. 15 A and B.

Fig. 8 is the coke resulting from the carbonisation of a briquette made by the compression of pulverised coal. The structure is only imperfectly resolved by the planar lens. Compare Fig. 10.

Fig. 9.—Enlargement of Fig 6. Coke from Arley goal carbonised in vertical retorts with steaming. The continuity of the bubble sponge structure can be followed on this photograph from cells of 1 mm. down to 0·05 mm. diameter. The more minute cells in the walls of the larger bubbles which appear only as small diffraction discs, when visually resolved by the 16 mm. apochromat show the continuity of this structure down to a minuteness of 0·001 mm.

Figs. 10—14.—Coke structure. Photomicrographs by G. Beilby in 1922, prepared under the conditions described for Figs. 3—8.

Fig. 10 is coke resulting from the carbonisation of the briquetted blend of Mitchell Main and Ellistown Main at a higher temperature than that employed in Fig. 8.

Fig. 11 is vitreous carbon prepared from sugar, described on page 342 T. Though large bubbles, both burst and unburst, are seen, the more minute structure seen in coke is absent.

Fig. 12 is the broken surface of a briquette made from pulverised coal (about 60 mesh) heated to 380° C. and compressed at 2 tons per sq. in.

Fig 13 and 14 show oak charcoal across and along the grain of the wood. The structure is practically a reproduction of the natural cell structure of the wood. There is little or no evidence of fusion and bubbling.

Fig. 15.—Coke produced in the laboratory assay apparatus. Natural size.

A and B—Dalton Main, a typical coal which produces a satisfactory coke for use as smokeless fuel for domestic purposes. Compare with Fig. 7.

C—Mitchell Main, a fusible coal which froths on carbonisation. Compare with Fig. 5.

Fig. 16.—Laboratory assay coke showing the result of blending coals of widely differing fusibility.

A—The carbonaceous residue from Ellistown Main breeze is practically a non-coherent powder.

B—The coke from Mitchell Main is an open sponge.

C—The coke from a blend of 40% of Ellistown Main with 60% of Mitchell Main is relatively hard and dense and occupies a much smaller volume than the original coal.

Fig. 17.—Laboratory assay coke from blends of Mitchell Main and Ellistown Main coal.

A and B are the cokes as seen in elevation and plan of the blend, Mitchell Main 80%, Ellistown Main 20%.

C and D are the cokes as seen in elevation and plan of the blend, Mitchell Main 60%, Ellistown Main 40%.

The greater shrinkage of the 60-40 blend is very obvious.

Communications.

EFFICIENCY IN CENTRIFUGAL DRAINING.

BY THOMAS J. DRAKELEY AND LESLIE H. WILLIAMS.

In a former communication, it has been shown by Drakeley and Martin (J., 1921, 308—310 T) that the reduction of the speed at which the basket of a centrifuge was revolved from 1198 to 697 revolutions per minute failed materially to affect the separation of liquor from the crystals. An investigation has therefore been made to determine how the speed of revolution is related to the efficiency of the centrifuge. The efficiency of the centrifuge has been defined (*loc. cit.*, 309 T) as the percentage of the total mother liquor which has been extracted from the charge of crystals at any particular moment of the run.

At the higher speeds, no further separation of mother liquor occurred after the crystals had been spinning for fifteen minutes, but a small loss of moisture was noted with longer spins although no liquor separated from the crystals. No doubt the loss was due to the drying effect of the air blowing through the charge after the liquor had been extracted. Whilst the latter drying effect may assume great importance in works practice, it was decided to eliminate this somewhat doubtful factor and run the centrifuge in all experiments for fifteen minutes, so that comparable results might be obtained for the extraction of mother liquor from the crystals.

Hence in the following experiments arrangements were made to obtain widely different speeds, and in each case the centrifuge was run for a period of fifteen minutes. At the end of that period, the efficiency of the separation effected in the time was determined by the method described in the previous paper. Each result given in Table I. is the average of six individual experiments.

TABLE I.

Spratt's centrifuge (Manlove, Alliott and Co., Ltd.). Diameter of basket, 14 inches. Time for attaining stated speed, 15 seconds. Time of spin, 15 minutes.

Ref. no.	Maximum speed r.p.m.	Efficiency %
1	100	10·8
2	124	27·6
3	197	52·5
4	330	64·8
5	368	66·6
6	476	70·6
7	602	70·9
8	697	71·4
9	868	72·6
10	1198	73·5

The results plotted in Figure 1 show that the speed may be reduced to a remarkable extent before the efficiency of the separation effected in fifteen minutes is seriously diminished. Indeed it will be observed that at a speed of 476 revolutions per minute, that is, considerably less than half the maximum speed, the efficiency is only 2·9% lower than the maximum.

Whilst it may justly be contended that this 2·9% drop in efficiency may, in a particular case, represent an inadmissible addition to the moisture content of the crystals, it, nevertheless, shows that high speed is not the sole factor in centrifuge practice. Indeed the present-day tendency to advertise centrifuges which work at enormous speeds seems to be emphasising a doubtful advantage.

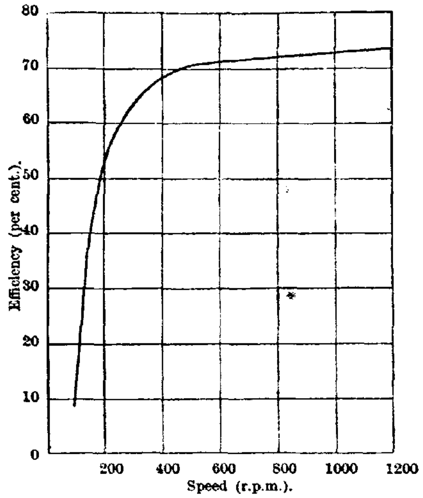


FIG. 1.

Bryson (J. Ind. Eng. Chem., 1921, 13, 993) suggests that possibly the question of the arrangement of the particles under the centrifugal force may influence the efficiency of the separation. When particles collect under the comparatively low force of gravity they assume a cubical piling arrangement. In this state, the maximum volume of interstices between the particles is afforded for the passage of the mother liquor. Even with low speeds and therefore small centrifugal force, the crystals may arrange themselves in cubical piling. However, when the speed of the basket is very great, the high centrifugal force is stated to cause the particles to assume the most stable arrangement, that is, hexagonal piling. But with hexagonal piling the volume of the voids is reduced to the utmost, and thus the exit area for the mother liquor is a minimum.

It was thought possible that the change from cubical to hexagonal piling might be sufficiently marked to give a sharply defined change in the type of the extraction or efficiency curve.

The apparent efficiency, that is, the percentage of the total mother liquor which has flowed from the drain of the centrifuge at any particular moment, was determined at various speeds and times to test this suggestion. The values are given in Table II., and the efficiency is plotted against the time in Fig. 2.

TABLE II.

Spratt's centrifuge. Diameter of basket, 14 inches. Time for attaining stated speed, 15 seconds. Size of crystals, 0—⅛ inch.

Apparent efficiency (per cent.).

Time (mins.).	Speed (r.p.m.). 100	124	197	330	368	476	602	697	1198
0·5	—	—	—	—	—	10·0	14·2	18·0	35·0
1·0	—	—	—	13·1	15·8	20·1	25·0	46·5	55·8
2·0	—	—	18·5	24·5	29·6	34·4	46·7	59·0	65·4
3·0	—	9·4	25·0	31·1	37·1	43·0	56·1	64·5	69·2
4·0	—	—	30·8	36·7	44·3	48·4	60·8	67·0	70·5
5·0	—	13·4	34·9	40·3	48·6	52·4	63·0	68·9	71·7
7·5	—	17·4	40·4	49·9	57·0	59·8	66·8	70·5	72·0
10·0	7·2	20·4	44·8	56·5	60·8	66·5	69·3	71·1	72·5
15·0	10·8	27·6	52·5	64·3	68·6	70·6	70·9	71·4	73·5

An examination of the curves in Fig. 2 shows that there is no marked change in the character of the extraction, and consequently no evidence of a change from cubical to hexagonal piling.

It should be observed, however, that before the above experiments were made the crystals in the basket were allowed to drain free from excessive liquor, so that comparable results could be obtained. When the crystals have thus drained, the fluidity of the resulting charge is far less than if they were placed in the basket with a greater quantity of liquor. This decrease in fluidity would naturally hinder any possible change in the arrangement of the particles from a cubical to hexagonal piling system, and hence this may account for the absence of the anticipated indication in Fig. 2.

Experiments were therefore made in which the charge was introduced into the basket with a sufficient excess of mother liquor to give more fluidity. It was found impossible to obtain results which could be treated mathematically, but it appeared that, as a general rule, the best treatment is to remove the major part of the mother liquor at a low speed and then, after the fluidity of the charge is thereby rendered negligible, to run the basket at a higher speed to remove the remaining liquor (*cf.* Bryson, *loc. cit.*).

The reason no results can be given, but only the general conclusion from the experiments, is due to the fact that, for no apparent reason, the charge sometimes formed an almost impervious cake on the sides of the basket which prevented the separation of the liquor. At other times, with the same speed and the same crystals, and seemingly the same conditions, the above peculiarity was not noticed.

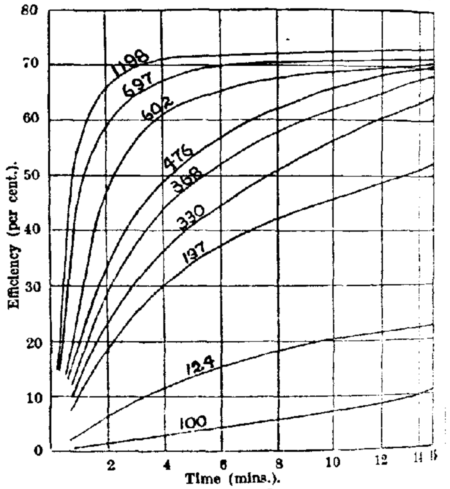


FIG. 2.

For works practice, especially with fine material, it would appear to be advisable to commence centrifuging with the lower speed, so that the initial piling is probably largely cubical and the fluidity is reduced to maintain that system of piling. Then a higher speed may be used to complete the removal of the liquor, but even in this case, the high speed should actually be the lowest speed capable of producing the required results.

The author's thanks are due to Mr. J. Reader Faul for his assistance in connexion with the plant necessary for driving the centrifuge.

The Chemical Department,
Northern Polytechnic Institute,
London, N. 7.

Communications.

HE EXTRACTION OF GLUCINA (BERYLLIA) FROM BERYL.

r HUBERT THOMAS STANLEY BRITTON, M.SC., A.I.C.

Beryl, including the gem forms emerald and aqua- arine, is the chief source of glucinum salts. Its mposition corresponds with the formula

$$3GlO.Al_2O_3.6SiO_2$$

ıd therefore contains about 13·5% of glucina. It coloured in differing shades by traces of ferric :ide. Glucinum also occurs in the less common inerals, such as chrysoberyl, euclase, phenacite, ucophane, gadolinite, etc. Beryl is by no means ıch a rare mineral as is generally believed. It is und in America, Switzerland, Norway, Scotland, eland, Madagascar, and other countries—much of ıe supply being of no use to the jeweller. Up to ıe present, very little technical use has been made these supplies, although slight use has been made glucinum nitrate in the incandescence mantle dustry.

Metallic glucinum has many unique and useful operties. Its specific gravity (1·6) is much lower ıan that of aluminium (2·6). Besides having an :ceptionally high melting point, 1278° C., it can be loyed with many metals, for example, with uminium, copper, silver, and iron (*vide* Lebeau, ɔmptes rend., 1897, **125**, 1172; Osterheld, Z. anorg. ıem., 1916, **97**, 1).

The isolation of glucina from beryl involves the oublesome separation of the two remarkably milar oxides, glucina and alumina. The difficulty this separation may be inferred from the number ıd variety of methods which have been put forard. Many of them have been investigated by the ıthor (*vide* Analyst, 1921, **46**, 359—366, 437—445; 22, **47**, 50—60). Only four were found under rtain conditions to be quantitative, and of these, is doubtful if any one could be worked commercılly. It was decided, therefore, to try to develop method of separation which could be employed on large scale. These efforts have not been cometely successful. It has been found, however, that 'er 90% of the alumina from beryl can be separated om the glucina quite easily.

Beryl is not attacked by acids, except perhaps hen finely divided by hydrofluoric acid. In order effect its decomposition, it must first be ground the consistency of a flour and then fused with a ıitable flux. Grinding can be carried out satisctorily in an agate mortar. For this purpose, ɔy (Amer. J. Sci., 1863, **36**, 83) employed a goldıartz mill. Lebeau (Comptes rend., 1895, **121**, 641) und that fusion of pulverised beryl alone in an ectric furnace caused the volatilisation of some of s silica, after which the residue was easily attacked r a mixture of sulphuric and hydrofluoric acids. he following fluxes have been used by various vestigators: (*a*) caustic soda and caustic potash chaub, Annalen (Crell), 1801, **17**, 174), (*b*) calcium ıoride and sulphuric acid at 100°—200° C. in a ad dish (Scheffer, Liebig's Annalen, 1859, **109**, 4), (*c*) ammonium fluoride, potassium fluoride, dium carbonate, potassium carbonate, calcium cide (Joy, *loc. cit.*). The most convenient of these ıxes is potassium hydroxide. Fusion with potash ın best be carried out in a silver crucible, as was ıggested by Schaub. If care is taken to employ as w a temperature as possible, the fusion can also effected satisfactorily in a nickel crucible. When intimate mixture of finely ground beryl and an cess of potassium hydroxide is heated over a ınsen flame fusion takes place readily. Generally, half an hour will be found sufficient. If the fusion is carried out at too high a temperature, such as that attained in a gas muffle furnace, the crucible will be attacked appreciably, much nickel being found in the fused mass. The fused mass is ground, placed in a beaker and covered with water. The silico-aluminate of glucinum and potassium which has been formed, is then decomposed with a slight excess of concentrated sulphuric acid. The precipitated silicic acid is rendered amorphous by carefully heating on a sand-bath, after which the solution is diluted and filtered. The mother-liquor now contains the glucinum, aluminium, and traces of iron.

Before passing on to the isolation of the glucina from the mother-liquor, brief reference should be made to the process of isolating glucina from beryl which has been worked out recently by Copaux (Comptes rend., 1919, **168**, 610). In this method the precipitation of silica is eliminated. If one part of finely pulverised beryl is heated at 850° C. with two parts of sodium silicofluoride, the following reactions are stated to take place, due to the dissociation of the silicofluoride at 750° C. The glucina is converted into a double fluoride, thus:

$$2GlO+SiF_4=SiO_2+2GlF_2,$$
$$2NaF+GlF_2=Na_2GlF_4.$$

and similarly with the alumina to form artificial cryolite, Na_3AlF_6. Treating the pulverised fritted mass with boiling water will dissolve the sodium glucinum fluoride, which is soluble at 100° C. to the extent of 28 grams per litre, whereas the double aluminium fluoride is only very slightly soluble. The aqueous extract contains about 1% of silica and 2% of alumina. The addition of boiling sodium hydroxide solution to the extract decomposes the double glucinum fluoride, glucinum hydroxide being precipitated. Copaux claims that this method is capable of securing 90% of the glucina present.

As previously stated, fusion with potash can be carried out at a conveniently low temperature, and furthermore the removal of the silica presents very little difficulty. Besides the sulphates of glucinum, aluminium, and of possible traces of iron, the mother liquor also contains potassium sulphate and sulphuric acid. Various workers have taken advantage of the sparing solubility of alum and have tried to remove the alumina completely as alum. Pollok endeavoured to separate the last trace as alum by adding to the solution an equal volume of alcohol. He found, however, that some glucinum sulphate also crystallised out with the alum (Trans. Roy. Soc., Dublin, 1904, **2**, 8, 139). No definite information appears in the literature showing the extent to which alumina can be extracted in this way. This possibility has been investigated therefore by the author from the standpoint of the phase rule.

In the following considerations, the amount of iron which may be present will be of so small a magnitude as to be almost without influence. Hence it will be disregarded; incidentally, its removal is a matter which presents very little difficulty. Suppose that the free sulphuric acid in the mother liquor has been neutralised with potash. Such a solution would be an example of a four-component system, the components being the three sulphates and water. After concentrating and allowing to attain equilibrium at a fixed temperature, it is possible that either a single solid phase, or two coexistent solid phases, or in special instances, three solid phases may crystallise out together. Including sulphuric acid, the solution will contain five components, and therefore on crystallisation at any temperature, may yield any of the foregoing combinations of solid phases together with the possibilities of four solid phases, should the solutions contain the solutes in certain concentrations. The following are some of the solid phases which may crystallise

▲

from these solutions: alum, potassium sulphate, glucinum sulphate tetrahydrate, aluminium sulphate with eighteen molecules of water, and potassium glucinum sulphate dihydrate.

Before proceeding to investigate to what extent the alumina can be removed in the form of alum, it was considered advisable to learn something about the crystallisation of alum in the ternary system: potassium sulphate, aluminium sulphate, water, and also of the double sulphate of glucinum and potassium in the ternary system: potassium sulphate, glucinum sulphate, water at a suitable temperature. These two systems, therefore, have been investigated (*vide* Britton, Trans. Chem. Soc., 1922, **121**, 983; Britton and Allmand, *ibid*, 1921, **119**, 1463). By referring to the isotherm at 25° of the former system, it will be observed that alum attains equilibrium with solutions having a very extensive range of concentrations of aluminium and potassium sulphates. Moreover, the amount of aluminium sulphate retained in the liquid phase in equilibrium with alum is usually small. In the second system, the field at 25° of the potassium glucinum sulphate is small and the solutions in equilibrium with it contain considerably more glucinum sulphate than aluminium sulphate in the case of the alum field in the previous system. The solubility of aluminium sulphate and of glucinum sulphate in water at 25° are almost equal. Thus it appears reasonable to expect that in the quaternary system—beryllium sulphate, aluminium sulphate, potassium sulphate, water—alum will be the only solid phase to separate at 25° from solutions of a very wide range of concentrations.

In view of this, it was considered unnecessary to work out an isotherm of the quaternary system. It was decided, however, to investigate how far separations could be made when the aluminium and beryllium sulphates were taken in the molecular ratio of one to three respectively, this being the ratio in which the oxides occur in beryl. In measured quantities of water, known amounts of potassium sulphate were dissolved. These amounts were approximately sufficient to produce saturated solutions at 25°. At a few degrees above that temperature, weighed quantities in the above ratio of aluminium and glucinum sulphates were dissolved. these amounts having been arranged to bear some simple relationship to the potassium sulphate already in solution. These solutions were placed in a thermostat at 25° and mechanically stirred until equilibrium was established. Both the liquid and solid phases were then analysed. Table I. gives the results, expressed in molar proportions, obtained.

TABLE I.

Temp. 25° *C.*

No	Liquid phases.						Al_2O_3 extracted %	Solid phase.
	K_2SO_4.		$GlSO_4$.		$Al_2(SO_4)_3$.			
	Taken	Found	Taken	Found	Taken	Found		
1	1	0·236	3	3	1	0·246	75·4	Alum
2	2	1·194	3	3	1	0·203	79·7	"

From these results, it will be seen that almost 80% of the aluminium sulphate can be removed from aqueous solutions in the form of alum. In separation No. 2, the molar proportion of potassium sulphate taken was twice that employed in No. 1. This, however, could only be done by halving the amounts of aluminium and glucinum sulphates taken, as the solutions had been nearly saturated with potassium sulphate before the other two sulphates had been dissolved. Again, the solubility of potassium sulphate in water is by no means great, neither does it increase appreciably with rise in temperature. It appears that increasing the proportion of potassium sulphate results in a relatively greater separation of alum. On the other hand, the solutions become weaker in glucinum sulphate. This will be seen from Table II. which gives the results in weight percentages which are otherwise given in Table I.

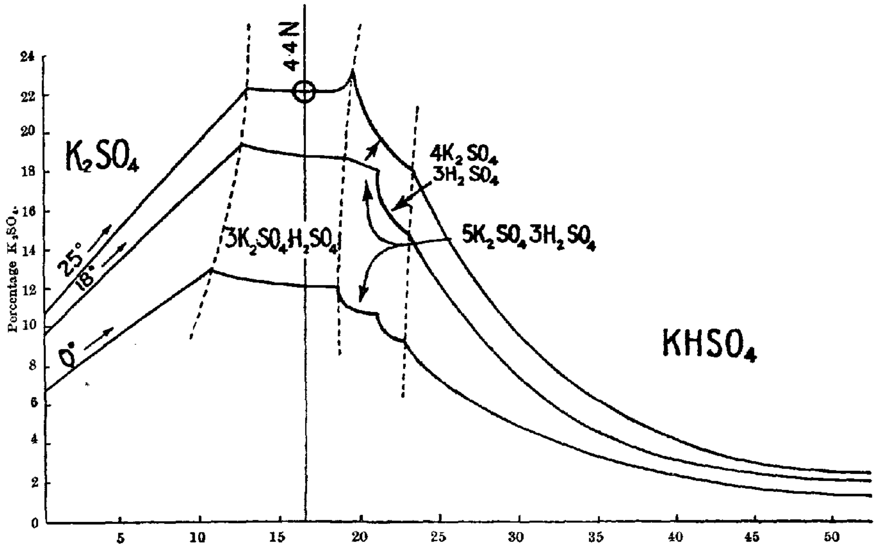
TABLE II.

No.	K_2SO_4.	$GlSO_4$.	$Al_2(SO_4)_3$.	H_2O.
1	1·73	13·24	3·54	81·49
2	5·11	7·74	1·71	85·44

It is difficult to neutralise exactly the free acid in a solution of a glucinum salt. Any excess of potassium hydroxide beyond that required to neutralise the free acid in an aluminium sulphate solution would be indicated by the precipitation of a little aluminium hydroxide, but in the case of an acid solution of glucinum sulphate more potassium hydroxide than that required for the neutralisation of the free acid would have to be added before a precipitate of glucinum hydroxide would be produced. This is due to the peculiarity possessed by soluble glucinum salts of being able to retain in solution comparatively large amounts of glucinum hydroxide; in fact, in a concentrated solution one mol. of glucinum sulphate may cause the solution of two mols. of glucinum hydroxide (*vide* Berzelius, J. Chem. (Schweigger), 1815, **15**, 296; Parsons, J. Amer. Chem. Soc., 1904, **26**, 1433; Parsons, Robinson, and Fuller, J. Phys. Chem., 1907, **9**, 651). For this reason, it seemed desirable to employ dilut sulphuric acid solutions. Before attempting furthe separations, a few determinations were made t ascertain the effect which sulphuric acid of abou 5*N* concentration would have on the solubility o alum, potassium sulphate, glucinum, sulphate, an aluminium sulphate.

It was found that at 25° the solubility of alum i 8·81*N*. sulphuric acid was 6·23 g. of anhydrous alu per 100 g. of solution as compared with 6·75 g. i aqueous solution. In the case of both glucinu sulphate and aluminium sulphate in sulphuric aci solutions, the solubilities are also diminished. A 25°, the solubility of glucinum sulphate in wat is 29·94 g. per 100 g. of solution, whereas in 5 sulphuric acid it becomes 15·91 g. (Britton, Tran Chem. Soc., 1921, **119**, 1970). For aluminiu sulphate Würth found that the solubility fell fro 27·8 g. in water to 20·4 g. in 4·3*N*, and to 15·4 in 6·2*N* sulphuric acid (Z. anorg. Chem., 1913, 7 360). At first, no reference could be found to t solubility of potassium sulphate in sulphuric ac and consequently one solubility determination w made. It was found that at 25° C., 22·04 g. potassium sulphate was dissolved in 100 g. sulphuric acid solution, the percentage of t sulphuric acid being 16·55 and its normality 4· The solid phase in equilibrium with the solution w found to be the acid salt corresponding to t formula, $3K_2SO_4,H_2SO_4$, as the slightly moist so contained 84·0% of K_2SO_4 and 15·7% of H_2S (calculated: 84·2% and 15·8% respectively). It w then found that this compound had been prepa by several workers, and that Stortenbeker (R Trav. Chim., 1902, **21**, 400) and D'Ans (Z. ano Chem., 1909, **63**, 225) have investigated the tern system—potassium oxide, sulphur trioxide, wat at 0°, 18°, and 25°. From the above result, it w be seen that in 4·4*N* sulphuric acid, the solubility potassium sulphate is about double that in wat It was decided therefore to investigate fully t data obtained by Stortenbeker and D'Ans, in or to find to what extent the solubility of potassi sulphate could be increased. These results h been recalculated and curves showing the relati ship between the solubility of potassium sulph and the concentration of sulphuric acid, plott As no data concerning the volumes of the liq phases analysed are given, the concentrations of acid could not be expressed in normalities.

From these curves, it will be observed that those uid phases in equilibrium with $3K_2SO_4,H_2SO_4$ ntain the maximum amounts of potassium lphate. By considering the position of the point rresponding to 4·4*N* sulphuric acid which was tained by the author, it will be inferred that these ncentrations are in the region of 5*N*.



Curves at 0° & 25° C:—calc'd from D'Ans' data.
,, ,, 18°C:—Stortenbeker's data.

These considerations show that whereas the solu- ity of the two very soluble salts, aluminium and cinum sulphates, in sulphuric acid of about 5*N* somewhat reduced, that of potassium sulphate is siderably increased. Again, the small solubility alum is slightly decreased. If these conclusions relatively true when all the salts are present in ution, then it appears that a method has been nd by which the potassium sulphate content may enhanced. From the previous experiments, this ms to be the condition necessary to cause a ater separation of alum. This is confirmed by results obtained from the following separation. 100 c.c. of approximately 5*N* sulphuric acid the e quantities as in No. 2 of glucinum sulphate aluminium sulphate were dissolved, but, taking antage of the increased solubility, the amount otassium sulphate dissolved was doubled. Hence initial solution contained the sulphates of cinum, aluminium and potassium in the molecular portion of three to one to four respectively. r allowing it to attain equilibrium in a thermo- at 25° C. for two days, the composition of the id phase was found to be that given in Tables and IV. (No. 1).

TABLE III.

Molar proportions.

Liquid phase.							
K_2SO_4.		$GlSO_4$.		$Al_2(SO_4)_3$.		Al_2O_3 ex- tracted.	Solid phase.
aken	Found	Taken	Found	Taken	Found	%	
4	3·122	3	3	1	0·124	87·6	Alum
4		3	3	1	0·071	92·9	,,

lower temperatures the solubility of alum in r is considerably less, but the range of solutions luminium and potassium sulphate in equilibrium with alum at 0° C. is of the same order as that at 25°. It therefore seemed probable that a better separation would ensue if the solution were allowed to attain equilibrium at a lower temperature. For the purpose of comparison, a separation was carried out by taking the same quantities employed in the previous separation and allowing the solution to attain equilibrium by standing in an ice-chest for two days, the average temperature of the solution being 2° C. The figures obtained are those, No. 2, given in Tables III. and IV. It will be observed that lowering the temperature resulted in an increased separation of alum, the amount of alumina thereby recovered being 92·0% of the amount taken. The solid phase in each case was analysed and found to be alum.

TABLE IV.

Percentages by weight.

No.	K_2SO_4.	$GlSO_4$.	$Al_2(SO_4)_3$.	H_2O.	H_2SO_4.	Normality
1	10·17	5·90	0·79	62·36	20·78	5·51
2		4·80	0·37		19·74	4·98

Hence in an actual beryl separation, it is advisable to adjust the concentration of the sulphuric acid in the mother liquor, after the silica has been filtered off, to about 5*N* by the addition of potassium hydroxide. Then saturate the solution with potassium sulphate whilst boiling and set to crystallise at a low temperature preferably at 0° C. Although the solid phases obtained in the experimental separations were always alum, it is important that all the solid phases obtained should be examined. This can be done rapidly by dissolving a suitable quantity, dried between filter papers, in water and titrating a sufficiently dilute solution with *N*/10 sodium hydroxide at 100° using phenolphthalein (*vide* Britton, Trans. Chem. Soc., 1922, 121, 983).

By this method the greater part of the alumina can be separated. It is probable that the process may be repeated several times with advantage, but due attention must be paid to the nature of the solid phases obtained.

The glucina left in the mother liquor may be extracted by the addition in the cold of a concentrated solution of sodium hydroxide such that the last drop just causes the re-solution of the precipitated hydroxides, diluting with sufficient water and boiling for forty minutes. In this way the glucinum hydroxide will be deposited in the so-called crystalline form, which can be filtered and washed easily. There will be little chance of any aluminium hydroxide being deposited as the aluminate solution will have been rendered comparatively stable by the large amount of sodium hydroxide required for the solution of the relatively large amount of glucinum hydroxide. The glucinum hydroxide thus obtained may contain a small quantity of iron oxide. This can be removed by dissolving in a little dilute nitric acid and boiling to oxidise the iron. The solution is then cooled, neutralised, diluted to a suitable volume, and saturated with sodium bicarbonate. By raising to and keeping at boiling point for a half minute, stirring well all the time, it will be found that all the ferric oxide and aluminium hydroxide, if any, will be precipitated, leaving the glucina alone in solution (for details, see the papers in the "Analyst," to which reference has been made). The latter process, of course, may be alone sufficient, *i.e.*, omitting the sodium hydroxide process. Unless special care is taken, however, some glucinum hydroxide will be carried down with the aluminium hydroxide and consequently lost.

The author desires to thank the Chemical Society for a grant from its Research Fund.

University of London,
King's College.

VOLUMETRIC DETERMINATION OF PHOSPHATE IN SOLUTION.

BY FRANK W. BURY, M.SC.

It has been shown (Rosin, J. Amer. Chem. Soc., 1911, 33, 1099—1104) that it is possible to determine the amount of sodium phosphate in solution volumetrically by means of silver nitrate if the solution be kept neutral during the addition of the latter:

$$3Na_2HPO_4 + 6AgNO_3 = 2Ag_3PO_4 + 6NaNO_3 + H_3PO_4.$$

Rosin's method consisted in first adding the phosphate solution to an excess of standard silver nitrate, and then rendering the solution neutral by adding a suspension of zinc oxide in water, drop by drop, shaking vigorously for two or three minutes after each addition, and testing for free acid by litmus paper. The precipitate was filtered off and the amount of silver nitrate used found by determining the excess by Volhard's method.

Rosin's method was tested but was found tedious and difficult of execution. Since the zinc oxide suspended in water is barely alkaline, it is almost impossible to attain the neutral point. Excess of zinc oxide vitiates the result.

Copper carbonate was tried instead of zinc oxide, the excess of silver nitrate being determined by titrating the filtrate with potassium ferrocyanide, using the dissolved copper as an indicator. In this case the copper carbonate was added in excess, as it was found to have little effect on the silver nitrate.

When ordinary sodium phosphate, Na_2HPO_4, was used the results obtained by this method were as reliable as those obtained by Rosin's method.

For the acid phosphates, NaH_2PO_4 and KH_2PO_4, the method adopted by Rosin was found to be the better one, although neither method was really good.

Borax was tried as it was thought that the neutral point could then be more readily obtained. The method adopted was to add a measured quantity of the phosphate solution to a measured excess of $N/10$ silver nitrate solution, and run in from a burette $N/10$ borax solution until the liquid was neutral to litmus. The solution was filtered and the excess of silver nitrate determined either (1) by Volhard's method or (2) by adding a measured quantity of $N/10$ potassium chloride and titrating the excess of potassium chloride with $N/10$ silver nitrate, using potassium chromate as an indicator. Of the three methods tried this proved to be the most satisfactory, the results being most reliable. The results of a few titrations with borax are given below.

$N/10AgNO_3$ c.c.	Na_2HPO_4 c.c.	KH_2PO_4 c.c.	NaH_2PO_4 c.c.	$N/10AgNO_3$ used c.c.	Calculated result.
40	10	—	—	17·92	18
20	—	10	—	9·9	9·98
20	—	10	—	8·17	8·175
20	—	10	—	8·40	8·417
20	10	—	—	8·45	8·42
40	—	—	20	25·00	25·00
20	—	—	10	7·51	7·51
40	—	—	20	15·09	15·02

The phosphates were kindly supplied by the British Drug Houses with a statement as to their purity. Their statement was confirmed by finding the amount of P_2O_5 per 100 g. gravimetrically. The correct results were calculated from these data.

East London College,
University of London.

Liverpool Section.

eeting held at the University of Liverpool, on Wednesday, November 22, 1922.

DR. E. F. ARMSTRONG IN THE CHAIR.

Harter Memorial Lecture.

SOME ACHIEVEMENTS OF CHEMICAL NDUSTRY DURING THE WAR IN THIS COUNTRY AND IN FRANCE.

BY WILLIAM MACNAB, C.B.E., F.I.C.

One effect of the late great war was a demand for an unprecedented amount of various explosives and, later on, for many chemicals of curious and unpleasant properties. As I had the privilege of iding and of being closely associated with the construction and running of many of the factories which were erected in this country and had also the opportunity of visiting most of the similar factories in France from time to time, I propose to give a few particulars of some work which was accomplished in both countries.

At first the demand was met by the existing government and private explosives manufactories and the rapid extension of these works, but it was soon seen that the Government must erect many new factories.

Picric acid was the explosive with which most of our shells were filled on the outbreak of war, for TNT had just been officially adopted and the stock of it and means of manufacture were very limited. America came to our aid by sending over considerable quantities of picric acid and TNT while our new plants were being got ready, and the high prices paid for these commodities induced many private manufacturers to start making picric acid —with woefully wasteful methods in the early days.

The first Government factory for the manufacture of TNT was erected at Oldbury on ground belonging to Messrs. Chance and Hunt. The first sod was cut at the end of February, 1915, and exactly three months after, the first ton of TNT was produced and packed ready for delivery. This factory was designed for an output of 250 tons per week and very soon attained and passed that quantity

It was early seen that the supply of toluene from coal tar would be insignificant, and means were adopted for increasing the quantity by stripping the toluene in the gas supplied for heating and lighting purposes.

Another source, however, was also available, namely petroleum from Borneo. The Asiatic Petroleum Company had large distilleries in Holland, where they separated the benzene, toluene, and xylene in the crude petroleum and concentrated them as far as possible by distillation—for it is impossible by that means to separate these aromatic hydrocarbons entirely from the paraffins with which they are associated—and were thus able to produce a spirit containing about 55% of toluene and the balance of light paraffins or petrol. When this mixture was treated with suitable nitrating acids the toluene was nitrated to mononitrotoluene and, after separating from the acid and washing, the petrol could be distilled off, leaving a very pure mononitrotoluene. This compound had been supplied to German dye manufacturers before the war, but, as the Dutch Government would not permit mononitrotoluene to be shipped to England, arrangements were made for the transference of the entire distillery etc. to Portishead, near Bristol, and the Asiatic Company erected plant at Oldbury for the production of mononitrotoluene from their Borneo spirit. Similar plant was also erected by them on a site adjoining the much larger TNT factory, which was later erected at Queen's Ferry.

The manufacture of explosives demands the use of strong acid mixtures containing often only a small percentage of water, and this requires efficient denitration and concentration plant as well as oleum.

The capacity in this country for the production of oleum was very limited and soon oleum became one of the most precious of chemicals. Large quantities were purchased in America, but there were amazing experiences in the case of some shipments from that country, where the drums either were not strong enough or else, owing to the oleum being of a strength which attacked the steel drums, the oleum got loose in the ship. Those who are familiar with that form of sulphuric acid can imagine the task which confronted those of the staff of the Department of Explosives Supply who were sent to the ship when it arrived in the Thames to get its cargo discharged and the bottom of the ship saved from disappearing as sulphate of iron.

Steps were taken at once to erect plant for concentrating sulphuric acid and also for making oleum. As it was impossible at first to get the blocks of volvic lava which are used in the construction of the Kessler and Gaillard plants, owing to the French having reserved all the available supplies for their own use, recourse was had in the first instance to the various cascade systems formed of silicon-iron or silica vessels. These had to be forced to their utmost capacity, and those who had to work them—and the inhabitants living near some of the factories—had an unpleasant time from the acid fumes in the atmosphere in the early days.

The first oleum plants erected were on the Mannheim system in which the sulphur dioxide and air are passed over heated iron oxide, whereby a conversion of about 40% of the sulphur dioxide into sulphur trioxide is effected. The remaining sulphur dioxide and air are heated again and passed over platinised asbestos to effect the final conversion. The chief source of supply came later from Grillo plants which were erected at Queen's Ferry, Gretna, Avonmouth, and elsewhere.

In addition to a dearth of chemicals, it soon became apparent that there was going to be a dearth of chemists to work the new factories which were being erected, due to the patriotic way in which the greater number of chemists of suitable age had enlisted.

Arrangements were made and a large number were recalled from the colours and sent to the existing explosives works, where they got some training preparatory to beginning in the new works. There was also a great dearth of skilled workmen accustomed to chemical or explosives work, but many of these younger chemists became leading process hands and well and intelligently did they carry out their work, with—I am certain—great benefit to themselves in their subsequent careers if they remained in industrial chemistry. The magnificent part that women played in connexion with the manufacture of war chemicals, undertaking often very disagreeable and dangerous work, and doing it well, cannot be forgotten in a general survey of the chemical industrial activities brought about by the war.

An admirable feature of the nation's time of trial was the whole-hearted way in which different manufacturers offered their information and services to the common cause, and one would fain wish that a means could be discovered in time of peace to get more joint effort and mutual help among chemical manufacturers, as one way of best meeting the competition of other countries.

Our own chemical industry received a great stimulus during the war, but it must not be forgotten that this also occurred in other countries, and—apart from Germany—we must reckon on much more competition from more extended and more intelligently conducted chemical manufacture, especially in France and America. It behoves us to take courage from the great things we undoubtedly accomplished, and utilise to the full the experience gained, not falling asleep nor relapsing into old rule-of-thumb ways.

It might be thought that in Government factories erected under the stress and menace of war, where the steadying influence of dividends and shareholders was not at work, the factories would be run on extravagant lines. A careful study, however, of the Second Cost Report, issued by the Factories Branch of the Department of Explosives Supply, will show that yields and costs compare favourably with those of any of the private factories.

Monthly meetings of the superintendents and heads of departments from the different Government factories were held in London, and the results and conditions of working discussed and criticised, and in this way mutual help was given and a healthy spirit of emulation created between the staffs of the different factories, which bore excellent fruit.

A few statistics of the amounts of some chemical materials produced during the war will show the enormous scale on which explosives were made :—

Picric acid	68,500 tons
TNT	238,000 tons
Ammonium nitrate	378,000 tons
Cordite	139,000 tons

Let us look at these materials a little more in detail.

Picric acid.—The method of manufacture of this substance in the early days was carried out most inefficiently. The phenol was first sulphonated in iron vessels, then transferred to small earthenware jars, into which nitric acid was run at a slow rate. During this nitration process copious brown nitrous fumes were given off and allowed to escape into the air and were lost, besides causing an almost intolerable nuisance. With the view of diminishing the latter, the operations were generally so arranged that the nitration process was started in the evening and the brown fumes escaped under cloak of darkness. These conditions passed muster when the output was comparatively small, but as the demand increased, steps were taken to conduct the nitrous fumes to proper absorption towers, whereby a large percentage of nitric acid was recovered.

Although the manufacture of picric acid was chiefly carried out by private firms, a great deal of work was done by members of the Department of Explosives Supply which resulted in improved working, both as to cost and yield.

Finally a process was perfected whereby the nitration of the phenolsulphonic acid could be carried out in large cast-iron pots by means of strong nitrosulphuric acid, thus avoiding the disadvantage of having to use the small earthen nitrating pots on account of the dilute acid hitherto employed for the nitration.

A most ingenious process for the continuous nitration of the sulphonic acid was devised and successfully worked by Messrs. Brookes Chemicals, Limited, at Lightcliffe, near Halifax. The plant consisted of a long and narrow trough about 80 feet by 2 feet by 19 inches deep, made of acid-proof brick and cement, divided into several compartments. The sulphonation was carried out discontinuously the ordinary way, but with only two molecules of sulphuric acid instead of four. The sulphonic acid after dilution was run together with four molecules of spent acid from the process into the first compartment of the trough (6 ft. long). The mixture was heated with live steam to 100 C., and then overflowed into the nitration compartment (64 ft. long). Four molecules of 65% nitric acid ran in at a number of points along the trough, which was covered in so that the nitrous fumes could be collected and carried to absorption towers. The mixture was kept at 100°—110° C. during nitration, and then passed to the end section of the trough (10 ft. long), where the picric acid in fine crystals and the spent acid were cooled by water coils and stirred by compressed air. Thence it was blown at short intervals by means of an air ejector into earthenware filters.

The home production of picric acid increased to 32,000 tons for the year 1917, but afterwards fell off as the quantity of TNT kept on increasing and the various amatols (TNT and ammonium nitrate) —of which it formed a proportion—were employed in preference to picric acid as filling for shells.

As both the strong acid nitration process and Brookes's continuous process were only developed towards the end of the war, comparatively little picric acid was produced by their means. It is satisfactory to see, however, that the manufacture was greatly improved and carried to a high degree of perfection, both in regard to plant and process, as the result of the careful study and experiment devoted to this manufacture. A large works was laid out and partly completed for the preparation of picric acid by the French process, in which sodium nitrate is used direct instead of nitric acid. I shall refer to this process when discussing the work carried out in France, but this factory never came into action on account of the falling off of the demand for picric acid.

Another method of preparing picric acid was also successfully worked, chiefly by Messrs. L. B. Holliday and Company. It consisted in the conversion of dinitrophenol into picric acid. This dinitrophenol was formed from benzene, which was first converted into dinitrochlorobenzene (a product manufactured by the United Alkali Company before the war). On treating this substance with caustic soda it is converted into sodium dinitrophenolate and—on further treatment with acid—into dinitrophenol, which can be nitrated to picric acid in cast iron vessels by means of strong acids. This process had the advantage of enlarging the output of picric acid, for the supply of phenol from tar, from which to make the picric acid, was limited.

A considerable quantity of synthetic phenol was made in this country also, chiefly by the South Metropolitan Gas Company and by Brunner, Mond and Company, and it was instructive to see how readily an "inorganic" firm like Brunner, Mond and Co. successfully turned themselves into most efficient manufacturers of an organic material by a complicated process. This manufacture, however, never attained anything like the large output reached by the French owing to the gradual disus of picric acid as a charge for shells.

When the war began comparatively little TNT was made here, and the total manufacturing output capacity was only about 20 tons per week. The procedure involved long periods of nitration. Thanks to a visit to France, where a process of nitrating toluene direct to TNT in one operation was seen at work, it was decided—when laying out the works at Oldbury—to aim at much quicker nitration than was being attained here, by providing much more efficient mixing and cooling. Processe had also been carefully worked out at the Research Department, Woolwich, which enabled the Oldbury works to be successfully started right away, and the full estimated output reached in a very shor time.

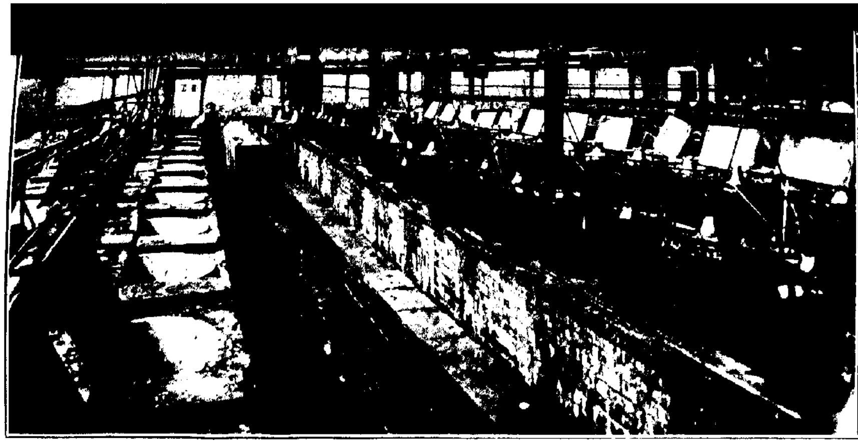


Fig. 1. Pot process. 80 galls.

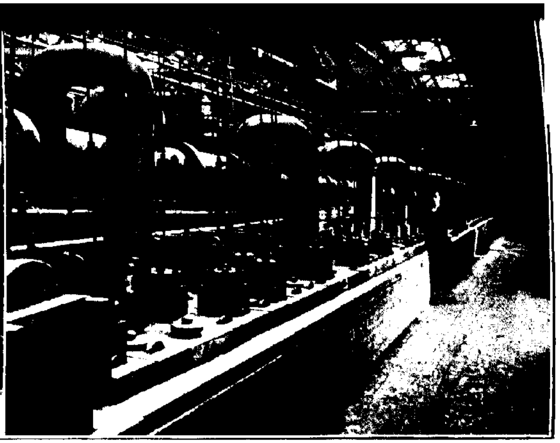


Fig. 2. Nitration plant. Centre view commencing end in background.

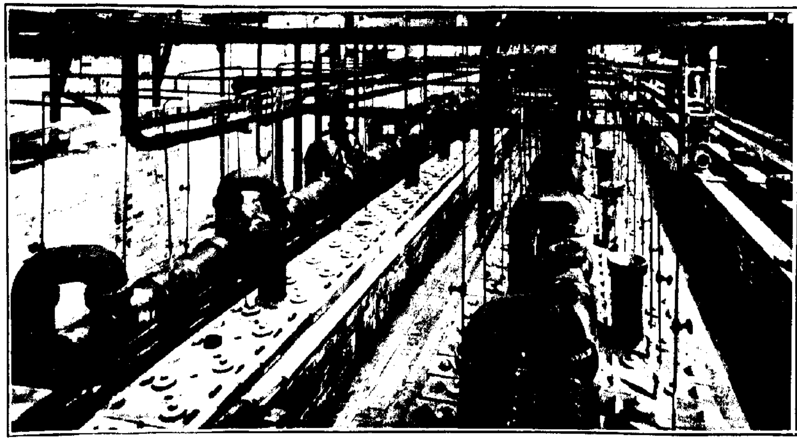


Fig. 3. Nitration plant. Centre view.

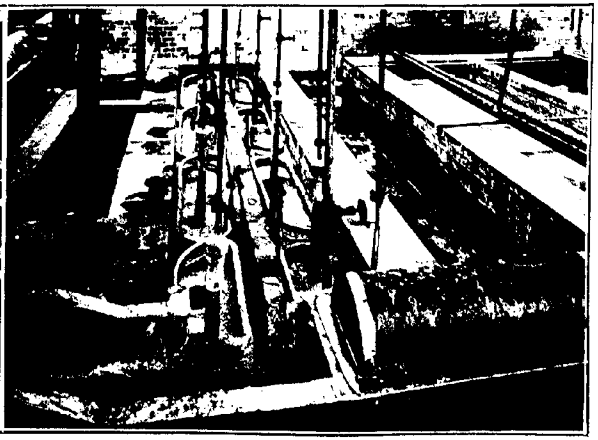


Fig. 4.—Picric coolers, after the nitration.

The largest works for making the TNT were ·ected at Queen's Ferry, near Chester, where the ıtput reached about 100 tons of TNT per day. his large output, however, was only attained by ıe most careful forethought and expeditious modes working and excellent "team" work between l the departments involved. For such an output TNT about 600 tons of fresh mixed acid had to prepared, 600 tons of spent acid had to be enitrated, 400 tons had to be concentrated, and ıen there was the production of 120 tons of nitric cid, both for the TNT and for the nitrocellulose hich was also produced there. There was also a rillo plant which made 250 tons per day of SO_2. he keeping of a proper balance of these enormous uantities of acids in their various stages was work f no mean order, and it may be claimed that the ystem of preparing the mixed acids worked with regularity and accuracy that left nothing to be esired.

The nitric acid and water content of the acid for ıe nitration of cotton had to be within limits of ·2%.

I think that the most outstanding feature of the ıanufacture of TNT, as carried out in the Government factories, was the very great reduction of the ime occupied in nitration. Before the war the ctual time of nitration for the three stages in hich the process was generally carried out was bout 40 hours, whereas afterwards it was reduced) about 10 hours, thus permitting a much greater utput from the plant.

A very ingenious system of continuous countercurrent washing of the TNT was devised at Oldbury y Holley and Mott and adopted elsewhere. he same principle was also applied there to the itration of MNT to TNT, so that there was a continuous output of washed TNT in the one case, and n the other crude TNT from one end of the plant nd spent acid from the other.

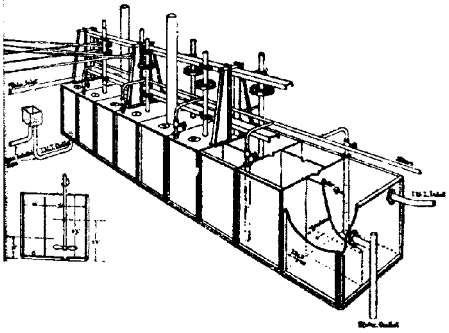


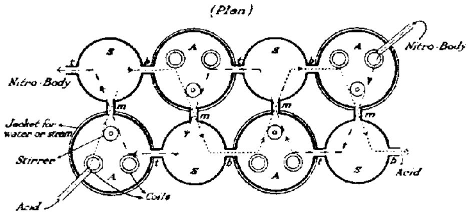
FIG. 5.

The continuous washer consists of a series of large d small compartments communicating with each ıer by specially placed openings (Fig. 5). In the ge compartments stirrers are fixed which keep e contents well mixed. The molten TNT enters e first large compartment, where it is mixed with sh water coming from the small compartment, e emulsion passing through a series of perforations o the small compartment. In this, where there no agitation, the TNT sinks to the bottom and ws forward, through an opening in the bottom the dividing plate, into the next large compartnt, where it is agitated with less acid water. e water flows from the small settling compartnt through an opening, at a higher level, in the e of the end compartment to waste, or from the ıer small compartments counter current to the T to the next large mixing compartment. Clean water enters the large compartment at the other end of the plant, meeting the well-washed TNT, which has travelled counter current to the water through the compartments where the TNT and water are successively mixed and allowed to separate.

The nitrating plant is constructed on the same principle, the compartments, however, consisting of separate cylinders connected at suitable levels as indicated on Fig. 6.

Diagram showing Counter Current Flow in Continuous Nitration Plant.

(Plan)



S-Separator A-Agitator t-Connection near top
m-Connection half-way up. b-Connection near bottom.

FIG. 6.

A system of purification of TNT by means of sodium sulphite, for which we are indebted to the French, was put into successful operation. It depended on the fact that, when crude TNT is allowed to crystallise, the crystals are very nearly pure TNT, the impurities being concentrated on the surface of the crystals. As first devised in France, the molten TNT was allowed to cool slowly in shallow pans and this toffee-like material was broken up and then washed with sulphite solution. It was subsequently found that, if molten TNT and water were allowed to cool while being constantly stirred —the TNT separated out in fine crystals—on adding sulphite solution to this magma, the impurities were dissolved and small crystals of TNT of great purity could be separated by filtration and washing with water.

At first TNT was not considered by the Home Office to be an explosive within the meaning of the Act and could be used without the usual restrictions of the Explosives Act. This belief undoubtedly resulted in greater expedition in the production of the explosive when it was so greatly needed in the early days and possibly was an advantage. It was not long, however, before there were unpleasant indications that it was not the well-behaved substance it was formerly considered to be.

There is still much to be learned about TNT. Generally speaking, it is a very stable substance, not easily brought to explosion. It has been chipped by hammer and chisel out of tanks and vessels in which it had solidified without accident, and yet a violent explosion has occurred during the removal of the plug of an old cock, which had stuck, through which molten TNT had passed, although it had been steamed to free it from TNT.

Large quantities have been known to burn without exploding, but, unfortunately, several instances occurred in which fire led to most disastrous explosions of TNT.

The freedom from serious explosions at the Government factories was matter for much thankfulness.

In addition to explosion risks, considerable trouble was caused at first to the health of the workers from the injurious action of the TNT. Some individuals were much more easily and adversely affected than others, indeed some were quite immune to the action of the nitro-compounds. By careful selection of the workers and attention to health and cleanliness, their health was soon kept in excellent condition. It is not easy to get workers, male or female, to take simple precautions and avail themselves of the means provided for protection against noxious fumes or dusts; however, patience, sympathy, and explanatory information, do much in leading them into good and healthful ways of working.

The manufacture of sulphuric and nitric acids developed rapidly as the demand for more and more explosives increased. At first the disposal of the nitre cake was effected at Gretna, by mixing it with water and running it into the sea. At Queen's Ferry, it was sent in trucks and dumped into the sea on the Welsh coast. Soon, however, the necessity of conserving the sulphuric acid arose and nitre cake was utilised in many industries instead of sulphuric acid. Two methods were adopted of producing the bisulphate in more convenient form than broken cake. One consisted in running the molten bisulphate from the retort into large, shallow, circular pans, in which ploughs, attached to radial arms, revolved. As the bisulphate cooled and began to crystallise, it was kept from solidifying in one mass and the friction of the crystals on each other resulted in a fine, dry powder being produced, which was easy to pack and convenient to use. The other method consisted in allowing the bisulphate to flow from a pipe, subjecting the molten stream to a strong blast of air, which atomised and chilled it, producing a fine powder.

The production of sulphuric acid and oleum was carried out on a great scale. At Queen's Ferry, 250 tons a day of SO_3 was made by the Grillo process, a portion being dispatched to other factories.

The average monthly production of sulphuric acid (as 100% H_2SO_4) for the three months Dec., 1916—Feb., 1917 was 114,700 tons. Of this 17,000 tons came from contact plants. Explosives absorbed 50,600 tons, sulphate of ammonia 21,200 tons, and superphosphates 14,500 tons.

Oleum was also produced by the Tentelew and Mannheim plants, but by far the largest amount came from the Grillo plants at Queen's Ferry, Gretna, Avonmouth, and Greenwich, also the most economical working.

An interesting development of the demand for lead burners was the rapid supply of competent operatives. Lead burning had been a somewhat close craft, and comparatively few were initiated into its inner mysteries.

One of the best and most experienced burners undertook the teaching of candidates, and before long there were sufficient capable lead burners for all requirements. Advantage was also taken of experienced men in Australia, and several of the complicated leaden nitrators for nitroglycerin, all complete for use at Gretna, were sent from Melbourne.

Many chemists and engineers came from Australia and other colonies and played important parts in the factories, and have now returned with much useful knowledge and experience which should bear good fruit in their home lands. Let us hope they have also carried back the conviction that the old country is not so effete as it may have sometimes appeared when viewed from afar through the telescope of ignorance or imperfect knowledge.

The manufacture of M.D. cordite, the regulation propellant explosive, involved the use of acetone. The stock of this essential solvent was small, and supplies had to come from overseas and were uncertain and inadequate. R.D.B. cordite was accordingly evolved at the Research Department, Woolwich, and made at Gretna and elsewhere. It was necessary to produce a propellant which would give the same ballistics as M.D. cordite for the same size and weight of charge, so that existing cartridge cases, rifles, and guns could be used without alteration.

To those acquainted with the interdependence of chemical composition and physical state and form of a propellant and its ballistic results, it will be recognised that it was no mean achievement during the rush and stress of war to produce an explosive which did its work so admirably.

R.D.B. cordite was composed of nitroglycerin, "soluble" nitrocellulose, and mineral jelly, whereas M.D. cordite contained "insoluble" nitrocellulose or guncotton. This enabled ether-alcohol instead of the scarce acetone, to be used as the promoting solvent or gelatiniser. Alcohol from the home distilleries and the colonies was used and much whisky was held by the Government in case it might be necessary to resort to it for the alcohol it contained.

A large plant, which made 75 tons a day of ether, was erected at Gretna on the design of Barbet, of Paris, which worked excellently.

A striking instance of the pluck and presence of mind of a girl worker occurred in the ether factory. She was filling a can with ether from a large tank, when it burst into flame; before running away, she managed to shut off the cock delivering the ether, and thus prevented the development of a serious fire.

The manufacture of a satisfactory nitrocellulose for R.D.B. is much more difficult than the production of guncotton for M.D. cordite; not only must the percentage of nitrogen be kept within the limits of ±0·1%, but it must be perfectly soluble in ether-alcohol, and the solution must have a certain viscosity. The first two conditions are mainly dependent on the composition and temperature of the nitrating acids, and can be steadily maintained. This involves great accuracy in preparing the mixed acids. When it is remembered that the content of nitric acid and water must not vary more than ±0·2%, it will be realised that the greatest credit is due to the chemists who devised and controlled the excellent system of acid mixing and maintaining the balance of the huge quantities of acid being made, mixed, denitrated and concentrated.

The third condition, the viscosity, however, is greatly influenced by the character of the cotton. This led to much investigation and experimentation, and it was only after the effects of the preliminary treatment of the cotton waste at the mills had been carefully studied and standardised that uniformly satisfactory nitrocellulose and R.D.B. could be regularly produced. Thus the introduction of R.D.B. led to a much better knowledge of the properties and preliminary treatment of cotton.

A large plant for refining 40 tons per day of crude glycerin was erected at Gretna under the supervision of Mr. van Ruymbeke, and worked excellently.

Before America came into the war, and when it was being realised that the supply of glycerin might not be sufficient to meet the demand, the erection of a large factory to produce a nitrocellulose propellant was begun at Henbury. On America definitely joining the Allies, the work on this factory was discontinued—a wise decision, seeing that finished powder could be imported from America in about one-fourth of the tonnage required for the importation of the equivalent raw materials, nitre, sulphur, pyrites, and cotton, and the destructive activities of the U-boats were still a serious menace.

For the concentration of sulphuric acid, the chief feature was the extensive use made of the Gaillard tower. As the volvic stone use by Gaillard could not be procured at first, many of these towers were constructed of acid-proof tiles, which withstood the heat and acid fumes excellently. At Queen's Ferry there were 16 towers 9 ft. diam. × 50 ft. in height, and when the maximum output was obtaining, even the few grains of SO_3 per cub. ft. of gas discharged to atmosphere, permitted by the Alkali Act, became a serious nuisance to the workers in the factory, and also to the neighbourhood. After some time, Cottrell's electrical precipitator was installed and completely stopped the nuisance, besides recovering about 25 tons per day of 50% acid.

There was a curious evidence of the comparative stability of DNT. The spent acid from the TNT manufacture always contained some DNT in solution. A portion separated out during denitration and was recovered, but the acid sent forward for concentration still contained some DNT. It was undoubtedly chased out of the sulphuric acid in the Gaillard towers, but turned up unharmed in spite of the electric strain of 80,000 volts, in the Cottrell precipitator where some was recovered, and finally it formed an incrustation on the exit stack and fell down inside from time to time and was collected.

Another important manufacture which attained large proportions was that of ammonium nitrate.

At the beginning of the war the high explosive shells were filled either with picric acid or with TNT. To those of us who were acquainted with the strength and merits of the ammonium nitrate class of explosives, the employment of a large percentage of ammonium nitrate, along with TNT, seemed the obvious way of producing more explosive from the limited amount of TNT available. The War Office, and especially the Admiralty, were very conservative, and did not approve of an explosive containing a hygroscopic ingredient. Had there been a less strong man than Lord Moulton at the head of the Department of Explosives Supply, the merits of ammonium nitrate explosives would not have been so quickly ascertained and utilised. He insisted that they should be studied as the only means of ensuring an adequate supply of explosives, and thanks to the diligent work of the Research Department we soon had the various amatols (mixtures of ammonium nitrate and TNT). Large quantities of ammonium nitrate were procured from Norway. Brunner Mond and Co. soon entered the lists, and before long were turning out large quantities of ammonium nitrate by three different processes at their own factories and at others which they erected for the Government. The first was a modified ammonia soda process in which sodium nitrate replaced the chloride. Then calcium nitrate, at first obtained from Norway, was treated with ammonium carbonate, the reaction being quantitative. Afterwards, the calcium nitrate was produced by the Ammonia Soda Co. and by Brunner Mond and Co. from calcium chloride and sodium nitrate. The largest quantities were, however, ultimately produced by the double decomposition of ammonium sulphate and sodium nitrate.

It is so easy to write the equations for these reactions and so difficult to carry them out. There was ample scope for the phase rule, and fortunately one of its brilliant exponents was on the spot in the person of Captain F. A. Freeth, who, by the aid of an elaborate series of curves and diagrams, was able to get in full sympathy with all the phases of the different substances and bring them completely under control.

A large factory was erected at Swindon by the Government for making ammonium nitrate from sodium nitrate and ammonium sulphate, and it turned out about 2000 tons per week.

Many other chemical manufactures were started for the first time, or existing ones increased and modified, but it is not possible to deal with them here. I wish, however, to say a word about the skill and real heroism of those who were engaged in devising and working the processes for making poison gases. Some were killed, some permanently injured, and nearly all suffered abominably, yet they carried on in the most self-sacrificing manner. Truly the chemists did not fail the nation in its time of need!

France.

Now, as to some of the achievements of chemical industry in France. Towards the end of 1914 I had occasion to visit France when the seat of the Government had been transferred from Paris to Bordeaux. There I found heads of departments carrying on the administrative work of the country and a great war under most trying conditions. Some in hotels, in the University, schools, barracks, and other public buildings. Think what it must have meant, to transfer hurriedly all the working papers and documents for carrying on the affairs of a great country and restart the machine again. I shall never forget the impression I got of the grim determination to hold on, the same spirit that inspired later the immortal words at Verdun: "Ils ne passeront pas."

The most cordial relations developed between the Ministère des Munitions and our own Department of Explosives Supply, and members of the staffs exchanged visits and inspected the different factories from time to time. They communicated information freely, and helped us in many ways, and we reciprocated to the best of our ability. I paid many visits and followed the growth and operating of many factories with the greatest interest. We were justly proud of what we were accomplishing here, but I always returned from France somewhat chastened and full of admiration and astonishment at what they were accomplishing. Here we had our difficulties with "priorities" and other hindrances to rapid constructive work, but we had not, like the French, many of our largest engineering and constructional works in the hands of the enemy; and yet—in spite of such embarrassing difficulties—they made magnificent efforts and achievements.

In 1914, I visited the large Arsenal near Lyons and saw shells being filled with picric acid in a way which would have made our officials' hair stand on end!

In a very extensive building, there were erected a large number of glycerine baths in which cans of picric acid were stood until the acid was melted ready for pouring into the shells. The baths were heated by open coke fires and the building was thronged with workmen. As the officer in charge truly said: "With the enemy on our doorstep and our soldiers crying out for ammunition, risks must be taken in factories which would not be thought of in peace time." It is satisfactory to be able to record that no disaster occurred in that particular department.

Immediately after returning from this visit I went to Woolwich Arsenal and was much impressed, possibly dismayed, with the leisurely manner in which shells were being filled with picric acid there. The fact of a large and important part of one's country having been invaded and occupied by the enemy accounts for many apparent anomalies in the way in which French and English regarded many things during the early days of the war. Perhaps it took us a little longer to get into our stride, but we soon had no occasion to be dissatisfied with our output.

In France, the manufacture of explosives—both for military and civil purposes—was practically a monopoly of the State. It was conducted by the "Service des Pourdes et Salpêtres," which was established on 13 Fructidor in the year V., otherwise August 30, 1797. This Department had at the beginning of the war 10 factories, two for nitrocellulose at Angoulême and Moulin Blanc, five for propellant Poudre B, at Le Pont du Buis, Ripault, St. Médard, Toulouse and Sevran-Livry; and three for disruptive explosives at Esquerdes, Vonges and St. Chamas. About 6000 persons were employed in these factories at first and this number rose to 120,000 in 1917.

Workers employed in explosives factories from 1914 *to* 1918.

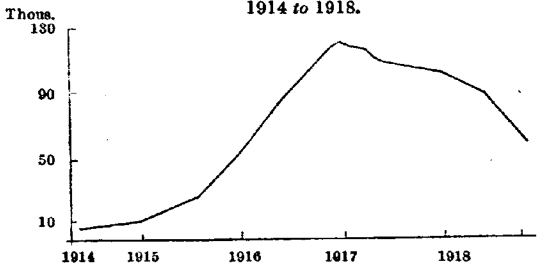


FIG. 7.

The French were not unprepared in regard to explosives for a great war. The general staff had elaborated a plan during peace in which it was provided that there should be capacity for producing 24 tons of propellant powder per day. The actual capacity of the Government factories on the outbreak of war was about 22 tons a day, and there was a stock of 750 tons in the country, so that the anticipated requirements of 24 tons per day could be easily supplied until the factories could bring up their outputs sufficiently. The facilities for making high explosives were very limited, but sufficient stocks had been accumulated to serve for the few months during which it was believed a great war could last, and it was not considered necessary to have available factories for these explosives.

Almost from the first, however, it was seen that the consumption of all kinds of explosives was going to exceed anticipations, and the Battle of the Marne led to greatly increased demands.

Even the greatest difficulty was experienced in keeping up the supply of powder for the Army. The Navy assisted by giving up many guncotton torpedo charges, which were sent to the factories to be broken down and worked up into powder. During the scare which followed the explosion on the "Liberté," large quantities of powder had been sunk in Toulon Harbour. This powder was dredged up, found to be stable enough, and was re-worked, and —in one way and another during the trying first months of storm and stress—the troops were kept supplied.

In addition to enlarging existing factories, two entirely new works were erected at Bracqueville, near Toulouse, and at Bergerac to produce 100 tons and 60 tons per day respectively of Poudre B. These works were finely laid out and constructed, reinforced concrete playing a leading part in the building, and also in the chimney stacks.

Large numbers of orientals from Annam and Cochin China, and natives from Algeria and Senegambia, were employed in the explosives works. Special arrangements for their housing and oversight had to be made, thus causing additional work. The provision of a competent staff for the different factories was no easy matter, for there was no large and well-developed organic chemical industry in France, from which experienced men could be obtained; however, professors, teachers, and many others were enlisted, and the factories were successfully brought to the desired output.

During repeated visits it was intensely interesting to see the rapid growth of these factories and often to learn, on a succeeding visit, that what had previously seemed a very large output was then being doubled.

Angoulême is the largest nitrocellulose factory, and was equipped with the Selwig nitrating centrifugals and the Thomson displacement nitration process. Pending the arrival of new plant for these excellent processes, recourse was had to the old Abel small pot process, which could be easily and quickly installed, with all its inconvenience of much labour and noxious fumes.

Nitrocellulose.

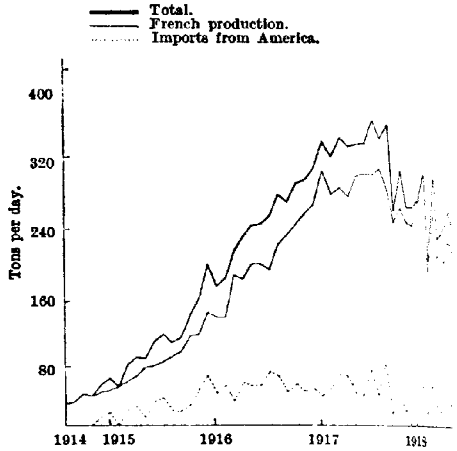


FIG. 8.

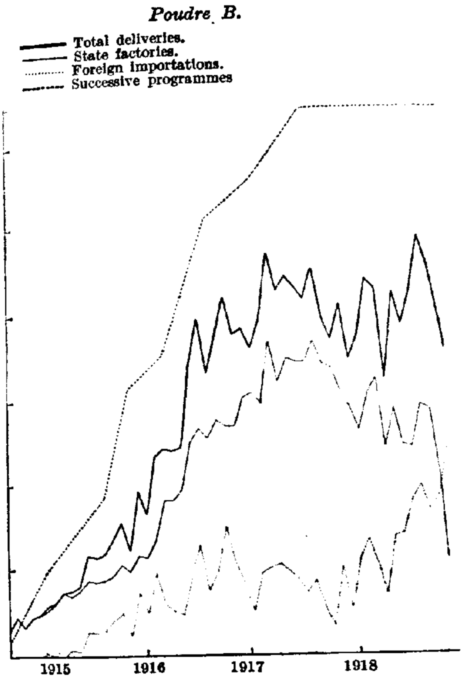
The manufacture of the French Poudre B requires a large amount of alcohol as such and after conversion into ether. Here, again, many ingenious methods were adopted for eking out the precious liquid. Many of the large distilleries were in the occupied territory, and this added much to the difficulties of supply. A useful source of alcohol was found in the quantities of alcoholic extracts of absinthe, which had been impounded owing to its consumption having been prohibited recently. Attempts were made to produce alcohol from the large quantities of cider fruit available, but were unsuccessful until it was discovered that by mixing a certain proportion of beetroot with the apples fermentation could be carried out satisfactorily.

In making the French powder a mixture of "insoluble" and "soluble" nitrocellulose is gelatinised by means of ether-alcohol and then pressed out in the form of ribbon which is subsequently cut into suitable lengths or strips or small squares. The ribbon had to be dried to get rid of the solvent and at first a considerable quantity of ether-alcohol was recovered by drawing the air, laden with the solvent, from the drying chambers through a carbonic acid refrigerating system. Later on a greatly improved recovery was obtained by absorbing the ether-alcohol in the air in cresol in suitable scrubbers according to Bregeat's patent.

The output of Poudre B. reached as much as 370 tons per day, and the total production of this powder in France, during the war, was 306,700 tons, whilst 117,000 tons was imported from America.

Picric acid.—The production of picric acid became one of the chief necessities and numerous proposals were put forward to procure an adequate supply.

In Germany before the war, nearly all the picric acid was made from chlorobenzene, as they had plenty of chlorine from their electrolytic processes. No chlorine was available in France, but—not to ave out any possible means of increasing their ipplies—1000 tons of chlorine was ordered from merica. It was never used for picric acid, as the rst gas attacks in April, 1915, had occurred, and is chlorine was handed over to the Service du latériel Chimique de Guerre for experiment and ibsequent use in counter gas attacks.



Poudre B.

FIG. 9.

The chief source of the raw material for picric acid was the synthetic phenol made from benzene. The amount of phenol available from coal tar was small, and the French had obtained most of the phenol they required from Germany. One firm, however—the Société Chimique des Usines du Rhône—was making about 1 ton of synthetic phenol per day before the war at St. Fons, near Lyons. Arrangements were made successively for increasing the output to 10, 15, and 30 tons per day, and finally the company erected for the Government a new factory at Peage de Roussillon, further down the Rhône, which produced 75 tons per day in 1917. This was a magnificent factory, and we in England benefited much in carrying out our processes for making synthetic phenol from the greater experience of the French, who freely gave information.

The process consisted in the sulphonation of benzene with strong sulphuric acid in the usual way. Later on Guyot improved this stage greatly by passing the benzene in vapour form into acid, heated to 100° C., and condensing any unabsorbed benzene and the water which had been formed by the reaction. After drying, the unabsorbed benzene re-entered the cycle. By this method nearly all the sulphuric acid was utilised, thereby effecting considerable economy in acid, lime for neutralisation, and attendance.

The product of sulphonation was diluted with water and neutralised with lime, then treated with sodium sulphate or carbonate to convert the calcium benzenesulphonate into the sodium salt. The sodium benzenesulphonate solution was separated by filtration from the calcium sulphate or carbonate, and then concentrated *in vacuo* to crystallising point. The crystals were then heated until the water of crystallisation was driven off.

A great improvement in this stage was ultimately introduced. To the product of sulphonation, which contained a considerable amount of free sulphuric acid, sufficient normal sodium sulphate was added to form sodium benzenesulphonate, which, under certain conditions of concentration and temperature, crystallised out almost completely from the solution. This method avoided the neutralisation with lime and expensive evaporation of the sodium benzenesulphonate solution. The yield was not quite so high as by the old method, but this was much more than counterbalanced by economy in lime, fuel, time, and labour. This method, along with the process of sulphonation of benzene in the state of vapour, marked distinct progress in the manufacture of phenol.

The sodium benzenesulphonate, after fusion with caustic soda and extraction with water, gave a solution of alkaline phenate and sodium sulphite which was precipitated. The sodium phenate solution was decomposed by sulphuric acid, which set free the phenol, which was decanted and distilled under vacuum, while the sodium sulphate in solution was recovered after concentration and crystallisation, and used again in the earlier stage of the cycle. Altogether, from Government and private factories, 200 tons per day of synthetic phenol was obtained.

The manufacture of picric acid attained large proportions. Private factories ultimately turned out about 100 tons per day. New Government factories for making picric acid were erected at Sorgues near Avignon, Bassens near Bordeaux, and Oisel near Rouen, their joint output being about 180 tons per day. The works at St. Chamas, near Marseille, were also greatly extended and produced a large amount of picric acid and other explosives.

The process almost invariably followed in France consisted in first sulphonating the phenol, then running the acid sulphonate into a mixture of sodium nitrate and dilute nitric acid contained either in small earthenware nitrating pots—each mounted on a small trolley—or else into large cast iron pots lined with acidproof bricks and cement. The large cast iron pots were connected permanently to condensing and absorbing towers and the small pots, when charged with nitre and dilute nitric acid, were moved to stations and connected to absorbing towers. The sulphonic acid was run in, and a current of air blown through the contents served to control the reaction, remove the fumes and promote the formation of the picric acid in fine crystals. When the evolution of fumes ceased, after about 3 hours, the pots were removed to a distance and allowed to stand for 14 hours, when the nitration was complete. The crystals of picric acid were separated by filtration, washed and dried.

This process has the advantage of not requiring plant for the manufacture of nitric acid, the dilute nitric acid above referred to coming from the condensation and oxidation of the nitrous fumes evolved. On account of being directly associated with the sodium nitrate in the nitrating pot, the picric acid has always a higher ash content than when made with nitric acid. This was looked on with disfavour by our authorities, although the French found it unobjectionable. Special relaxation in the specification was contemplated had the factory erected in England for making picric acid according to the French practice come into operation.

TNT was also made in France in considerable quantities, but this manufacture never attained the proportions reached in England. At first the toluene was nitrated direct to TNT in one operation, requiring about 10 hours in the nitrating vessels; this enabled a larger output to be obtained from the plant, which was a great advantage in the early days, but this process involved a larger consumption of acid and was abandoned when more plant could be procured. A three-stage process was generally followed afterwards.

In order to increase still further the supply of explosives endeavour was made to nitrate the mixtures of *o*-, *m*-, and *p*-xylenes contained in the Borneo spirit, but this gave a most unsatisfactory product, both from the manufacturing and usage points of view. The French, however, studied the problem and finally evolved a good process which produced an excellent explosive substance very similar in explosive character to TNT.

The xylenes in the spirit existed in three isomeric forms, *m*-xylene being the only one which gave a suitable trinitroxylene. As it was impossible to separate these xylenes by physical methods, the separation was effected by treating the Borneo xylene spirit with 94% sulphuric acid. Under suitable conditions of time and temperature, only the *o*- and *m*-xylene are sulphonated. After washing, the *p*-xylene and the aliphatic hydrocarbons are distilled off and the remaining *o*- and *m*-xylenesulphonic acids are heated to 130° C. with dilute sulphuric acid, when the *m*-xylenesulphonic acid is decomposed and the *m*-xylene driven off, the sulphonic acid of *o*-xylene not being split up until 160°. This reaction with hot dilute sulphuric acid involved the use of silicon-iron vessels or other acid-resisting materials. Considerable success was obtained by painting ordinary cast-iron vessels with a special acid-resisting composition.

Nitro and nitrated explosives.

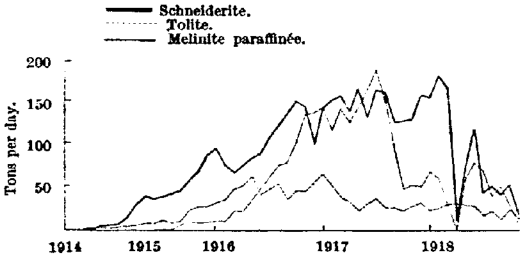


FIG. 10.

Arrangements had been made in England for making *m*-xylene in this way, but were not carried out as the supply of toluene proved sufficient for our needs.

Chlorate and perchlorate explosives.

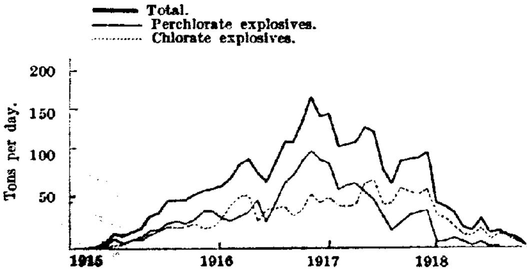


FIG. 11.

The manufacture of chlorates and perchlorates was carried out on a considerable scale at Chedde and elsewhere to the extent of 80 tons of sodium chlorate and 73 tons of ammonium perchlorate per day. Explosives made from these compounds as base, being too sensitive for use in high-velocity shells, were chiefly used in hand grenades and trench mortars, also for aeroplane bombs.

At Angoulême "Yperite" or mustard gas was made according to a process devised by the Société Chimique des Usines du Rhône. The output contemplated was 24 tons per day; at the Armistice 6 tons per day was being made from 2 units, two others were ready to start and the full output would have been reached by the end of the year. Angoulême also turned out 70 to 80 and Bassens 25 to 30 tons per day of nitrogen peroxide, which formed the base of the explosive "anilithe" used for filling aeroplane bombs. Like us, the French found themselves embarrassed by large quantities of mustard gas after the armistice, and much was taken to sea and drowned.

The supply of oleum soon proved insufficient, and large quantities were imported from America until new plants were erected and brought into operation. One oleum plant at Thann, in Alsace, was dismantled while under fire and successfully removed during the night and erected and re-started at St. Denis.

Consumption of 66° *sulphuric acid and oleum, January* 1915 *to October* 1918.

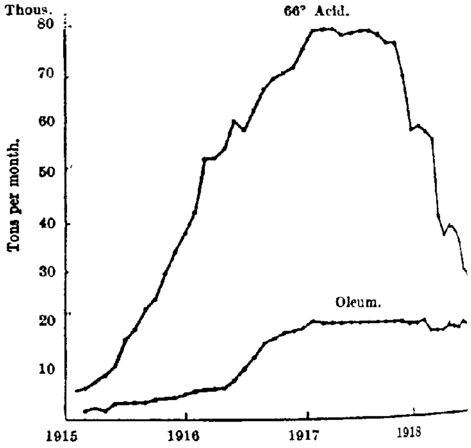


FIG. 12.

The manufacture of nitric acid from saltpetre was nearly always carried out according to the Valentiner process. The French seemed to be able to procure much larger and better earthenware plant than we could make. It is interesting in this connexion to recall a visit to the celebrated porcelain works at Sèvres, where were seen many of the most skilled makers of the delicate porcelain articles busily moulding large vessels for different kinds of chemical work.

The French, however, did not consider it safe to rely entirely on Chile saltpetre for their nitric acid requirements. There was a small factory at Rôche-de-Rame working the Pauling process and producing 2 tons per day of 50% nitric acid. This was taken over by the Government; later, plant was erected by the Norwegian Company to work the Birkeland and Eyde process at Soulom in the Pyrenees, where the Midi Railway Co. had erected a large hydroelectric power station and could offer 12,000 kw.-h. for this purpose. About 300 tons, calculated as strong nitric acid, was delivered per month from this works, either as nitric acid or ammonium or sodium nitrates, as required.

A large plant was also erected at Angoulême for the oxidation of ammonia, derived from cyanamide, by the Kuhlmann-Ostwald process.* Arrangements were made for the supply of 3500 tons of cyanamide per month and the plant was in full work in 1917.

The submarine menace becoming still more serious, it was decided to create new works capable of producing 500 tons of nitric acid and 150 tons of ammonium nitrate per day. This involved a supply of 1000 tons of cyanamide and electric energy of 125,000 kw.-h. This power was found in the Pyrenees, the Alps, and centre of France, and provision was also made for supplying a reserve amount from steam.

At the time of the armistice two of the new works had begun to manufacture and the others were nearly completed.

With all the plant in operation, France would have been independent of outside supplies of nitre. In this branch of chemical industry they got much ahead, and still remain far in advance of us.

And here I wish to express my thanks to my friend, Professor Haller, of Paris, for permission to draw on the information contained in his two papers published in the Bulletin de la Société d'Encouragement pour l'Industrie Nationale, November/December, 1920, and for the loan of his slides, and to members of the Service des Poudres et Salpêtres, who have kindly helped me from time to time.

In this sketch I have endeavoured to indicate the really magnificent efforts that were made in this country and in France in chemical industry during the war, and the enormous outputs of many and varied chemical products. As achievements of chemical industry, all concerned may regard them with pride.

And yet it is a bitter thought that all this intensive effort and expenditure of brains and intelligence resulted literally in smoke and destruction of life and property that is truly appalling. As chemists, we know better than most people the awful possibilities of suffering and destruction another great war would entail, unrestricted as it would be in every sense.

It seems to me that it is especially laid on us to bear this in mind and combat every tendency which might lead to war, and endeavour to prevent mankind from entering on such a suicidal course.

Fortunately there is a more cheerful and hopeful way of looking at these chemical activities. Chemical industry, in nearly all its branches, received a great stimulus from the war. A very large number of chemists were brought into close contact with industrial work, and have gained a valuable experience in factories, and have become practically acquainted with the construction of plant and running of chemical processes, and—in many instances—the *coup de grâce* has been given to rule-of-thumb methods.

We were fortunate too in having at the head of the Factories Branch of the Department of Explosives Supply K. B. Quinan, whose good influence on our chemical industry is being widely felt, especially through the work of the younger men who have assimilated—and practise—his excellent methods of studying and handling technical problems. Quinan was an inspiration to all of us who had the privilege of working with him. He had much in common with the distinguished chemist in whose memory these lectures have been established, and was very desirous that the country should derive as much benefit as possible from the knowledge and experience gained during the war.

We may look forward with hope to holding our own and competing successfully in all branches of chemical industry if we seek for, and apply, the highest scientific knowledge available.

The Universities and Colleges I am sure wish to help industry as much as possible, whether by pure research or by imparting more technical teaching to those chemists intending to enter on an industrial career. Many of the professors and teachers did splendid work during the war, and were brought into close contact with many works and those controlling them. This experience, as well as the broadened sympathy which must have resulted between professors and manufacturers, should also be very helpful in developing technical education on sound lines.

In looking over the long list of Hurter's activities and accomplishments one cannot help regretting that we had not the advantage of his great abilities when faced with so many difficult and important industrial problems which he would have delighted in attempting to solve, and yet one has to recognise the pain it would have been to one so closely allied to two nations caught in the horrid cataclysm of war and feel glad that he was spared that experience. The war showed us our lack of men of Hurter's stamp, men of high scientific attainments coupled with the knowledge and practice of technical working. Undoubtedly we had some splendid ones, but not nearly enough. Hurter has left us a great legacy in showing us the way in which technical problems should be handled, which is often of more general use than the solving of particular ones. Let us hope these Hurter memorial lectures will help effectively to keep his name and influence before us and induce us to pay closer attention to what he can teach us.

In passing, I would like to refer to a subject I have much at heart and which seems to me not unsuited to be mentioned in a Hurter memorial lecture.

The Institution of Chemical Engineers has just come into actual being. There has been much talk and discussion from time to time as to the definition of a chemical engineer, but whatever our individual opinions may be as to his education and his scope, I am certain we are one and all desirous of seeing British chemical industry in a flourishing condition. Some one in a works must have a good knowledge of both chemistry and engineering if the work is to be wisely co-ordinated and the best results obtained.

It is not easy to prescribe the best means of educating and developing men of this class, but I am convinced that it should be attempted. I would earnestly ask those who are actively connected with the technical side of chemical industry, as well as professors and teachers, to give this new Institution their whole-hearted support, sympathy, and advice, so that its activities may be wisely directed and prove a real force.

There can be no difference of opinion as to the immense value of Hurter's contribution to the technology of chemistry, whether we consider his studies of the means of promoting action between gases and liquids which were conducted in such a scientifically systematic manner, or his work in connexion with the manufacture of chlorine, or indeed any of his many activities. He seems to me to represent the highest type of industrial chemist or chemical engineer, whose example should be an inspiration to all of us.

I cannot but think that he would have approved of this new Institution, and if it takes him as an ideal after which to strive to fashion its members, chemical industry will benefit and Hurter's memory be kept greener than ever.

---

* Professor Haller has pointed out that, although the ammonia-oxidation process bears the name of Ostwald, the principle was established by Kuhlmann, of Lille, in the first half of last century.

Communication.

THE NITROMETER METHOD FOR THE DETERMINATION OF NITROGEN IN NITRATES AND NITRIC ACID.

BY H. W. WEBB, M.SC., F.I.C., AND M. TAYLOR, D.SC.

The following investigation was undertaken to determine the cause of repeated discrepancies observed in practice between the percentage of nitric acid in samples of commercial acid, as determined by means of the nitrometer on the one hand and by titration with alkali on the other. The total acidity by titration with alkali was found to give values agreeing with the total obtained by determining the nitrous acid with permanganate and the nitric acid by the ferrous sulphate method of Bowman and Scott.

The experiments here described were hence carried out with the object of deciding whether the discrepancy was due to inherent errors in the method, or to faulty manipulation.

The materials employed consisted of (1) potassium nitrate recrystallised until free from chloride and sulphate, and dried at 120° C.; (2) concentrated nitric acid freed from chlorine and sulphuric acid by distillation, and from oxides of nitrogen by bleaching.

In the case of potassium nitrate the accuracy of the method was checked by direct weighing, while in the second case the acid was titrated against standard sodium hydroxide solution. *N*/1 Hydrochloric acid was prepared by distillation under known pressure, according to the method of Hulett and Bonner (J. Amer. Chem. Soc., 1909, **31**, 390), and was used as the standard in alkali titrations.

The sodium hydroxide solution was free from carbon dioxide and was prepared by allowing clean sodium, supported by a nickel gauze, to deliquesce into a nickel crucible in an atmosphere free from carbon dioxide (Ostwald-Luther, "Phys. Chem. Messungen," 3rd German Edn., 1910, 491).

All the instruments employed were calibrated, the nitrometer by means of mercury, and burettes by means of water. An Ostwald-Luther calibration pipette was used in the case of the burettes. Standardised weights were used.

The sulphuric acid used in the nitrometer was tested for freedom from nitrogen (1) by shaking with mercury in the nitrometer, (2) by the ferrous sulphate test, (3) by diphenylamine, which gave only a faint blue coloration on warming and standing.

The pure 97% acid was diluted to 91—92% before use in the nitrometer.

Manipulation.—The quantity of sulphuric acid was kept as low as was compatible with complete washing in of the nitrate.

According to Marqueyrol and Florentin (Bull. Soc. Chim., 1911, **9**, 201) long shaking with strong sulphuric acid and mercury causes reduction of nitric oxide to nitrous oxide and nitrogen, therefore unnecessarily long shaking was avoided. After introduction of the materials the nitrometer was given one shaking consisting of 30 to 40 separate shakes. It was then allowed to stand for about twenty minutes and the process repeated until no more gas was liberated. Usually a slight increase in volume was observed after the second shaking, and further shaking produced no further increase. In no case was a decrease in volume observed as a result of repetition of the shaking. The level of the open limb of the nitrometer was adjusted until there was practically no influx of acid from the cup on opening the tap.

It was observed that the thermometer attached to the outside of the nitrometer responded more rapidly to change in temperature than the gas. During a reading the thermometer would rise from 0·5° to 1·5° C., while, with rapid reading, the gas showed no change in volume. Consequently the temperature was always read before the final adjustment and reading of the volume of the gas. For the same reason the readings should be taken in a room free from fluctuations of temperature such as are caused by draughts or direct sunlight. The barometer readings were corrected for temperature and the pressure was corrected for the column of sulphuric acid in the cup, the density of the acid being taken as one-seventh that of the mercury. The volume of the sulphuric acid in the nitrometer was read to allow of correction for the solubility of nitric oxide in the acid.

In the calculations 1917 atomic weights were used, and Gray's value 1·3402 g. was taken as the weight of 1 litre of nitric oxide at 0° C. and under 760 mm. pressure. Using these values, 1 c.c. of nitric oxide is equivalent to 4·5154 mg. of potassium nitrate and to 2·8144 mg. of nitric acid.

Results with potassium nitrate.

(1) 0·3106 g. KNO_3 yielded 74·5 c.c. NO at 22·7° C. under 755·7 mm.

Volume of 91—92% H_2SO_4 in nitrometer = 20·5 c.c.

Percentage of KNO_3 in purified potassium nitrate (not corrected for solubility of NO) = 74·5 × 755·7 × 4·5154 ÷ 760(1 + 22·7 × 0·003665)3·106 = 99·42.

(2) 0·3152 g. KNO_3 yielded 75·5 c.c. NO at 25° C. under 757·7 mm.

Volume of H_2SO_4 in nitrometer = 20·5 c.c.

Percentage of KNO_3 (uncorrected) = 99·45.

(3) 0·2836 g. KNO_3 yielded 67·75 c.c. NO at 22° C. under 757·55 mm.

Volume of H_2SO_4 in nitrometer = 12·5 c.c.

Percentage of KNO_3 (uncorrected) = 99·55.

(4) 0·3010 g. KNO_3 yielded 71·6 c.c. NO at 20·8° C. under 760·1 mm.

Volume of H_2SO_4 in nitrometer = 11 c.c.

Percentage of KNO_3 (uncorrected) = 99·64.

The above experiments show that the larger the volume of sulphuric acid in the nitrometer the greater the error in the determination of the percentage of potassium nitrate. Therefore before reducing to standard conditions a correction for the solubility of nitric oxide in the acid must be applied to the volume actually read.

According to Lunge (J., 1885, **4**, 448) 10 c.c. of 96% sulphuric acid dissolves 0·35 c.c. of nitric oxide at 18° C. and under 760 mm., while according to Tower (Z. anorg. Chem., 1906, **50**, 382) 10 c.c. of 90% acid dissolve only 0·193 c.c. of nitric oxide at 18° C.

Table I. affords a comparison of the effect of these two different corrections.

TABLE I.

1. No. of expt.	2. Wt. of KNO_3 g.	3. Vol. uncorrected c.c	4. % of KNO_3 calc. from vol.	5. Vol. of acid in nitrometer c.c.	6. Lunge's corr. vol. c.c.	7. Tower's corr. vol. c.c.	8. % of KNO_3 corrected for solubility of NO, according to	9.
							Lunge.	Tower.
1	0·3106	68·39	99·42	20·5	69·04	68·77	100·3	99·97
2	0·3152	69·42	99·45	20·5	70·08	69·79	100·4	99·99
3	0·2836	62·49	99·55	12·5	62·89	62·72	100·1	99·92
4	0·3010	66·39	99·64	11·0	66·75	66·59	100·1	99·94
Mean							100·2	99·96

The numbers in columns 6 and 7 were obtained by adding the number of cubic centimetres, presumed to be dissolved, to the actual number read and subsequently reduced to standard conditions. The percentages obtained by applying Tower's correction differ inappreciably from 100%, while Lunge's correction gives a value slightly too high. It is hence evident that the nitrogen in potassium nitrate can correctly estimated by means of the nitrometer ien 91—92% sulphuric acid is employed, and the lubility of nitric oxide in this acid is assumed to 0·2 c.c. in 10 c.c. of acid.

Experiments with nitric acid.

The acid purified by distillation was titrated ainst pure sodium hydroxide solution free from rbon dioxide. To avoid loss of fume it was ighed directly into a deep flask containing nearly ough sodium hydroxide to neutralise it, and lium hydroxide was then added to exact utrality.

(1) 1·7715 g. nitric acid required 48·02 c.c. 0·5530*N* NaOH solution. HNO_3 = 94·47%.

(2) 1·8381 g. nitric acid required 49·82 c.c. 0·5530*N* NaOH solution. HNO_3 = 94·46%.

Nitrometer estimations gave the following sults:—

(1) 0·2664 g. nitric acid yielded 94·9 c.c. NO at 21·2° C. under 763·9 mm.
Volume of acid in nitrometer = 21 c.c.
Percentage of nitric acid (uncorrected) = 93·55.
Corrected for solubility of NO according to—
Lunge = 94·28.
Tower = 93·97.

(2) 0·2183 g. nitric acid yielded 78·8 c.c. NO at 18° C. under 740·2 mm.
Volume of acid in nitrometer = 25 c.c.
Percentage of nitric acid (uncorrected) = 92·82.
Corrected for solubility of NO according to—
Lunge = 92·91.
Tower = 93·44.

(3) 0·2137 g. nitric acid yielded 71·0 c.c. NO at 21·7° C. under 763·2 mm.
Volume of acid in nitrometer = 18 c.c.
Percentage of nitric acid (uncorrected) = 94·31.
Corrected for solubility of NO according to—
Lunge = 95·11.
Tower = 94·78.

(4) 0·2128 g. nitric acid yielded 75·0 c.c. NO at 17·8° C. under 751·4 mm.
Volume of acid in nitrometer = 32 c.c.
Percentage of nitric acid (uncorrected) = 92·04.
Corrected for solubility of NO according to—
Lunge = 93·42.
Tower = 92·81.

The cause of the discordance shown by these lues was detected by weighing the acid from an um bulb into a weighing tube containing strong phuric acid. In one experiment the weight of d removed from the oleum bulb was 0·2079 g. and weight of acid transferred to the weighing tube s 0·2066 g.—a loss of 0·6%.

Calculated from the weight of acid in the weigh- tube, 0·2066 g. nitric acid yielded 74·2 c.c. NO 18° C. and under 748·2 mm.
Volume of acid in nitrometer = 25 c.c.
Percentage of nitric acid (uncorrected) = 93·35.
Corrected for solubility of NO according to—
Lunge = 94·41.
Tower = 93·96.

second experiment:
eight of acid taken from oleum bulb = 0·2194 g.
eight of acid transferred to nitrometer = 0·2138 g., indicating a loss of nearly 3%.
2138 g. of acid yielded 76·5 c.c. of NO at 16·6° C. under 746·1 mm.
olume of acid in nitrometer = 20 c.c.
ercentage of nitric acid (uncorrected) = 93·19.
orrected for solubility of NO according to—
Lunge = 94·04.
Tower = 93·67.

will be noticed that the greater loss of fume he second experiment has caused a further drop he percentage of nitric acid, in the acid which hes the nitrometer.

In an attempt to weigh the acid in a sealed bulb loss of fume was observed on sealing, and the percentage of nitric acid after applying Tower's correction was only 92·22.

At this stage the nitric acid was re-titrated against sodium hydroxide solution by weighing into standard soda solution.

1·5054 g. nitric acid required 40·79 c.c. 0·5530 *N*NaOH solution. HNO_3 = 94·43%.

TABLE II.

Percentage of HNO_3 in redistilled nitric acid.

Determined by the nitrometer.			
Uncorrected for solubility of NO.	Corrected for solubility of NO according to Lunge.	Tower.	Determined by titration with alkali.
93·55	94·28	93·97	94·47
92·82	93·91	93·44	94·46
94·31	95·11	94·78	94·43
92·04	93·42	92·81	—

From the values recorded in Table II. it is evident that the method of weighing the acid into sodium hydroxide solution, instead of into water, for the alkali titration, gives concordant results. On the other hand, fuming nitric acid cannot be weighed without loss into sulphuric acid, in the small quantities required for a nitrometer estimation.

In the following experiments this loss was minimised by weighing a large quantity of nitric acid into a deep bottle of about 150 c.c. capacity containing a known weight of 97% sulphuric acid. The mixed acid of known composition can then be weighed from the oleum bulb into the cup of the nitrometer.

The following figures show the extent to which loss of fume was eliminated by this method.

Weight of nitric acid determined by difference in weight of oleum bulb content 4·2740 g.
Weight of nitric acid determined by increase in weight of bottle containing sulphuric acid 4·2726 g.
Therefore the loss of fume is now less than 0·04%.
Weight of 97% sulphuric acid 53·8264 g.
Weight of nitric acid added 4·2726 g.
Percentage of fuming nitric acid in the mixed acid 7·354.

In the first experiment the weight of mixed acid employed was determined by difference in weight of the oleum bulb and checked by re-weighing in a stoppered tube.

Weight of mixed acid taken from oleum bulb = 2·6456 g.
Weight of mixed acid in stoppered tube = 2·6458 g.

These weights showed that the mixed acid could safely be weighed into the cup of the nitrometer, and its weight taken as the difference between the weights of the oleum bulb contents. Therefore in the second experiment the double weighing was dispensed with.

(1) 2·6458 g. of mixed acid containing 0·1946 g. of nitric acid yielded 72·4 c.c. NO at 19·0° C. under 728·8 mm.
Volume of acid in nitrometer = 17 c.c.
Percentage of HNO_3 in fuming acid (uncorrected) = 93·91.
Corrected for solubility of NO according to—
Lunge = 94·69.
Tower = 94·34.

(2) 2·1410 g. of mixed acid containing 0·1575 g. of nitric acid yielded 58·6 c.c. NO at 19·0° C. under 729·4 mm.
Volume of acid in nitrometer = 12 c.c.
Percentage of HNO_3 in fuming acid (uncorrected) = 93·99.
Corrected for solubility of NO according to—
Lunge = 94·64.
Tower = 94·39.

It was thought possible that the nitric acid might contain enough carbon dioxide to have appreciable effect in the titration of the acid with soda solution.

A large quantity (3—4 g.) of the acid was therefore weighed into a known volume, in excess, of standard sodium hydroxide solution, and the excess titrated with $N/10$ hydrochloric acid solution. The sodium hydroxide had been previously standardised against hydrochloric acid using the same two indicators.

Strength of caustic soda solution using methyl orange indicator = 1·1803N.
Strength of caustic soda solution using phenolphthalein indicator = 1·1785N.
(1) 55·165 c.c. of sodium hydroxide mixed with 4·3396 g. HNO_3 required:
(a) For neutrality to methyl orange 0·66 c.c. 0·1013N HCl solution.
(b) For neutrality to phenolphthalein 0·63 c.c. 0·1013N HCl solution.
(a) Using methyl orange, HNO_3 = 94·45%.
(b) Using phenolphthalein, HNO_3 = 94·40%.
(2) 50·18 c.c. of sodium hydroxide solution mixed with 3·9038 g. HNO_3 required:
(a) For neutrality to methyl orange 7·84 c.c. 0·1013N HCl solution.
(b) For neutrality to phenolphthalein 7·11 c.c. 0·1013N HCl solution.
(a) Using methyl orange, HNO_3 = 94·34%.
(b) Using phenolphthalein, HNO_3 = 94·31%.

These values show that the percentage of carbon dioxide present is so small that it can be neglected in considering the results.

Table III. compares the results obtained by weighing the nitric acid as mixed with those obtained by alkali titration of the nitric acid.

It is hence evident that when fuming nitric acid is weighed out in such a manner that loss of fume is avoided the use of the nitrometer gives values for the percentage of nitrogen, calculated as nitric acid, which agree within 0·15% with the values obtained by titration with alkali.

TABLE III.

Percentage of HNO_3 in redistilled nitric acid.

Determined by the nitrometer, weighed, with 97% H_2SO_4.			Determined by titration with alkali, using as indicator	
Uncorrected for solubility of NO.	Corrected for solubility of NO according to		Phenolphthalein.	Methyl orange.
	Lunge.	Tower.		
93·91	94·69	94·34		
			94·47	
			94·46	
93·99	94·64	94·39		
			94·43	
			94·40	94·45
			94·31	94·34
Mean		94·37	94·41	94·40

Conclusions.

1. The nitrogen in potassium nitrate can be correctly determined by means of the nitrometer when 91—92% sulphuric acid is employed, and the solubility of the nitric oxide in this acid is assumed to be 0·2 c.c. in 10 c.c. of the acid.

2. When nitric acid is weighed out in such a way that loss of fume is avoided the nitrometer determination gives values for the percentage of nitrogen, calculated as nitric acid, which agree within 0·15% with the values obtained by titration with alkali.

3. The correction for the solubility of nitric oxide in sulphuric acid (0·35 c.c. of nitric oxide in 10 c.c. of sulphuric acid) given by Lunge (*loc. cit.*) is too high when 91—92% sulphuric acid is used.

4. The nitrometer should be used in a room free from rapid fluctuations in temperature, and the temperature should be read before the volume of gas, in each case.

5. A large quantity of the nitric acid for analysis should be weighed with a known weight of strong sulphuric acid contained in a deep vessel and the necessary amount of the mixed acid weighed into the nitrometer.

Technical College, Cardiff.

Chemical Engineering Group.

Meeting held at the Chemical Industry Club on November 10, 1922.

THE DE-WATERING OF PEAT BY PRESSURE.

BY PROF. J. W. HINCHLEY, WH.SC., A.R.S.M., F.I.C.

(Abridged.)

Peat is a material which occurs in extraordinarily large areas all over the world, and is formed by the decomposition of plants in the absence of air.

The quality of the peat is determined by the character of the plants which led to its formation, the latitude of the place and the geological formation of the country.

Since water forms the medium by which contact with air is prevented, the country where the peat accumulates is shaped like a basin and the subsoil consists of an impermeable layer of clay or similar material.

It will be realised that there is enormous variation, both chemically and physically, in the quality of peat from different bogs, and any discussion on the treatment of peat cannot be exact in a general way, since the behaviour of the peat from different districts must vary considerably. Peaty matter contains on an average, when free from moisture, about 58% of carbon, the remainder being mainly hydrogen and oxygen, and according to the conditions under which the deposit is formed, associated ash may vary from 0·5 to 20 or 30%. It s obvious that peat will contain such chemical substances (or their decomposition products) which characterise the plants from which it is produced, and it is found that while some peats contain as much as 10% of waxes, resins, etc., others may contain less than 1% of these substances. As a general rule peat contains less sulphur than the plants from which it is derived, and it is interesting to note that this elimination of sulphur may often be observed in peat bogs. In the Doncaster Bog, or example, the light-coloured peat which is found near the surface of the bog is continually giving off ulphurous gases, while the black peat immediately under it is absolutely free from smell.

On account of its comparative freedom from ulphur, and its well-divided condition, dry peat urns with higher efficiency in furnaces than coal nd does not seriously attack the metal parts of he plant. On this account peat-fired plant has a ower rate of depreciation than coal-fired apparatus. Peat carbon is a valuable raw material in industry, nd it is possible to obtain from it an almost hemically pure carbon. Its finely-divided condition makes it most convenient also for the manufacture of decolorising and activated carbons. Raw eat in fairly-drained bogs usually contain from 85 o 90% water, *i.e.*, each part of the dry substance s associated with from 6 to 9 parts of water. The eat also contains a quantity of colloidal material hich is useful in some processes for the utilisation f peat, whilst in other processes steps are taken o destroy it. The shrinkage of air-dried peat as ut from the bog, on account of the presence of this olloidal material, is generally about 70%.

Up to the present, the only methods of utilising eat which have persisted have depended upon airrying. The simplest process consists of exposing ods cut from the peat bog to the air for a sufficient ngth of time. Variations of this process consist n "kneading" or "masticating" the peat in such way that the plasticity is increased; so that, on rying, the contraction is greater and the density f the final product is raised.

As peat occurs in the bog, it may be taken roughly, that one cubic metre of peat weighs 1000 kg. (say one ton), and as in the course of drying, contraction takes place, the density of the final peat may vary from 0·2 to 1. It is obvious that the quality of the peat will vary with its depth from the surface of the bog, the upper layers or youngest peat being most fibrous and the oldest peat, that at the bottom of the bog, being most decomposed. At the same time, owing to the water-logged condition of the bog, the lower layer will not only be more decomposed, but may contain colloidal material washed from the other layers. The density of the dried peat from the lower layers on account of pressure will be much greater than that from the upper layers, while the content of water is usually less. Peat from the upper layers of many bogs is of a fibrous character, and, after drying, makes a most useful "litter" for animals, and the dust gives a packing for fruit and similar goods. The products of the decomposition of the vegetable matter have disinfectant properties, which render the material of extremely great value for these purposes, whilst, after use, it is available as a manure.

The efficiency of methods of obtaining peat by air-drying is limited by the character of the climate, and in few cases can more than two "crops" per year be obtained. It is obvious, therefore, that the commercial utilisation of peat can only be small, since the rate of working from a bog is so slow. Attempts have been made and very large sums of money have been lost in machine-devices for drying peat at a sufficiently rapid rate to produce commercially an industrial fuel or other industrial products.

Now the calorific value of ashless, dried peat is at the most, 6000 calories per kg. The best British peats have a calorific value of about 5500 calories per kg. The calorific value of peat as burnt in furnaces is somewhat lower than this, on account of the "equilibrium-moisture" associated with it, and may generally be taken at about 3500 calories per kg. Of all the processes for the rapid drying of peat, it will be clear without much consideration that a direct drying operation could not be a commercial success. In the best drying plants at least 600 calories is required for the evaporation of one kg. of water, so that the association of one kg. of peat with 6 kg. of water would mean that the whole of the heat energy available from the peat on combustion would be required for its drying. Recently, the problem of drying by direct heat has been resuscitated through the development of the "heat pump evaporator." Heat pump evaporators are now made which may be depended upon to evaporate at a rate such that 1 kg. of steam will evaporate 4 kg. of water. Whether this process can be applied to such a material as peat is extremely doubtful, since the difficulties associated with evaporating liquids in such apparatus are enormously increased with a material like peat.

The author has been engaged for several years past on methods of de-watering peat by pressure and is convinced that such methods offer an attractive commercial solution of the problem.

In drying peat by heat or by air-drying processes, the presence of the colloidal matter may be a distinct advantage, but in getting rid of the water by pressure, the presence of this material is a most serious objection, and methods have to be adopted by which it is completely or largely destroyed. Both extreme cold and heat are capable of bringing about this result, and the problem of getting rid of the water is reduced to devising a mechanical process which shall not only be practical but will pay.

It has been stated that the percentage of water in peat as it occurs in a drained bog is usually from 85 to 90%. By a simple pressing operation in the cold, which can be carried out by means of a "squeezing-conveyer" at the bog itself, this percentage of water may be reduced to from 80 to 81%, or four parts of water to one part of peat. A pressure of 50 lb. per sq. in. is necessary and the time of application will depend on the thickness of the layer.

Curves showing change in pressure, thickness of cake, flow of water.

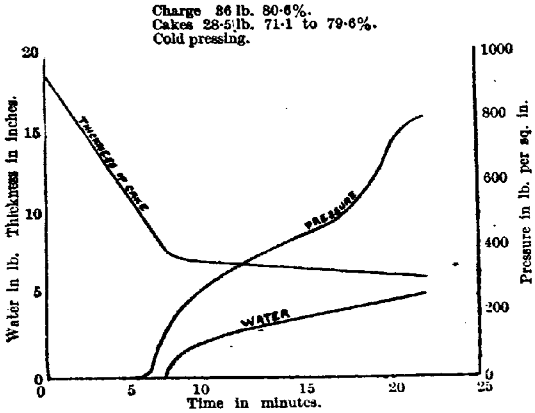


FIG. 1.

Practical experiment by the author has shown that in suitable apparatus it is not necessary to destroy entirely the colloidal matter present in the peat to remove the water successfully by pressure down to approximately 50%. Ekenberg has stated that a temperature of over 150° C. is required for this purpose. The author has found, however, that temperatures approaching the boiling point of water are sufficient provided that suitable apparatus is used.

The work of the author has been carried out in a press, which, from a mechanical point of view, may be seriously criticised, but from a practical point of view is extremely effective and efficient. Experiments on this small press showed that after warming to the boiling point of water, suitably applied pressure rising slowly to half a ton per sq. in. reduced the water-content of Norfolk peat below 50%. In some of the experiments with certain Norfolk peats a figure of 35% was obtained, but generally the figure was 42 to 45%. It will be obvious that the final percentage of water will depend upon many factors, but mainly upon the original vegetation from which the peat was formed and its age.

With peat from the Doncaster district a final moisture content of 55% was found to be the limit, and in experiments with peat from other districts in this country it is found that the lower limit for practical purposes varies from about 40 to 55% of moisture.

With regard to the cold pressing of peat, it is desirable to know to what extent cold pressing can be applied, and Fig. 1 is a curve obtained in experiments on Somerset peat, from which it will be seen that at a pressure of nearly 800 lb. per sq. in. and pressing under the very best conditions the percentage of water was only reduced to an average of about 75%. The press used is shown in Fig. 2 mounted at the works of Armstrong, Whitworth and Co. The stroke of this press was 18 in. and the area of the pistons 120 sq. in., the width of the cake

FIG. 2.

being 5 in.; the head and piston of the press were solid, and the sides of the press were formed of filtering surfaces consisting of tinned steel wire gauze.

It will be noticed from the curve that the particular peat used on that occasion did not part with any water until a pressure of 150lb. per sq. in. had been reached. On examination of the press after the cold pressing was concluded, it was found that the filtering surface was completely choked, and that a considerable amount of work in cleaning was necessary before the press could be used again.

As already stated, the sides of the chambers were provided with filtering material, and the mechanical construction of this part of the press calls for a great deal of ingenuity in order that the filtering surfaces of large presses can be renewed without much loss of time. The pistons slide on strips of metal which are used to hold the filtering surfaces in position, and at the same time protect the filtering surface from wear from the piston itself. Now it will be noticed that in this method of working the direct pressure of the press does not come upon the filtering surface. During no part of the process of pressing does the peat behave as a fluid, and only to some extent does it behave as a semi-fluid. There is little doubt, however, that near the end of the stroke of the press the lateral pressure is not more than one-third of the vertical pressure, whilst at the beginning of the pressing the lateral pressure near the piston is about four-fifths. Arrangement are made in the press so that steam may pass through one filtering surface and discharge through the opposite filtering surface and *vice versa*. At the same time when the press is full of peat the admission of steam may be used to blow out any accumulation of deposit at the back of the filtering surfaces. It will be realised, therefore, that the surface of the peat nearest the filtering surface is submitted to the highest temperature conditions, and that normally in a pressing operation the colloidal matter in the centre of the cake is only partially destroyed, while that nearest the filtering surface is wholly destroyed.

The operation of pressing in this little press may be completed in from 20 mins. to half an hour, and in the first two minutes of this operation the steaming may take place. Visible steam is not produced.

Curves showing change in pressure, thickness of cake, flow of water.

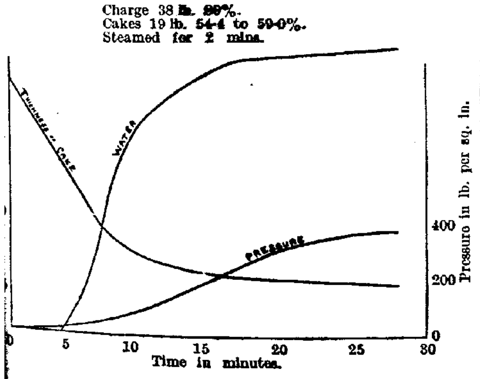


FIG. 3.

he curves (Fig. 3) show a typical hot pressing of omerset peat by which the percentage of water was educed from 80% to about 57%. On comparing the curves of Fig. 3 with Fig. 1 it will be noticed how the water curve lies much above the pressure curve in the latter case, and it will also be realised that the pressure necessary is now less than 500 lb. per sq. in. Now the reduction of water content from 80 to 60% means that one part of peat associated with four parts of water has become one part of peat associated with one and a half parts of water, that is by this process of pressing, two and a half parts of water associated with the peat have been eliminated. The cost of a press and its wear and tear are not such serious matters with pressures up to 500 lb. per sq. in. as with pressures formerly considered necessary. The reduction of the water content from 55 or 60% to 25 or 30% is not a very serious problem, although at first sight it would appear so. To begin with, the peat cakes are discharged from the press at a temperature of about 95° C., and in cooling down to the ordinary temperature while exposed in a suitable way to the air, the actual water content is reduced nearly to 50%. The further drying to 30% (the usual air-dried peat figure) may be carried out in the course of 4 or 5 hours by passage through a long tunnel dryer the air of which is heated by the waste heat from the power plant.

A simple estimation of the amount of energy required to carry out this pressing operation is desirable. In the first instance, at the factory one part of peat is associated with four parts of water, and it may be taken that to heat this material to 100° C. about 320 calories per kg. of dry peat present would be required. Assuming that the dried peat had a calorific value of 5000 calories per kg., this means that between 6 and 7% of the energy of the peat is required for this process. If, however, air-dried peat with a calorific value of, say, 3500 calories is being burnt in the power plant, this would be equivalent to 9% of the heat energy available from that peat. Assuming that the power plant has an efficiency of 50%, which ought to be a sufficiently conservative value, this would mean that 20% of the energy of the peat would be required for the steaming process.

The cost of the pressing processes in heat energy is readily reckoned, and will be found to be approximately 0·7% of the heat energy contained in the peat. Since, however, hydraulic plant is notoriously inefficient, 7 times this value may be taken as a figure certain to be realised, and it may be assumed that not more than 5% of the energy of the peat will be needed for the pressing operations. These considerations show that one quarter (20% + 5%) of the peat produced must be burnt in the power plant to produce the energy necessary for the process, three-quarters of the production being available for the market or other purposes.

The little press illustrated has been worked for six weeks continuously without any difficulty with the filtering surfaces and with practically no variation in its performance. It was designed after several years of experiment as a small portion of a larger commercial press of six chambers to take a charge of 1½ tons per operation. Such a press with accessories would cost about £2000, and would treat about 60 tons of 80% peat per day of 24 hours, yielding 30 tons of peat cake and about 20 tons of dried peat per day, of which 5 tons would be burned in the power plant, giving a net yield of 15 tons per day.

The commercial efficiency of this process is bound up with that of the method of obtaining peat from the bog.

This subject is an extremely wide one, but it may be assumed that with a project of reasonable size, the modern excavator or a modification of the dredger would give that low cost of winning from the bog that is necessary.

entirely from straw is found to be much weaker than that made from esparto. Straw, however, is a cheap material, and is capable of producing a very white pulp, which also has the property of hydrating and partially gelatinising during the "beating" process. This gives a "hardness" and "rattle" to the finished paper which is considered desirable for many purposes. Straw pulp is, therefore, useful when mixed with other pulps, such as those from esparto, cotton, or flax, to produce fine qualities of paper.

It is possible that since the introduction of liquid chlorine in cylinders this "gas bleach" will come into favour once more. The production, handling, and control of chlorine at a mill were difficult and expensive undertakings, whilst hypochlorites were simple and convenient to use, with the result that hypochlorites came into general use in place of elementary chlorine. This position may easily be reversed now that the supply of chlorine on a commercial scale in a convenient and easily used form is possible.

In America liquid chlorine has already been extensively used in some paper mills for the production of bleach liquor from milk of lime. In America, as in Europe, large plants had been installed for the production of liquid chlorine for war purposes, and even during the war attempts were made to apply this liquid chlorine to paper making. It was believed that its use would improve the whole practice of bleach liquor production and would eliminate an unpleasant portion of the mill—that is, the bleach-mixing plant. It was these motives, rather than the hope of effecting economies, which inspired the earlier work. The war and the increase in production and increase in efficiency of liquid chlorine plants put the whole matter on a different footing and definite economies were effected.

The process used is as follows:—Suitable quantities of lime of high calcium content and of water are placed in a tank and kept constantly agitated. Quicklime may be used if necessary, but it is preferable to use slaked lime and so avoid delays for cooling. Milk of lime is pumped from this tank to the top of an absorption tower, which is usually built of, or lined with, stoneware. The tower is packed with small cylindrical stoneware rings so as to give a large absorption surface. The milk of lime flows down this tower and returns to the original tank. When sufficient time has elapsed to ensure a good circulation being established, chlorine gas is introduced at the base of the tower and absorbed in the descending stream of lime. Circulation of the liquor through the tower is maintained until the solution has reached any desired strength up to about 50 grams of available chlorine per litre. The chlorine supply is then cut off and the agitator and circulating pump stopped. The liquor is allowed to settle and the clear bleach solution run off to stock tanks. The small amount of sludge remaining is allowed to accumulate during several repetitions of the above proceeding. When this accumulation of sludge has become too large for convenience it is pumped to a sludge tank and washed by agitating it with water. After settling the wash water is run off to the original mixing tank as make-up liquor for another batch of lime. Usually it is sufficient to wash the sludge twice before disposing of it as refuse. In some cases the use of a sludge tank has been found to be unnecessary as the washing can be carried out in the lime mixing tank.

The chlorine is supplied from cylinders or, in the case of a large plant, from tank wagons. In America liquid chlorine is drawn off from a tank wagon into an evaporator consisting essentially of an iron still surrounded by a water tank which is maintained at a temperature of about 70° C. by injecting a suitable quantity of steam into i Liquid chlorine is dripped into the evaporator an gas drawn off to the absorption towers.

In 1921 an efficiency test was made by th Electro Bleaching Gas Company of New York on plant installed by them at a large paper mill i Canada. This plant consists of a hydrating tan for slaking quicklime, three agitating tanks used a mixers for the batches of milk of lime, an absorptio tower, a sludge tank, and three stock tanks fo finished liquor. Each batch of milk of lime con tained about ten to twelve thousand gallons an the chlorine was absorbed at a rate betwee 400 and 500 lb. per hour. When the availabl chlorine content reached 35—40 grams per litre depending upon the amount of excess lime present the process was stopped and the liquor allowe to settle. A fresh batch from another slaked lim tank was then started.

Ten batches of bleach liquor were made, and th entire contents of a tank wagon were consume in the test. The wagon was weighed at the begin ning and end of the run. Analyses of the mil of lime, the finished bleach liquor, and the refus sludge were made. The total chlorine (i.e. available Cl, chloride and chlorate) present in th original milk of lime was 2602 lb. The tota chlorine in the finished liquors was 32,642 lb. Thu a total of 30,040 lb. of chlorine had been absorbed The weighings of the tank wagon showed it to con tain 30,000 ± 100 lb. Thus the efficiency of absorp tion must have been practically 100%. Of th 30,040 lb. of chlorine absorbed, 29,790 lb. wa present as available chlorine. This means th efficiency of absorption from a bleach-making poin of view was 99·17%. There had been practicall no formation of chlorate. Analysis of the sludg as it was run to waste showed it to contain a tota of 92 lb. of available chlorine, *i.e.*, 0·31% of th available chlorine absorbed. The amount of lim used was 1·052 lb. of quicklime per lb. of chlorin absorbed.

The whole test shows the plant to be very efficient and it has decided advantage over the usual metho of producing bleach liquor from dry bleachin powder. The liquor contains less lime sludge, an therefore settles more quickly. Strong bleac liquors can be prepared and diluted as required fo use. Thus a comparatively small plant has a larg output. The reduced quantity of sludge to be dis posed of naturally means more efficient washin and therefore less available chlorine goes to th refuse tip. Also the cost of sludge disposal i reduced in proportion as the sludge is reduced.

In this country, as yet, liquid chlorine has no effected any such enormous changes. Howeve with apparatus such as exists in present-day Britis paper mills and bleach fields it is possible t chlorinate milk of lime and produce bleach liquor direct. A rapid agitation is necessary and a fairl deep mixing tank is desirable.

Details of such a run are as follows:—The mi at which the trial was made uses bleach liquo at 5½° Tw., that is about 17·1 g. per l. o available Cl. 264 lb. of poor lime (85·6% CaO and 237 lb. of liquid chlorine were used. Th total quantity of bleach liquor at 5½° Tw. ob tained was 211·5 cubic feet, and it containe 231·0 lb. of available chlorine. The yield o available chlorine on the total chlorine absorbed i therefore 97·4%. This compares very favourabl with the efficiency of most bleaching mixing plants Using bleaching powder it is somewhat difficult t get even a 95% efficiency of extraction; in fact, s high a figure is probably rare.

There is one other method of using liquid chlorin to advantage in the production of bleach liquor and it is this last method which at the moment wil probably find most favour in the eyes of pape iakers and bleachers. It consists simply in hlorinating the free lime present in all bleaching owders, during the agitation of the bleaching owder with water to make bleach liquor. This rocess can be undertaken with ease in the usual ype of bleach mixer. All the extra apparatus equired consists of one or two dip pipes leading own to the bottom of the mixer, to which the hlorine cylinders can be connected. If the agitation of the mixer is very rapid, having a peripheral eed of 500 feet per minute or thereabouts, the lorine can be introduced into the bleach batch as quid and allowed to vaporise in the mixing tank. his allows the cylinders to be emptied rapidly, and t is possible, given a suitably deep tank and rapid gitation, to introduce the necessary quantity of hlorine in 20—25 minutes. When agitation is slow t is advisable to bubble chlorine gas into the liquor. his is done by using cylinders having no internal iphon pipe, which, therefore, deliver gas. This lows the process down somewhat, but is not a erious obstacle to success. It has been found by xperiment that average bleaching powder, containing 35—37% of available chlorine, can absorb by his process about one ninth of its weight of extra hlorine. The residual sludge is, of course, considerably reduced, sometimes to as little as one ourth of its normal bulk. The original sludge onsists chiefly of free lime, and this has gone into olution to form hypochlorite.

Bleaching powder casks contain about 6 cwt. of he powder. A cylinder of liquid chlorine contains 0 lb. of chlorine. Thus a cask of bleaching powder eighs a little more than 9 times as much as the ontents of one cylinder of chlorine. It will be een that one cask—one cylinder is a convenient ractical arrangement.

Details of a typical run are as follows:—

Weight of 35% bleaching powder used	= 4432	lb.
Available chlorine content of this quantity	= 1551·2	lb.
Chlorine added as liquid	= 360	lb.
Theoretically possible quantity of available chlorine in finished bleach liquor	= 1911·2	lb.

Actually 10,737 gallons of 6° Tw. bleach liquor was produced, containing 1863·9 lb. of available chlorine. The loss of available chlorine is therefore 47·3 lb. or 2·47%. This proved to be a more economical working than the usual mill practice, and in addition the process has all the advantages claimed for the American practice of chlorinating milk of lime in towers.

1. Stronger bleach liquors can be obtained if desired. In other words, the output of any given plant can be considerably increased without any other alteration than the provision of chlorine inlet pipes. In one case as much bleach liquor is being produced in three mixers as was originally made in five.

2. The quantity of sludge is considerably reduced. Instead of sludging out after each mixing, two or even three batches can be mixed in succession before the sludge need be washed and rejected..

3. The liquor settles faster. There is less solid to settle.

4. Economy of bleaching powder is effected The extraction of the available chlorine is more complete, chiefly because the reduced amount of sludge can be more efficiently washed.

5. There is less bleaching powder dust floating about the bleach house because less bleaching powder is used. This is a point to be considered, as bleaching powder dust is very irritating to the eyes, nose, and lungs.

This process of chlorinating bleaching powder during mixing has been in use in Germany for many years. It was seen by a Scottish papermaker at the Zanders Mill before the war, and shortly after the armistice a member of the United Alkali Company's chemical staff visited this mill and saw the process being operated. Practical trials were then made at an English paper mill in the summer of 1919, but at that time the cost of liquid chlorine did not permit of economical working. This cost factor has since changed, and the process now offers financial advantages.

Summing up the developments in the use of bleaching agents, it would appear that the advent of liquid chlorine as an everyday article of commerce will mark a new era in bleaching practice. Liquid chlorine is a comparatively new product in this country, and is only beginning to make its presence felt. It would be a bold statement to say that it is going to place bleaching powder among the obsolete chemicals either here or in America, but there can be no doubt that it is going to find extensive application either as an adjunct to bleaching powder or in special cases as a substitute for it. Bleach liquors will be made by the consumer. We are reverting to the position of over 100 years ago—with one difference, viz., liquid chlorine instead of chlorine gas.

DISCUSSION.

Mr. R. EASTON had observed that during the war dandy rolls were more liable to break down than previously. He asked whether the breakdown was due to chlorine in the pulp or whether other factors were responsible.

Mr. INMAN thought that it was very unlikely that surplus bleach liquor would survive the various paper-making operations which followed the bleaching process and pass along the machine to the dandy rolls unless an enormous excess had been used.

Dr. A. HOLT asked whether data were available as to the stability of strong solutions of hypochlorites in stock tanks.

Mr. INMAN said that the practice was to run the solutions into tanks where the sludge settled fairly quickly, and to use the hypochlorites practically as soon as they were made—actually they were not kept for more than two or three days. Some bleachers preferred fresh solutions which contained excess of alkali and acted slowly, while others preferred older solutions where the free alkali had been partly neutralised by carbon dioxide, and which bleached more quickly.

Mr. ARTHUR CAREY remarked that the greater speed with which sludge settled in the newer process was explained by the fact that calcium carbonate settled quickly, lime slowly, and chlorination of the hydroxide caused its removal, leaving only the material which gave a clean solution readily.

Mr. A. T. SMITH said that the American practice was very interesting as showing the trend of affairs when large-scale production was required. Variations in technique with scale of production did not explain why the use of towers was preferred to the direct way of passing the gas direct into milk of lime. There was no doubt about the convenience of making bleach liquors where they were to be used; further, the new process evaded the difficulty of sludge disposal, which was a serious matter in older works—it did not produce sludge in quantity. One main reason why liquid chlorine had not been used as widely here as abroad was the policy of the railway companies, who refused to grant facilities for transporting liquid chlorine.

The CHAIRMAN said that the question of transfer of liquid chlorine by rail was of great importance if it was to be used in paper manufacture.

Sydney Section.

Meeting held at Sydney on October 11, 1922.

MR. F. A. COOMBS IN THE CHAIR.

NOTE ON THE WAX COATING THE STEMS OF THE AUSTRALIAN "CANE GRASS," *GLYCERIA RAMIGERA*, F.v.M.

BY HENRY G. SMITH.

In addition to the name "Cane grass" this Australian plant is also known as "Bamboo grass." It is perennial and occurs plentifully in certain localities in New South Wales, Victoria, and South Australia. It is a coarse, cane-like species, has a hard stem, and grows in what are known as "cane swamps." It has considerable weather-resisting properties, and being quite suitable for thatching is employed for that purpose in localities where it grows abundantly. The sample from which the wax was prepared was forwarded to the Sydney Technological Museum by Mr. J. P. Butler, who procured it from the neighbourhood of Warren, New South Wales. The entire stem is coated with an almost colourless wax, which separates in flakes when the stem is sharply bent. The wax as thus separated melted at 82° C., and in appearance, melting point, and hardness, much resembles carnäuba wax, and might be equally well employed for industrial purposes. It is sufficiently hard and brittle to be powdered, and although but little soluble in ether, yet the ether has the property of separating the wax entirely from the stem, the greater portion falling to the bottom of the containing vessel as a whitish powder.

The peculiarity of *Glyceria* wax is its high acid value, thus indicating a large proportion of the wax to consist of one or more of the higher acids. The melting point of the separated acid was 82°, a figure suggesting it to consist largely of cerotic acid.

For the preparation of the wax in larger quantity the stems were cut to a convenient size, treated with cold ether, and the process repeated. 5¼ lb. of material—containing 10·6% of moisture—gave 55 grams of wax insoluble in ether, equal to 2·2%, and 10 grams soluble in ether, equal to 0·4%, or a total of 2·6%.

The portion soluble in ether was somewhat dark coloured, caused by the chlorophyll extracted at the same time, but the larger insoluble portion was quite light coloured. The ether-soluble portion melted at 73° C. by the capillary tube method in water, and the larger insoluble portion at 83°. *Glyceria* wax is insoluble in water, and but slightly soluble in alcohol, benzene, acetone, and chloroform in the cold, but mostly dissolves in any of those solvents when boiled, separating out again as the solution cools. The portion insoluble in cold ether was also insoluble in boiling ether.

The ether-soluble portion had sp. gr. 0·975 at 18° C., and the insoluble portion 0·9819 at 19° C.

The acid value was 54·26—54·33, and the separated acid constituents had m.p. 82° C.

The saponification value of the portion of the wax insoluble in ether was 89·4, and of the esters 35·1.

The portion of the wax soluble in boiling alcohol, and separated from the insoluble portion, had m.p. 84°—85° C.

Yorkshire Section.

Meeting held at Leeds on November 20, 1922.

PROF. J. W. COBB IN THE CHAIR.

NOTE ON THE DETERMINATION OF VOLATILE MATTER IN FUELS.

BY P. WEDGWOOD, B.SC., AND H. J. HODSMAN, M.B.E., M.SC., F.I.C.

(Department of Coal Gas and Fuel Industries, The University, Leeds.)

The determination of the volatile matter is one of the most important tests applied to fuels both for commercial and scientific purposes. For commercial testing a high degree of precision in the determination is unnecessary, but owing to the empirical character of the tests a uniformity of method is desirable which will not be secured unless the apparatus is simple and inexpensive. The method originally proposed by the American Chemical Society in its modified form has been widely adopted as forming the nearest approach to this want. Unfortunately in this method the use of a crucible of platinum is specified. Now platinum has obvious advantages, but as its cost is practically prohibitive, there is no hope that it will come into general use for the commercial testing of coal. Materials such as porcelain and silica differ so much in properties from platinum as to make their substitution in the American test impossible. A satisfactory substitute should be metallic, as otherwise the temperature necessary is unattainable in a crucible heated in the Bunsen flame.

After examining a number of metals and alloys we have found two materials, though, of course, there may be others untried by us, which proved reasonably satisfactory. They were Monel metal and mild steel treated with aluminium powder. For this purpose the crucible embedded in aluminium powder enclosed in an iron tube was heated in the muffle. Some such process is employed commercially under the name of "calorising."

The crucibles (turned out of the solid) were similar in dimensions to the ordinary platinum crucible—height 1⅜ in., diameter of top 1¼ in., diameter at base 1 in., and thickness of wall $\frac{1}{32}$ in. The well-fitting lid was pierced with a hole $\frac{1}{16}$ in. in diameter. To test the constancy of weight the crucibles were heated for periods of 7 minutes in the flame of a Méker burner to a temperature of 950° C. The gain in weight indicated that the effect of oxidation of the crucible in a determination of volatile matter on 1 gram of fuel would be to lower the result by 0·5% or less as compared with determinations in platinum.

	Treated steel crucible		Monel metal crucible	
	g.	Gain.	g.	Gain.
Original weight of crucible ..	47·2728	—	52·7800	—
Weight after 1st 7 mins. heating	47·2798	0·0070	52·7840	0·0040
,, ,, 2nd ,, ,,	47·2850	0·0052	52·7848	0·0008
,, ,, 3rd ,, ,,	47·2900	0·0050	52·7820	—0·0028
,, ,, 4th ,, ,,	47·2950	0·0050	52·7836	0·0016
,, ,, 5th ,, ,,	47·2956	0·0006	52·7848	0·0012
,, ,, 6th ,, ,,	47·3005	0·0049		

In use the gain in weight should be still less owing to the reducing atmosphere inside the crucible. The crucibles also seemed to develop in use a protective film of oxide.

A large number of coals have been tested, and some of the figures obtained for the volatile matter content using these two base metal crucibles are set out in a table, together with the results obtained when using a platinum crucible.

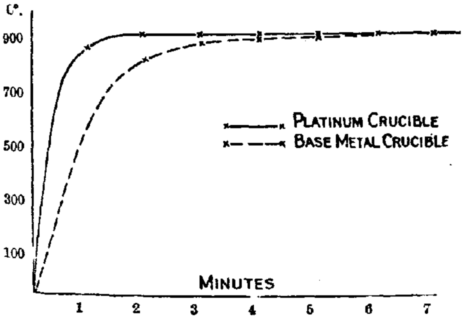
The method used was substantially the same as that specified by the United States Bureau of Mines. A large Méker burner was used surrounded by a sheet iron chimney lined with asbestos. The crucible was supported so that the bottom was 2½ cm. above the burner. The gas was adjusted to a predetermined pressure indicated by a simple water gauge so that the maximum temperature attained in the crucible was 930° C. The temperature was checked from time to time by means of a platinum/platinum-rhodium thermocouple. The crucible containing 1 g. of coal ground to pass a 60-mesh sieve (I.M.M.) was heated for exactly 7 minutes. It was then removed and placed on a clean steel block until cool enough to transfer to the desiccator. When quite cool it was reweighed.

The temperatures in the crucibles at the end of each minute during a period of 7 minutes' heating under the conditions of a test were measured. The temperature inside the platinum crucible rose rapidly to the maximum in 2 minutes, but in the base metal crucibles only after 4 minutes. Thus the charge was at 930° C. in the platinum crucible for 5 minutes and for 3 minutes only in the others (see fig.).

Percentage of volatile matter.

Sample.	Platinum crucible.	Steel treated with aluminuim.	Monel metal.
Coke	12·56	—	12·15
Dutch anthracite	10·17	—	10·12
Wyndham steam coal	18·60	—	17·81
Various Cumberland coals	27·10	27·65	26·34
	31·44	30·60	31·02
	33·90	33·56	33·62
	35·36	35·00	35·10
	36·86	36·17	36·02
Lignite	59·40 (54·55)	—	57·07 (53·80)

The loss of carbon particles in the stream of volatile matter was very noticeable in the last sample. When the crucible and its contents were subjected to a preliminary gentle heating for two minutes before heating for 7 minutes at the full temperature, the results (in brackets) in each case were lower and more concordant.



The results obtained in the base-metal crucibles are generally about 0·5% low when compared with those determined in platinum. This difference may be ascribed to various causes, of which the most obvious are:—(1) The increase in weight of the crucible depressing the apparent loss of volatile matter. (2) The greater loss by entrainment of carbon particles in the stream of volatile matter, due to the more rapid rise in temperature in the platinum crucible. (3) The fact that whereas the platinum crucible is at a temperature above 900° C. for about 6 minutes of the 7 minutes period, the base-metal crucibles are only maintained above this temperature for about 4 minutes.

But whatever crucible is used for volatile matter determinations, in order to obtain concordant results a specified procedure must be strictly adhered to. In commercial work extreme precision is unnecessary, and a knowledge of the volatile matter to the nearest 0·5% in most cases is sufficient.

In view of this and the fact that consistently good results can be obtained with suitable base-metal crucibles, the use of platinum does not seem essential.

Of the two materials tried Monel metal seems to behave the better. The crucibles can be turned in the lathe to a standard size and thickness. The finished crucible has, and maintains in use, its smooth surface and original shape. In this respect it is superior to platinum, which is soft and easily deformed. Above all, the metal withstands the continued action of heat exceedingly well. To test this the crucibles were put into regular use in the laboratory of the St. Helen's Coke Ovens, Cumberland. The original crucible after at least 50 determinations of volatile matter seemed quite unimpaired. Heating for 1 hour in the muffle furnace at nearly 1000° C. had little visible effect on it. It developed a thin oxidation film, tough and adherent. The increase in weight, however, exceeded the limit of permissible error in a determination of volatile matter. Under this harsh treatment it behaved better than the treated steel crucible which showed signs of disintegration, but it had also been previously used without much deterioration in more than 50 determinations. These experiments showed that the crucibles may not be used for determinations of volatile matter made in the muffle, the protective atmosphere of the flame being essential.

DISCUSSION.

Professor Cobb said that the determination of volatile matter in coal by the crucible method was always rather comparative than absolute and that agreement between observers was only to be attained by defining carefully the conditions of operation. Platinum was a reasonably satisfactory material for the crucible but very expensive. About two years ago at Leeds they had experimented with porcelain and silica but with limited success. Mr. Hodsman and Mr. Wedgwood continuing the work with metallic crucibles had, however, found Monel metal (and to a less extent "calorised" iron) much more promising. Of course, other alloys might be as good, or better, but they had given results which indicated definitely that a metallic substitute for platinum in this estimation could be found and probably had already been found in Monel metal.

Dr. Forster suggested that nichrome might be suitable, as it formed a thin layer of oxide on its surface which acted as a protection against further oxidation.

Mr. W. McD. Mackey said that with lignites it was better to dry the sample first, since the water vapour was liable to carry out small pieces. The old method of determining the volatile matter in coal was 3½ minutes on a Bunsen flame and 3½ minutes with a strong blowpipe; the results were much the same as those got now. using the adjusted Bunsen flame, 7 minutes. The essential thing seemed to be to get the temperature up as quickly as possible. It would be a good thing if the crucible could first be heated to the desired temperature and the coal dropped in. He thought a temperature above 750° C. could be got with silica if sufficient time were given.

Mr. Hodsman said that if a silica crucible were used in place of platinum, other conditions being as specified, the temperature within the crucible as measured by means of a thermocouple was about 750°. It would, of course, be possible to attain a higher temperature by suitably modifying the heating arrangements. That would, however, involve a departure from the conditions of the test. The coke with 12·5% of volatile matter had been carbonised at a low temperature.

Mr. Burrell asked if the roughness on the steel crucible could be removed by rubbing with sand. He noted that the bottom of the Monel metal crucible was rather thick.

Mr. Hodsman replied that the crucibles of treated steel had a roughened surface, even when new. They were thicker at the bottom than platinum and therefore attained the maximum temperature more slowly. He added that duplicate determinations might vary by 0·3%, but two observers might differ by 1% or more in their results, showing the need for uniformity of procedure. There were several pieces of apparatus for effecting the laboratory distillation of coal, among which was one described by Bone. Such methods had their uses but did not meet the need for a simple procedure suited to the summary analysis of fuels as daily practised by very large numbers of chemists in all kinds of laboratories.

Communication.

THE ACCELERATION OF VULCANISATION BY CINCHONA ALKALOIDS.

BY B. J. EATON, O.B.E., F.I.C., AND R. O. BISHOP, M.B.E., A.I.C.

In the course of an investigation on a residue obtained from cinchona bark, comparative experiments have been carried out on pure rubber-sulphur and rubber-sulphur-zinc oxide mixes, with the object of determining the accelerating effect of quinine, cinchonine, cinchonidine, and a mixture of the uncrystallisable alkaloids of cinchona bark known pharmaceutically as quinoidine.

The particular residue under investigation (referred to subsequently as Accelerator X) was obtained by one of us (B.J.E.) while on leave in England in 1921. It is stated to contain the amorphous alkaloids remaining after the separation of quinine and other crystalline alkaloids from the extract of the total alkaloids in cinchona bark. It is understood that the material is being used in certain rubber manufactories in England, and it appears from information since received that American rubber manufacturers have been acquainted with its use for some years.

Accelerator X is a brown, somewhat deliquescent substance which is very sticky under the moist, hot atmospheric conditions in Malaya. The solubility in water is slight, but in alcohol (95% by volume) complete solution can be effected. It is basic (soluble in acids and reprecipitated by alkalis), and has a distinct odour of quinoline and benzaldehyde. The nitrogen content, as determined by Kjeldahl's method, is 2·52%.

In the investigations described in this paper the accelerator was dissolved in 95% alcohol to produce a 20% solution. Different volumes of this solution were allowed to drip on to the raw rubber (in the form of crêpe) from a pipette. The samples of rubber thus treated were left exposed on glass plates until the alcohol had completely evaporated. A test was made on rubber treated with alcohol alone, which was found to vulcanise at the same rate as a control sample.

The subsequent addition of sulphur or sulphur and zinc oxide and the milling and calendering of the mix were carried out according to the standard practice adopted in this laboratory (Bull. 27, Dept. Agric. F.M.S., 1918). Vulcanisation was carried out in moulds in a steam autoclave at 140° C. The vulcanised samples were cut in the form of rings and these were tested on a Schopper testing machine in the usual manner, 24 hours after vulcanisation.

The results of the cures are judged by comparing the stress-strain curves with the "standard" curve (Bull. 27) and by a comparison of the stress-strain figures at break. The figures recorded are those giving the maximum product as a result of testing two rings, the curves of which have been shown previously to be sufficient for a comparison of rates of vulcanisation.

In order to compare the effect of Accelerator X with that of the crystalline alkaloids quinine,

Table 1.

Results of vulcanisations with Accelerator X.
Using a mix of raw rubber 90 parts, sulphur 10 parts.

Type of rubber.	Ref. exp.	Accelerator % on "rubber and sulphur."	Optimum time of cure from curve. Mins.	Time of cure giving max. tensile strength. Mins.	Load at break (kg. per sq. mm.) (*a*)	Elongation at break (orig. length = 100). (*b*)	Tensile product. (*a*×*b*)
Slab ..	126 As	nil	80	80	1·57	1016	1595
" ..	126 Gs	0·25	75	75	1·31	1014	1315
" ..	126 Hs	0·50	70	70	1·60	1045	1672
Crêpe ..	126 Ac	nil	165	165	1·42	1035	1469
" ..	126 Dc	0·25	150	150	1·28	1038	1328
" ..	126 Ec	0·49	120	120	1·62	1035	1675

Table 2.

Results of vulcanisations with Accelerator X.
Using a mix of raw rubber 90 parts, sulphur 10 parts, zinc oxide 4 parts.

Type of rubber.	Ref. exp.	Accelerator % on "rubber and sulphur."	Optimum time of cure from curve. Mins.	Time of cure giving max. tensile strength. Mins.	Load at break (kg. per sq. mm.) (*a*)	Elongation at break (orig. length = 100). (*b*)	Tensile product. (*a*×*b*)
Slab ..	126 Bs	nil	60	60	1·44	977	1406
" ..	126 Kas	0·25	40	45	1·44	955	1375
" ..	126 Las	0·50	35	40	1·70	960	1632
Crêpe ..	126 Bc	nil	135	135	1·24	965	1196
" ..	126 Ss	0·25	90	90	1·35	960	1316
" ..	126 Es	0·50	75	90	1·27	955	1212

cinchonine, and cinchonidine and with the product known as quinoidine a further series of vulcanisations were carried out with two types of mixings as below:—

Mix. A.	
Rubber	90
Sulphur	10
Alkaloid	1

Mix. B.	
Rubber	90
Sulphur	10
Zinc oxide	4
Alkaloid	1

In both series the pure alkaloid was added in the form of the solid crystals to the rubber during the mixing process. The quinine used for samples 163 Es and 163 Ec was a sample of Howard's quinine, while that used for samples 163 Jc, Fs, and Fc was a sample of Java quinine. Since the tensile curves for samples 163 Ec and 163 Jc coincide, it may be concluded that both samples of quinine are identical in their effect on vulcanisation.

(3) Quinoidine and Accelerator X are not as powerful as quinine, cinchonine, and cinchonidine, but they are possibly not pure amorphous alkaloidal bases, and probably contain a certain quantity of inert constituents which have no accelerating effect on vulcanisation.

(4) As one of us has shown previously, although the addition of organic and inorganic accelerators accelerated the vulcanisation of a slow-curing rubber (crêpe) relatively to a much greater extent than that of a naturally rapid-curing rubber (slab), the differences between a naturally rapid- and slow-curing rubber still exist after the addition of the artificial accelerator, *i.e.*, the slab or fast-curing samples still cure rather more rapidly than the crêpe or slow-curing rubber, both when (*a*) accelerator alone is added, and (*b*) accelerator plus zinc oxide is added.

TABLE 3.

Mixing A.

Type of rubber.	Exp. ref.	Accelerator used in mix.	Optimum time of cure from curve. Mins.	Time of cure giving max. tensile strength. Mins.	Load at break (kg. per sq. mm.). (*a*)	Elongation at break (orig. length=100). (*b*)	Tensile product. ($a \times b$)
Slab ..	126 As	nil	75	75	1·57	1016	1595
" ..	163 As	Cinchonine	30	35	1·58	960	1516
" ..	163 Bs	Cinchonidine	25	20	1·60	1030	1648
" ..	163 Es	Quinine	25	25	1·51	998	1506
" ..	163 Ks	Quinoidine	50	30	1·36	1030	1400
" ..	163 Ms	Accelerator X	45	45	1·56	1024	1597
Crêpe ..	126 Ac	Nil	165	165	1·42	1035	1469
" ..	163 Ac	Cinchonine	35	25	1·45	1014	1470
" ..	163 Bc	Cinchonidine	30	25	1·28	994	1272
" ..	163 Ec	Quinine	30	35	1·42	985	1398
" ..	163 Jc	Quinine	30	30	1·50	959	1468
" ..	163 Kc	Quinoidine	65	50	1·20	1020	1224
" ..	163 Mc	Accelerator X	60	50	1·40	1025	1435

TABLE 4.

Mixing B.

Type of rubber.	Exp. ref.	Accelerator used in mix.	Optimum time of cure from curve. Mins.	Time of cure giving max. tensile strength. Mins.	Load at break (kg. per sq. mm.). (*a*)	Elongation at break (orig. length=100). (*b*)	Tensile product. ($a \times b$)
Slab ..	163 Gs	Nil	60	60	1·22	980	1195
" ..	163 Cs	Cinchonine	15	15	1·63	1010	1646
" ..	163 Ds	Cinchonidine	15	25	1·90	890	1691
" ..	163 Fs	Quinine	15	25	1·93	905	1746
" ..	163 Ls	Quinoidine	15	25	1·65	942	1554
" ..	163 Ps	Accelerator X	15	30	1·82	910	1656
" ..	181 Bs	Accelerator X	15	25	1·70	973	1654
Crêpe ..	163 Gc	Nil	135	135	1·17	998	1184
" ..	163 Cc	Cinchonine	25	25	1·51	939	1417
" ..	163 Dc	Cinchonidine	20	40	1·61	870	1400
" ..	163 Fc	Quinine	20	25	1·54	935	1439
" ..	163 Lc	Quinoidine	25	30	1·32	930	1227
" ..	163 Pc	Accelerator X	25	30	1·49	945	1408
" ..	181 Bc	Accelerator X	25	45	1·61	954	1535

Additional comparative vulcanisations carried out on crêpe and slab rubber, using smaller proportions of quinoidine and Accelerator X, gave the results shown in Table 5.

The relationships between the various samples, especially in respect of rates of vulcanisation, are shown very clearly in the tensile curves, which are not reproduced here. The following points are, however, of interest:

(1) All the cinchona alkaloidal bases used, viz., quinine, cinchonine, cinchonidine, quinoidine, and Accelerator X, are fairly powerful accelerators.

(2) Quinine, cinchonine, and cinchonidine appear to be practically identical in their accelerating effect.

(5) Generally, the superiority of the slab rubber samples containing the added accelerator compared with the crêpe samples is maintained, but is not so marked except in the case of the samples to which zinc oxide has been added.

(6) The addition of zinc oxide accelerates the rate of vulcanisation of all the samples. It is not possible, however, to judge the samples containing zinc oxide by the same tensile curve used for the pure rubber-sulphur mixings, since the curve is different in type, and the highest tensile figures for the samples containing zinc oxide are obtained in the case of a curve indicating an "over-cured" rubber, as judged by the standard curve employed in comparing tests on pure rubber-sulphur mixings.

TABLE 5.

Type of rubber.	Exp. ref.	Amount of accelerator as percentage on "rubber & sulphur."	Amount of zinc oxide as percentage on "rubber and sulphur."	Optimum time of cure from curve. Mins.	Time of cure giving max. tensile strength. Mins.	Load at break (kg. per sq. mm.) (a)	Elongation at break (orig. length = 100). (b)	Tensile product. (a×b)
Slab ..	166 As	0·25% Quinoidine	nil	80	75	1·22	993	1211
„ ..	166 Bs	0·25% Accelerator X	„	80	75	1·25	990	1237
„ ..	166 Cs	0·5 % Quinoidine	„	70	60	1·51	1030	1555
„ ..	166 Ds	0·5 % Accelerator X	„	70	60	1·41	1006	1418
„ ..	166 Es	0·25% Quinoidine	4%	40	45	1·39	950	1320
„ ..	166 Fs	0·25% Accelerator X	4%	40	40	1·55	990	1534
Crêpe ..	166 Ac	0·25% Quinoidine	nil	150	120	1·01	1019	1029
„ ..	166 Bc	0·25% Accelerator X	„	150	120	0·98	1004	983
„ ..	166 Cc	0·5 % Quinoidine	„	120	105	1·05	980	1029
„ ..	166 Dc	0·5 % Accelerator X	„	120	105	0·97	966	937
„ ..	166 Ec	0·25% Quinoidine	4%	90	90	1·39	970	1348
„ ..	166 Fc	0·25% Accelerator X	4%	90	90	1·37	984	1348

(7) The results show that Accelerator X is probably a very useful organic accelerator, and also indicate that it probably consists of the amorphous alkaloids of cinchona bark known technically as quinoidine. Since this product is otherwise a waste product, it should be comparatively inexpensive compared with many artificial organic vulcanisation accelerators on the market.

Note.—No attempt has been made to isolate a more active accelerator from the crude product (Accelerator X) nor from quinoidine, neither have we determined whether all or any of the accelerator in these products is volatile in steam. It is proposed to continue the investigation on these points.

Experimental Vulcanising Laboratory,
Department of Agriculture,
Kuala Lumpur, F.M.S.